



Request for Information on Technology Issues of Video Frame Rate Conversion between Integer and Fractional Rates

SMPTE TC-10E Integer and Fractional Frame Rate Conversion Study Group

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards developing organizations, including ISO, IEC, ITU, ATSC, and SCTE.

General Information

SMPTE's Technology Committee on Essence (TC10E) has a Study Group, focused on Integer and Fractional Frame Rate Conversion. This Request For Information (RFI) originates from this Group.

In this RFI, the Study Group seeks information on the technology to convert video from fractional frame rates (24/1.001, 30/1.001, 60/1.001, 120/1.001) to the corresponding integer frame rates, including a contemplated new, higher frame rate of 120 fps. The RFI also seeks information on the reverse process, that is, conversion of video at integer frame rates, including 120 fps, to fractional frame rates (24/1.001, 30/1.001, 60/1.001, 120/1.001). The RFI also seeks comparative estimates of the complexity and achievable picture quality of the various possible conversion mechanisms. Where possible, RFI respondents are requested to provide demonstrations of such conversions, descriptions of the nature of such conversion techniques and their relationship to possible real-time product hardware, or, where not currently possible, estimates of when such demonstrations can be expected.

Objective

The objective of this RFI is to collect information regarding integer and fractional frame rate video conversion technologies that would aid this Study Group in its goal of producing a report that could inform SMPTE on this issue and potentially help to guide future standards work.

Definitions

“typical fractional frame rates”: 24/1.001, 30/1.001, and 60/1.001 frames per second.

“corresponding integer rates”: Integer rates of 24, 30, and 60 frames per second.

“higher integer frame rates”: Any integer frame rate above 60 frames per second, specifically including 100 and 120 frames per second.

“higher fractional frame rates”: Any fractional frame rate above 60/1.001 frames per second, specifically including 120/1.001 frames per second.

“typical 50 Hz region integer frame rates”: Integer rates of 25 and 50 frames per second.

Requested Points of Information

Respondents are asked to document:

- 1) Technologies for the effective conversion of video material to and from the following frame rates:
 - a. typical fractional frame rates
 - b. corresponding integer rates
 - c. higher fractional frame rates
 - d. higher integer frame rates
 - e. typical 50 Hz region integer frame rates
- 2) Conversion of real-world, existing SD and HD content that is interlaced and progressive.
- 3) Conversion technology that deals successfully with the range of artifacts present in real-world material (e.g. noise, compression artifacts, prior frame rate conversion artifacts such as may arise from prior conversion from 50 fps to 60/1.001 fps).
- 4) Technology for the objective measures of picture quality of the frame rate conversions, especially if such objective measures have been shown to correlate well with subjective measures of quality.
- 5) Information regarding the level of computational complexity and processing time of real-time and non-real-time frame rate conversions.
- 6) Information regarding the latency of conversion in live usage.
- 7) The visibility of artifacts or quality degradations in output video during slow motion and freeze frame effects that may be utilized *after* the conversion.
- 8) The analysis of accurate audio/video synchronization as well as accurate timed metadata elements such as ancillary data (such as ancillary time code and closed captions) and linear time code.
- 9) The effects of multiple generations of frame rate conversions.

In addition:

- 1) Responses should clearly identify when they are referring to live real-time conversion, to non-real time (including file-based) conversions, or to both.
- 2) Responses should include a comparison of the artifacts produced by their documented technologies to other well-known temporal conversions that are commonly used, e.g., 50 to/from 60/1.001 standards conversion, 3:2 pull-down motion judder, and to issues such as occasional frame drops/repeats injected by frame synchronizers.
- 3) Respondents are encouraged to provide video demonstrations from their proposed conversion process, or a schedule as to when such demonstrations may become available.

Submission Guidelines

Introduction

This part provides the information that is needed to respond properly to this RFI. We invite you to read it carefully.

Respondents

All interested parties are invited to respond to this RFI. Interested parties do not have to be a member of SMPTE to respond.

Communications

All communications regarding this RFI should be directed to rates-rfi@smpte.org.

Single Point of Contact Required

Respondents shall provide a Single Point of Contact for all communications regarding the RFI. It is the responsibility of the Point of Contact to disseminate communications from the Study Group appropriately within his/her organization.

Intent to Respond

We ask that you notify us by January 30, 2015, if you intend to respond. Such notification should be by e-mail to rates-rfi@smpte.org, and should include the organization name and the Single Point of Contact.

Withdrawal of Responses

If you need to withdraw a previously submitted Response to this RFI, you must do this in an e-mail sent to the Study Group's reflector before the cut-off date (February 27, 2015). The Study Group Chair will send confirmation e-mail acknowledging withdrawal of your Response.

Respondent Online Meeting

The Study Group will hold an online meeting with Respondents on February 3, 2015, at which time the team will discuss the RFI and address any questions that Respondents may have. Respondents should be aware that in the interest of fairness, all questions and answers may be documented and may be shared with other Respondents, whether they attend the meeting or not. Non-SMPTE members must RSVP to this meeting to rates-rfi@smpte.org to obtain information on how to access the online meeting. SMPTE members can find the details on the Kavi system, under the 10E Integer and Fractional Frame Rate Conversion Study Group's calendar.

Discussion and Demonstration Face-to-Face

The Study Group will organize a face-to-face meeting where RFI respondents will be invited to discuss their responses and demonstrate frame rate conversion technology in an open forum. Participation in this face-to-face meeting is not a requirement for response to the RFI.

Testing Material

RFI respondents may indicate if they will be able to make appropriately licensed testing material available for use by other respondents for the face-to-face meeting. This is by no means a requirement for response, but is encouraged to enhance the value of the study.

Queries

It is recognized that when Respondents review this RFI they might need to contact the Study Group at rates-rfi@smpte.org with points for clarification. The Group, guided by its Chair, will assist Respondents with background information, additional explanations, etc. Respondents should be aware that, in the interest of fairness, all questions and answers that serve to clarify the RFI or which provide additional information will be shared with other Respondents.

Sharing the RFI

This RFI is a public document. Provided that it is not modified in any way, it may be passed on to other parties who may have a bona-fide interest in responding to the RFI.

Partial Responses

We understand that it is unlikely that any single technological solution will fully address all the requested Points of Information requested in this RFI. Partial responses are perfectly acceptable.

Less is More

In providing the required information, you can always provide additional details or refer to complementary documents that you can include in your submission. Be aware that considering the very aggressive timeline that will follow, it may be in the interest of Respondents to highlight the most essential information to be considered.

Intellectual Property

Respondents are advised to review SMPTE's Intellectual Property Policy, as outlined in Section 9 of the Society's Standards Operations Manual version 3, which goes into effect January 31, 2015, and can be found at:

<https://www.smpte.org/sites/default/files/SMPTE%20Standards%20OM%20v3.pdf>

Particular attention should be paid to Section 9.1.4, part of which is reproduced below for convenience.

9.1.4 Declaration of Knowledge of Relevant Intellectual Property

This Policy imposes an obligation on all Members and Guests to notify the Technology Committee Chair, as early as possible in the development process, if they are aware, based on their actual personal knowledge, of patents or patent applications that might contain Essential Claims to a technology being proposed for inclusion in an Engineering Document.

The requirement to notify the Technology Committee Chair of actual personal knowledge of actual or potential Essential Claims is an ongoing obligation that begins with becoming a Participant Member or Observer Member of a Technology Committee, or attending a meeting as a Guest, and continues through any form of participation in the work or proceedings of the Technology Committee, including any form of participation by electronic means such as receipt of emails. Any required notice shall be given as soon as practically possible and in all cases shall be given within 45 days after the knowledge is obtained and in advance of any vote on the Engineering Document. The notice shall be either in the form of a verbal statement at a meeting, which shall be recorded in the minutes of the meeting, or in written form to the Chair of the responsible Technology Committee. The notice shall include all

relevant information available to the Member or Guest, such as patent or application number(s) and owner of the intellectual property, and shall identify the part(s) of the Engineering Document believed to be subject to Essential Claims.

Dates

The anticipated time schedule is as follows.

- Intent To Respond Due: January 30, 2015
- Open Q&A online session for respondents: February 3, 2015 (RSVP required to rates-rfi@smpte.org.)
- RFI closes: February 27, 2015 (Responses in advance of the deadline are acceptable and encouraged)
- Invitations sent out for Face-to-Face meeting technology discussions/demos: March 9, 2015.
- Face-to-Face Meeting for technology discussions/demos: March 18, 2015.

Submission Procedure

Submission Format

- Title Page
- Table of Contents
- Experience and Qualifications of Respondent
- Technology Discussion/Explanation
- Intellectual Property Disclosure (if applicable)

Submission Steps

1. Respondents should contact the Study Group Chair thru rates-rfi@smpte.org by January 30, 2015, to indicate their intent to respond.
2. When ready, please email your submission to rates-rfi@smpte.org.

NOTE: To be considered as valid all Responses to this RFI must be submitted per the process described in this RFI. Verbal or written submissions which are not made per the submission guidelines described here will NOT be accepted.