

Title: Simple Definition of GOP for Random Access

Status: Input Document to JVT

Purpose: Proposal

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1. SUMMARY

The document proposes a simple modification into the slice header syntax to signal random access positions. Consequently, all Network Adaptation Layers that use the slice header structure inherit the random access feature.

The document is organized as follows: Section 2 lists the needs for random access and concludes that random access is needed when accessing both a file and a received bit-stream. The coding constraints related to random access positions are analyzed in section 3. A brief review of previously performed work in VCEG/JVT is given in section 4. The proposed solution for accessing a received bit-stream randomly is presented in section 5. The solution is based on a simple modification in the slice header structure, and the proposed standard text is included in Appendix A (JVT-B041_Appendix_A.doc). Section 6 analyzes how random access is supported in the interim JVT file format and concludes that practically no changes are needed. Finally, the patent disclosure form is given.

2. NEEDS FOR RANDOM ACCESS

Random access property is needed at least in the following situations:

- A user seeks, winds, or rewinds a locally stored file.
- A streaming player requests a streaming server to play a file from an arbitrary position or to seek, wind, or rewind a file.
- A streaming player receives a packet or bit stream from an arbitrary position. Such a situation may result from tuning to a broadcast, for example. The player has to detect a stream position that provides a correctly reconstructed picture.
- A loss or corruption has been detected, and the displayed image is frozen, until a perfect recovery from the error is possible.

The former two situations are related to accessing a file from an arbitrary position, while the latter two situations require detecting of a random access position from a received bit-stream.

3. REQUIREMENTS FOR A RANDOM ACCESS POSITION

At least the following conditions have to be met in a random access position:

- The picture at the random access position has to be an INTRA picture or an SI picture proposed in VCEG-O47.
- The decoder must have received all necessary out-band information to decode the bit-stream. To be more specific, the decoder must have all parameter sets needed to decode the bit-stream. (See VCEG-N72r1 for the definition of the parameter set.)
- There must be no dependencies on the contents of the multi-picture buffer for motion compensation. In the JVT codec, this means that no pictures shall refer to pictures prior the random access position. In addition, the number of slots for long- and short-term pictures shall be reset.
- No code value in the bit-stream at or after the random access position must depend on or be predicted from any codeword received before restarting decoding at the random access position. In addition to avoiding the dependency on motion compensation references, the relation between picture numbers should be broken in a controlled manner as discussed later in this document. (See VCEG-O10r1 or JM-1 for the definition of the picture number.)
- The video buffering verifier / hypothetical reference decoder must not run to an invalid condition (e.g. buffer overflow), when buffering is restarted from the random access position. As no complete video buffering verifier has been designed for the JVT codec so far, the concrete response for this requirement is for further study.
- When accessing a file randomly, the time (in the presentation time-line) corresponding to the access position should be easily available. We did not identify such a need when receiving a packet or bit stream from an arbitrary position.
- Random access positions serve yet another purpose in file manipulation: it should be able to cut a file in pieces along random access positions and assemble another file from such pieces in arbitrary order.

4. PREVIOUS WORK

VCEG-O53r2 proposed a GOP layer in the video coding syntax including flags to indicate an independently decodable GOP and possibly missing reference pictures. However, the proposed syntax did not follow the syntax of the interim JVT file format (VCEG-O58), the IP transport framework (VCEG-N72r1), or the multi-picture buffering syntax (VCEG-O10r1). Moreover, VCEG-O53r2 did not take into account all the requirements presented in the previous section, such as the relation to the multi-picture buffer and to picture numbering. This proposal tries to address all these issues.

5. RANDOM ACCESS FOR TRANSPORT PURPOSES

We propose straightforward modifications to the slice header (adopted in VCEG-N72r1 and VCEG-O10r1) in order to detect a random access position from a received bit-stream. The modifications are summarized in this section and the proposed standard text is presented in Appendix A. Two changes to the current design are needed:

- VCEG-O10r1 specified a picture number to be incremented by 1 for each coded and transmitted picture. This definition serves both efficient picture number difference coding of multi-picture buffer operations and detection of lost pictures. If the difference of the picture numbers of two consecutively received and stored pictures is not 1, the decoder should infer a loss of pictures or corruption of data. However, because of file editing or when accessing a file or a bit-stream randomly, a discontinuity in picture numbers may occur naturally. Thus, we propose that the picture number shall be reset to zero in the first picture of an independently decodable GOP.
- A picture number of zero can signal the start of an independently decodable GOP or it can occur naturally when picture numbers wrap around. Thus, we propose that a "Start of GOP" parameter is included in the slice header whenever the picture number is equal to zero and the slice type indicates an Intra slice. If "Start of GOP" indicates the start of an independently decodable GOP, all indices of the multi-picture buffer shall be marked as "unused", and the maximum number of long- and short-term pictures shall be reset to the default value.

6. RANDOM ACCESS IN THE INTERIM JVT FILE FORMAT

This section analyzes which modifications the random access feature requires in the interim JVT file format.

A File Header Clump can be repeated throughout the JVT file. It identifies a random access position that can be used for file editing purposes. In other words, no meta- or media data prior to the selected File Header Clump is required for parsing any of the succeeding data. Furthermore, any segment can be parsed without a forward reference to any of the data succeeding the particular segment. Consequently, file sections beginning with a File Header Clump can be cut and pasted freely. No changes to VCEG-O58 are required.

A Segment Clump contains absolute start time of the segment. At least one segment follows a File Header Clump. Thus, the Segment Clump can be used to provide the timing information for random file access. No changes to VCEG-O58 are required.

Random access positions not aligned with the start of a File Header Clump can be identified from slice headers, which are included in the Alternate Track Header Clump. VCEG-O58 needs to be changed to reflect the new slice header structure presented in the previous section and in Appendix A.

The Alternate Track Header Clump contains a number of pictureInfo structures. A pictureInfo structure contains meta-data specific to a picture, namely a pointer to the media-data of the picture, slice and payload headers, relative picture display time, and an INTRA picture flag. The INTRA picture flag was supposed to serve as a random access position, but as explained earlier in this document an INTRA picture is not a sufficient condition for random accessing. Thus, we propose dropping the INTRA picture flag from the pictureInfo structure as an obsolete and useless feature.

7. IPR STATEMENT

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Telecommunication Standardization Sector



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Joint Video Coding Experts Group - *Patent Disclosure Form*

(Typically one per contribution and one per Standard | Recommendation)

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