UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

UNILOC 2017 LLC, Plaintiff, v. TELESTREAM LLC, Defendant.	C.A. NO. 19-cv-182-CFC JURY TRIAL DEMANDED

FIRST AMENDED COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Uniloc 2017 LLC ("Uniloc"), by and through the undersigned counsel, hereby files this First Amended Complaint and makes the following allegations of patent infringement relating to U.S. Patent Nos. 6,628,712 (the "'712 patent"), 6,895,118 (the "'118 patent"), and 6,519,005 (the "'005 patent") (collectively "the Asserted Patents") against Defendant Telestream LLC ("Telestream") and alleges as follows upon actual knowledge with respect to itself and its own acts, and upon information and belief as to all other matters.

NATURE OF THE ACTION

1. This is an action for patent infringement. Uniloc alleges that Telestream has infringed and/or is infringing one or more of the '712 patent, the '118 patent and the '005 patent, copies of which are attached as Exhibits A-C, respectively.

2. Uniloc alleges that Telestream directly infringes and/or has infringed the Asserted Patents by making, using, offering for sale, selling, and/or importing various products and services that: (1) dynamically switch and transcode program video and advertisement videos, (2) perform a method of coding a digital image comprising macroblocks in a binary data stream and

(3) perform a method for motion coding an uncompressed (pixel level) digital video data stream. Uniloc seeks damages and other relief for Telestream's infringement of the Asserted Patents.

THE PARTIES

3. Uniloc 2017 LLC is a Delaware corporation having places of business at 1209 Orange Street, Wilmington, Delaware 19801 and 620 Newport Center Drive, Newport Beach, California 92660.

4. Upon information and belief, Telestream is a Delaware corporation with a place of business at 848 Gold Flat Rd, Nevada City, California 95959. Telestream may be served through its registered agent at The Corporation Trust Company Corporation Trust Center, 1209 Orange Street, Wilmington, Delaware 19801.

JURISDICTION AND VENUE

5. This action for patent infringement arises under the Patent Laws of the United States, 35 U.S.C. § 1 et. seq. This Court has original jurisdiction under 28 U.S.C. §§ 1331 and 1338.

6. This Court has both general and specific personal jurisdiction over Telestream because Telestream is a Delaware corporation that has committed acts within this District giving rise to this action and has established minimum contacts with this forum such that the exercise of jurisdiction over Telestream would not offend traditional notions of fair play and substantial justice. Telestream, directly and through subsidiaries and intermediaries (including distributors, retailers, franchisees and others), has committed and continues to commit acts of infringement in this District by, among other things, making, using, testing, selling, importing, and/or offering for sale products that infringe the Asserted Patents.

7. Venue is proper in this District and division under 28 U.S.C. §§1391(b)-(d) and 1400(b) because Telestream is organized in this District, transacts business in this District and has committed and continues to commit acts of direct and indirect infringement in this District.

COUNT I: INFRINGEMENT OF THE ’712 PATENT

8. The allegations of paragraphs 1-7 of this First Amended Complaint are incorporated by reference as though fully set forth herein.

9. Uniloc owns by assignment the entire right, title, and interest in the ’712 patent.

10. The ’712 patent, titled “Seamless Switching of MPEG Video Streams,” issued on September 30, 2003. A copy of the ’712 patent is attached as Exhibit A. The priorty date for the ’712 patent is November 23, 1999. The inventions of the ’712 patent were developed by an inventor at Koninklijke Philips Electronics N.V.

11. Pursuant to 35 U.S.C. § 282, the ’712 patent is presumed valid.

12. Claim 4 of the ’712 patent reads as follows:

> 4. A method of switching from a first compressed data input stream to a second compressed data input stream, resulting in a compressed data output stream, said method of switching comprising the steps of:
>
> buffering, in which the data contained in the first and the second input stream are stored,
>
> controlling the storage of the input streams during the buffering step in order to switch, at a switch request, from the first input stream to the second input stream,
>
> transcoding the stream provided by the control step, the transcoding includes controlling occupancy of a buffer by feedback to DCT coefficient quantization in order to provide the output stream in a seamless way.

13. The invention of claim 4 of the ’712 patent concerns a novel method for switching from a first compressed data input stream to a second compressed data input stream, resulting in a compressed data output stream. ’712 patent at 1:6-9. Such an invention is useful in switching and editing MPEG compressed video signals. ’712 patent at 1:10-11.

14. At the time of invention of the '712 patent, encoding/decoding systems included a method of switching from a first encoded video sequence to a second one. '712 patent at 1:15-19. In order to avoid underflow or overflow of the decoded buffer, transcoding of the input streams is used to shift the temporal position of the switching point and to obtain at the output of the transcoders, streams containing an identical entry point and the same decoder buffer characteristics. *Id*. at 1:19-24. This prior art method has several major drawbacks. According to the background art, the output bit rate of each transcoder is equal to its input bit rate, which makes the switching method not very flexible. *Id*. at 1:15-28. Finally, the solution of the background art is rather complex and costly to implement as the switching device needs two transcoders. *Id*. at 1:32-35.

15. As demonstrated below, the claimed invention of claim 4 of the '712 patent provides a technological solution to the problem faced by the inventors—transcoding the stream provided by the controlling of two input streams where the transcoding includes controlling the occupancy of a buffer by feedback to DCT coefficient quantization in order to provide the output stream in a seamless way. This technological solution of claim 4 of the '712 patent provides an improved method of switching between encoded video streams that is "both flexible and easy to implement" and overcomes the disadvantages of the prior art. *Id*. at 1:38-40. For example, the solution of the '712 patent allows switching from a first compressed data stream encoded at a bit rate R1 to a second compressed data stream encoded at a bit rate R2, the output stream resulting from the switch being encoded again, using the transcoding system, at a bit rate R where R may be different from R1 and R2. *Id*. at 1:52-59. Thus, the patented solution has greater flexibility than the prior art and its "implementation will be less complex and less expensive" than the prior art in addition to being more flexible. *Id*. at 1:39-40, 1:52-59, 2:9-10, 2:33.

16. A person of ordinary skill in the art reading the '712 patent and its claims would

understand that the patent's disclosure and claims are drawn to solving a specific, technical problem arising in the field of video compression. In particular, the present invention relates to the technical problem involved in switching from a first compressed data input stream to a second compressed data input stream, resulting in a compressed data output stream, and is applicable, for example, to switching and editing MPEG compressed video signals. *Id.* at 1:6-12.

17. As detailed in the specification, the invention of claim 4 of the '712 patent provides a technological solution to the specific technological problems faced by the inventor that existed at the time of the invention. First the specification describes the prior art and the drawbacks associated with the prior art:

> International patent application WO 99/05870 describes a method and device of the above kind. This patent application relates, in encoding/decoding systems, to an improved method of switching from a first encoded video sequence to a second one. In order to avoid underflow or overflow of the decoded buffer, a transcoding of the input streams is used to shift the temporal position of the switching point and to obtain at the output of the transcoders, streams containing an identical entry point and the same decoder buffer characteristics.
>
> The previously described method has several major drawbacks. According to the background art, the output bit rate of each transcoder is equal to its input bit rate, which makes the switching method not very flexible. Moreover, said method implies that the first picture of the second video sequence just after the switch will be an Intra-coded (I) picture.
>
> Finally, the solution of the background art is rather complex and costly to implement as the switching device needs two transcoders.

'712 patent at 1:15-35.

18. In light of the drawbacks with the prior art, the inventor of the '712 patent claimed a new method where transcoding of the output stream is provided by the controlling of two input streams where the transcoding includes controlling the occupancy of a buffer by feedback to DCT coefficient quantization in order to provide the output stream in a seamless way:

To prevent overflow or underflow of this buffer, a regulation REG is performed; the buffer occupancy is controlled by a feedback to the DCT coefficient quantization. When switching from a video sequence encoded at a bit rate R**1** to another one that has been separately encoded at a bit rate R**2**, the respective decoder buffer delays at the switching point do not match. The role of the transcoder is to compensate the difference between these buffer delays in order to provide the output stream OS in a seamless way. Furthermore, the encoded bit rate R of the output stream can be chosen by the user.

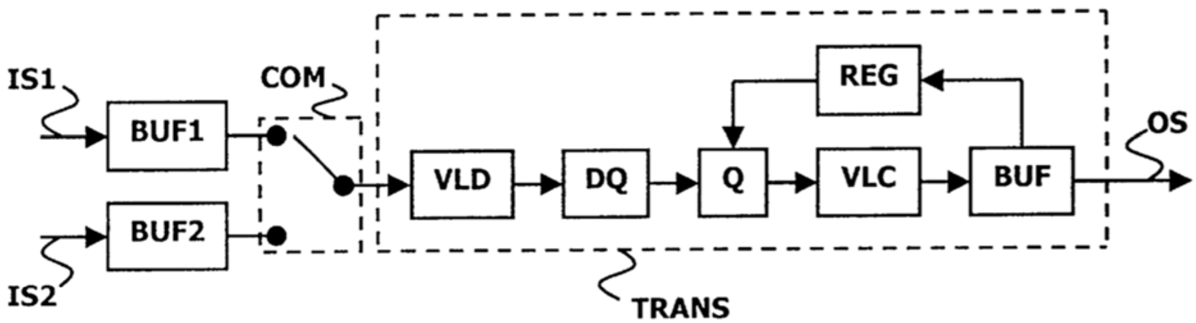


FIG. 2

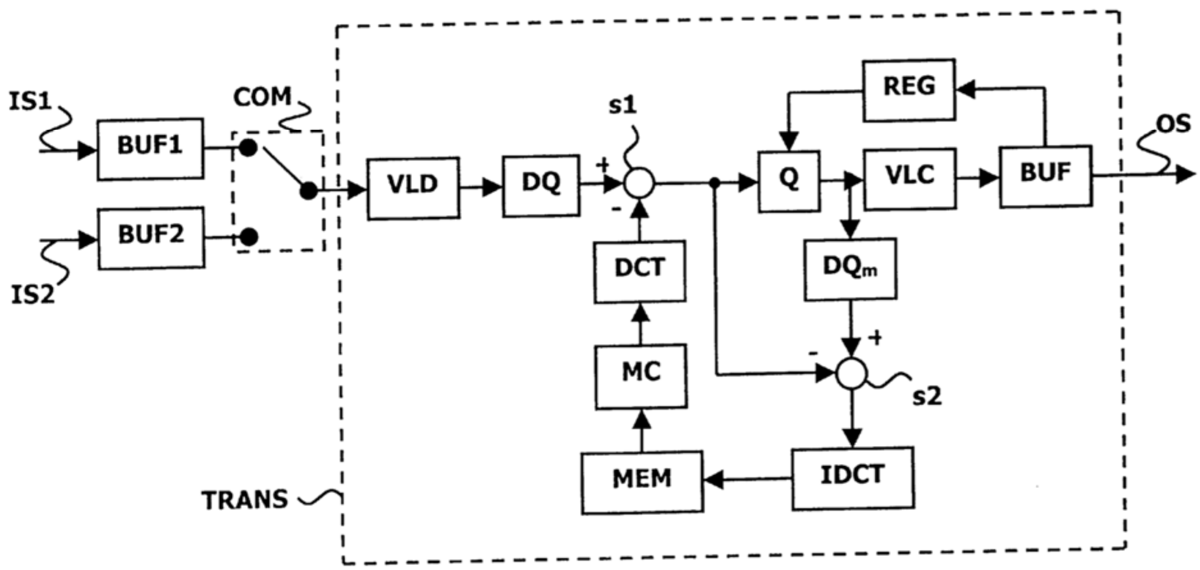


FIG. 3

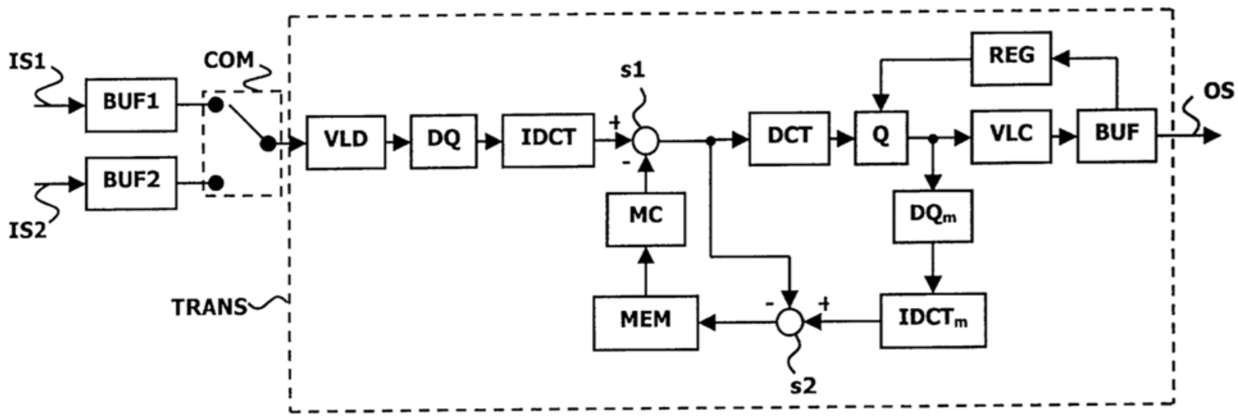


FIG. 4

’712 patent at 4:15-25, Figs. 2-4.

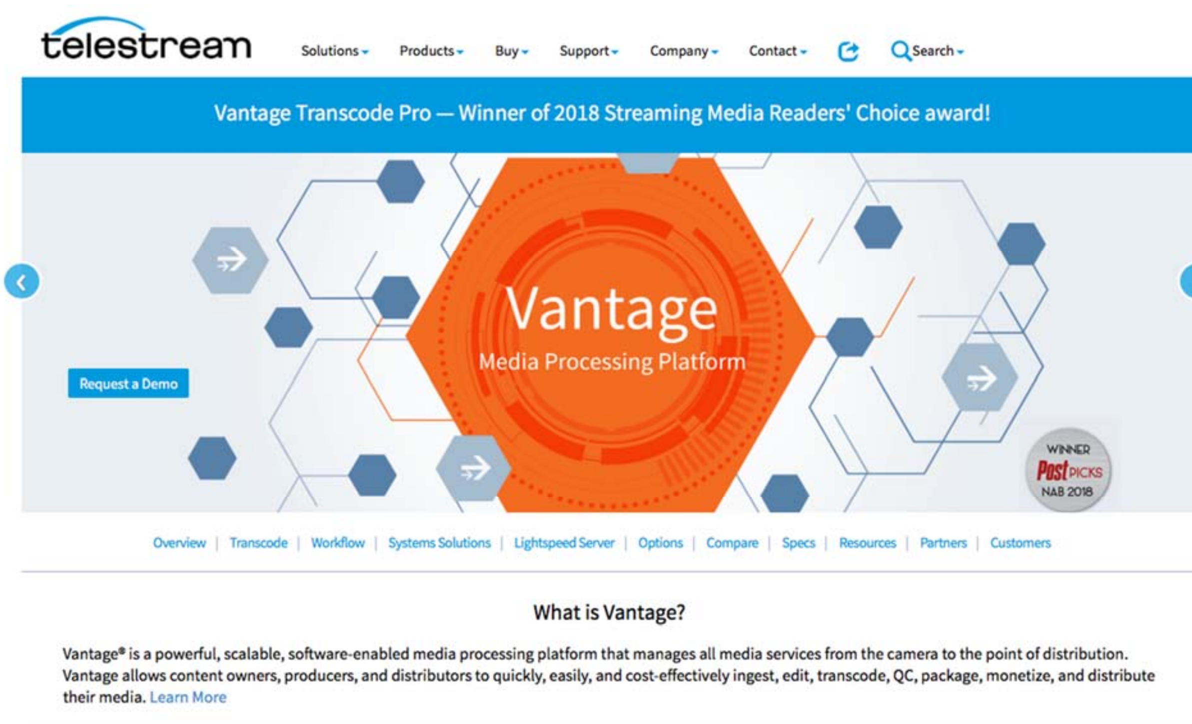
19. The claimed invention of claim 4 of the ’712 patent improves the functionality of switching from a first compressed data input stream to a second compressed data input stream, resulting in a compressed data output stream. ’712 patent at 1:5-2:37; 2:66-4:32. The claimed invention of claim 4 of the ’712 patent also was not well-understood, routine or conventional at the time of invention. Rather, the claimed invention was a departure from the conventional way of switching from a first encoded video sequence to a second one.

20. In light of the foregoing, a person of ordinary skill in the art would understand that the claimed subject matter of the ’712 patent presents advancements in the field of image compression. A person of ordinary skill in the art would understand that claim 4 of the ’712 patent is directed to a method of transcoding a stream provided by the controlling of two input streams where the transcoding includes controlling the occupancy of a buffer by feedback to DCT coefficient quantization in order to provide the output stream in a seamless way. Moreover, a person of ordinary skill in the art would understand that claim 4 of the ’712 patent contains the inventive concept of transcoding a stream provided by the controlling of two input

streams where the transcoding includes controlling the occupancy of a buffer by feedback to DCT coefficient quantization in order to provide the output stream in a seamless way.

21. Upon information and belief, Telestream has directly infringed at least claim 4 of the ’712 patent by making, using, testing, selling, offering for sale, importing and/or licensing in the United States without authority products and services such as Telestream’s Vantage media processing platform, including the stitching media functionality in the Vantage service that practices the method of switching from a first compressed data input stream to a second compressed data input stream, resulting in a compressed data output stream (collectively “the ’712 Accused Infringing Devices”) in an exemplary manner as described below.

22. The ’712 Accused Infringing Devices stitch multiple input video and audio files together and “produces a single output file.” The input files and the single output file all contain compressed video and audio data streams.



Source: http://www.telestream.net/vantage/overview.htm, last accessed Dec. 27, 2018.

2 | **Stitching Media in Vantage**
Synopsis

Synopsis

Stitching media in Vantage is an easy way to process multiple, sequential input files in a workflow which produces a single output file—effectively, *stitching* them together.

Stitching is ideal for combining short clips, removing black sections, extracting sub-clips, stitching program segments together, or adding sponsorship (or black frames) in the middle of a clip. You can also use stitching for adding bumpers or trailers (or both), without resorting to a non-linear editor (NLE). A typical application is to create a thirty-minute program with a bumper, three segments with ads and a trailer, and submitting them to a workflow that combines them to produce an MPEG-2 production output file.

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Stitching is performed during transcoding. Vantage supports video re-wrapping (direct convert) and transcoding; both performed via a Flip action in your workflow. (Audio is not direct converted; it is always decoded and re-encoded for normalization and fade.)

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Alternatively, Vantage can stitch input files together while encoding the video into a different format, in the same workflow. This allows you to encode the segments into any format supported by Vantage, as configured in the workflow's Flip action. For example, three SD MPEG-2 files can be stitched, and the media then re-encoded as a Windows Media file, or an MXF file.

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Supported Formats for Stitching

Vantage supports stitching of files in the following formats.

Container	Video Essence	Audio Essence
MPEG2 Program Stream	MPEG-2	PCM/LPCM/MPEG-2 Layer 1
VOD/MPEG2 Transport Stream	MPEG-2	PCM/MPEG-2 Layer 1/Dolby E
MXF OP1A	MPEG-2(SD & HD, I-Frame and Long GOP)	PCM/MPEG-2 Layer 1/Dolby E
	DNxHD	
	DV (DV, DV50, DV100)	
	Sony XDCam	
	AVC Intra	
P2 MXF OPAtom	DVCProHD	PCM/MPEG-2 Layer 1/Dolby E
	AVC Intra	
AS02 MXF	JPEG2000	PCM/MPEG-2 Layer 1/Dolby E
QuickTime MOV	DV	PCM/Dolby E
	DVCPro	
	DVCPro HD	
	ProRes	
	DNxHD	
	MPEG-2	
	AVC Intra	
GXF	MPEG-2	PCM/Dolby E
	DV	
	DVCPro	
	DVCPro HD	
	AVCI	

Source: "Vantage Application Note: Stitching Media in Vantage", page 3, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

23. The '712 Accused Infringing Devices buffer and store the data contained in the first and second input streams. The '712 Accused Infringing Devices provide two methods of stitching files—interactively and automatically. In both methods, the input streams are stored as input files. In interactive stitching, the input streams are also buffered and stored during the EDL (Edit Decision List) Ingest Workflow step.

Vantage provides two methods of stitching files. To stitch interactively, you use Workflow Portal, a Vantage client application that allows operators to select media (and optionally trim it) and submit an automatically-generated EDL for processing. Interactive stitching enables an operator to review each clip and optionally select mark-in and mark-out points, creating a list of media segments which is stitched together and then encoded in the same or different format, in a single, automated job process.

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

To stitch files automatically, you create and submit an EDL file to a fully-automated stitching workflow. Examples of both methods (each of which utilize the same, specially-formatted XML file known as a *TSEDL* file) are presented in this app note.

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Stitching Files Interactively

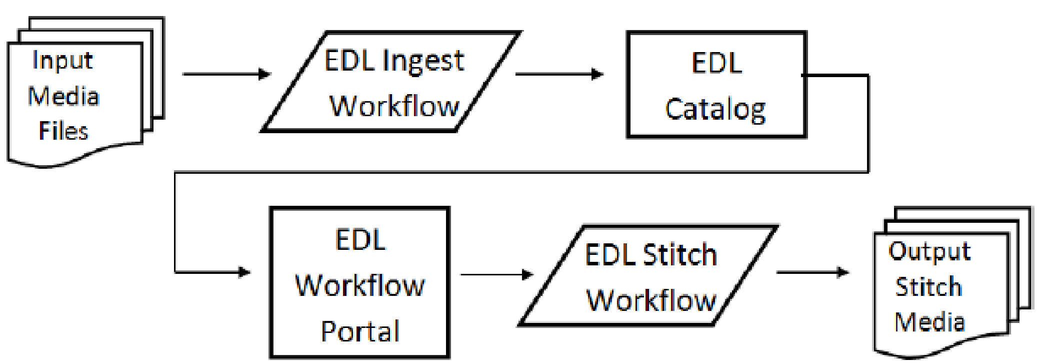
Interactive stitching uses Workflow Portal, where an operator browses a Vantage catalog and selects clips for stitching. (Optionally, the operator can also scrub clips and trim them as required).

Source: "Vantage Application Note: Stitching Media in Vantage", page 5, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Overview

Using Workflow Portal to perform file stitching requires two workflows: one—an EDL source ingest workflow—to encode source media intended for stitching, and register the media files in the Vantage catalog. The other—a stitching workflow—to stitch the files together and encode them into a single output file.

As the operator assembles each file, an EDL is automatically being created. The operator then submits the resulting EDL to the stitching workflow for processing.



Source: "Vantage Application Note: Stitching Media in Vantage", page 5, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Stitching Files Using a TSEDL File

In addition to stitching files using Workflow Portal, you can also stitch files by creating and submitting a Telestream EDL (TSEDL) file directly to a stitching workflow, to be automatically processed—without operator intervention. Before submitting a TSEDL for processing, you must first create and format the XML file correctly, and provide it with a *.tsedl* extension. These files can be created (and submitted) manually or programmatically.

You submit a TSEDL file like a media file—by dropping it into a folder monitored by the Watch action in a stitching workflow, or by submitting it manually or with an SDK-based program to perform job submission.

Source: "Vantage Application Note: Stitching Media in Vantage", page 17, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Sample TSEDL File

```
<?xml version="1.0" encoding="utf-8"?>
<VantagePlayList>
  <Name>NewEdlClip</Name>
  <File uuid="fe364478-116e-47d1-b692" path="d:\EDL\clip1.mxf"/>
  <File uuid="9E04A0DC-5E4D-4d7d-B015" path="d:\EDL\clip2.mxf"/>
  <EDL>
    <AudioFade name="Parameters" duration = "100" type = "cross"/>
    <Edit type="file" sequence="0" timecode_in="12:55:04:03@25"
      timecode_out="12:55:05:08@25" markin="700" markout="1300"
      file="fe364478-116e-47d1-b692">
      <ChannelMap>
        <Channel>
          <Source>2</Source>
          <Output>1</Output>
        </Channel>
        <Channel>
          <Source>SILENT</Source>
          <Output>2</Output>
        </Channel>
      </ChannelMap>
    </Edit>
  </EDL>
</VantagePlayList>
```

Source: "Vantage Application Note: Stitching Media in Vantage", page 18, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

24. The '712 Accused Infringing Devices control the storage of the input streams in the buffer system in order to switch, at a switch request, from the first input stream to the second input stream. As explained above, the '712 Accused Infringing Devices provide two methods of stitching files—interactively and automatically. In both methods, the mark-in point can be scheduled to switch from the first input stream to the second input stream, and if desired by the user, the mark-out point can be scheduled to switch from the second input stream back to the first input stream.

Vantage provides two methods of stitching files. To stitch interactively, you use Workflow Portal, a Vantage client application that allows operators to select media (and optionally trim it) and submit an automatically-generated EDL for processing. Interactive stitching enables an operator to review each clip and optionally select mark-in and mark-out points, creating a list of media segments which is stitched together and then encoded in the same or different format, in a single, automated job process.

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Sample TSEDL File

```
<?xml version="1.0" encoding="utf-8"?>
<VantagePlayList>
  <Name>NewEdlClip</Name>
  <File uuid="fe364478-116e-47d1-b692" path="d:\EDL\clip1.mxf"/>
  <File uuid="9E04A0DC-5E4D-4d7d-B015" path="d:\EDL\clip2.mxf"/>
  <EDL>
    <AudioFade name="Parameters" duration = "100" type = "cross"/>
    <Edit type="file" sequence="0" timecode_in="12:55:04:03@25"
      timecode_out="12:55:05:08@25" markin="700" markout="1300"
      file="fe364478-116e-47d1-b692">
```

Source: "Vantage Application Note: Stitching Media in Vantage", page 18, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

TSEDL Schema

> **markIn**. Specify the integer value of the mark-in frame, inclusive. Counting starts at 0, not 1.
>
> **markout**. Specify the integer value of the mark-out frame, exclusive.

Source: "Vantage Application Note: Stitching Media in Vantage", page 19, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

25. The '712 Accused Infringing Devices provide a transcoding system for switching input files that are of different formats to each other or of a different format from the desired output stream.

> Stitching is performed during transcoding. Vantage supports video re-wrapping (direct convert) and transcoding; both performed via a Flip action in your workflow. (Audio is not direct converted; it is always decoded and re-encoded for normalization and fade.)

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

> Alternatively, Vantage can stitch input files together while encoding the video into a different format, in the same workflow. This allows you to encode the segments into any format supported by Vantage, as configured in the workflow's Flip action. For example, three SD MPEG-2 files can be stitched, and the media then re-encoded as a Windows Media file, or an MXF file.

Source: "Vantage Application Note: Stitching Media in Vantage", page 2, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

Supported Formats for Stitching

Vantage supports stitching of files in the following formats.

Container	Video Essence	Audio Essence
MPEG2 Program Stream	MPEG-2	PCM/LPCM/MPEG-2 Layer 1
VOD/MPEG2 Transport Stream	MPEG-2	PCM/MPEG-2 Layer 1/Dolby E
MXF OP1A	MPEG-2(SD & HD, I-Frame and Long GOP)	PCM/MPEG-2 Layer 1/Dolby E
	DNxHD	
	DV (DV, DV50, DV100)	
	Sony XDCam	
	AVC Intra	
P2 MXF OPAtom	DVCProHD	PCM/MPEG-2 Layer 1/Dolby E
	AVC Intra	
AS02 MXF	JPEG2000	PCM/MPEG-2 Layer 1/Dolby E
QuickTime MOV	DV	PCM/Dolby E
	DVCPro	
	DVCPro HD	
	ProRes	
	DNxHD	
	MPEG-2	
	AVC Intra	
GXF	MPEG-2	PCM/Dolby E
	DV	
	DVCPro	
	DVCPro HD	
	AVCI	

Source: "Vantage Application Note: Stitching Media in Vantage", page 3, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

11. Specify the following:

Encoder—*QuickTime*

Video Stream—*H.264*

Input media file nickname—*Original*

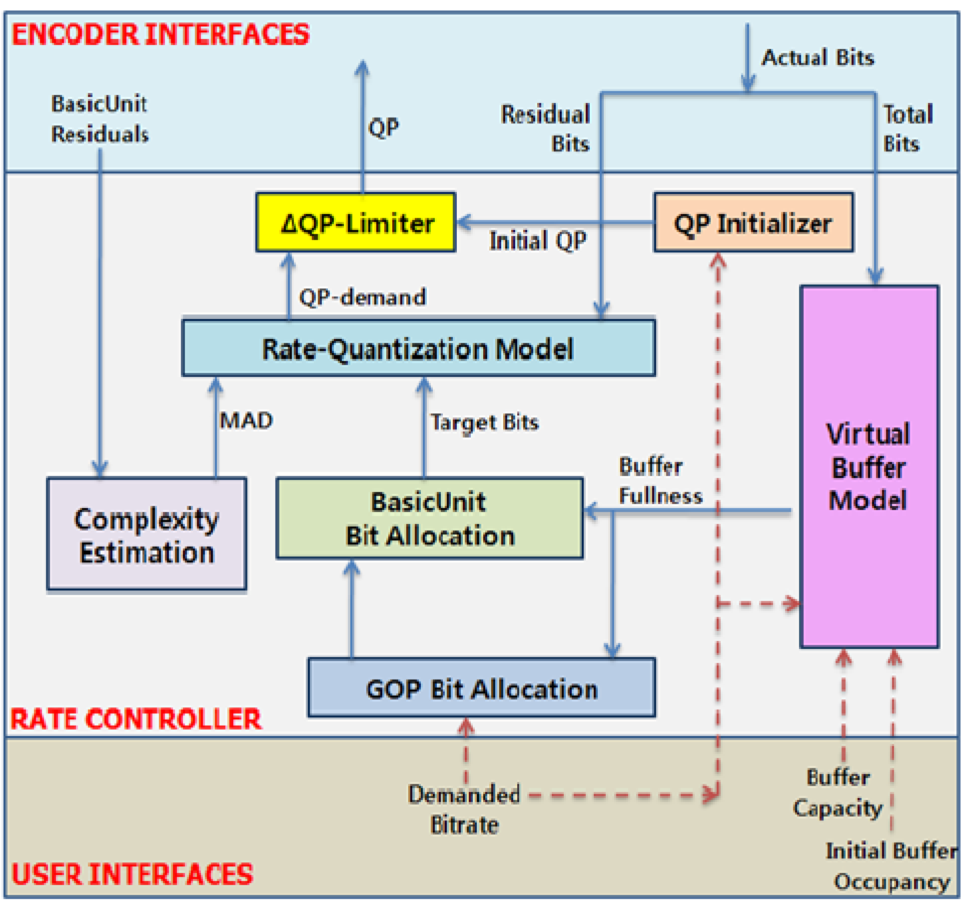
Output media file nickname—*Vantage Proxy*.

The nickname *Vantage Proxy* is assigned, so that Workflow Portal can identify which version of media in the binder should be displayed in the proxy player.

No configuration is required for this example. In your own workflow, configure as required.

Source: "Vantage Application Note: Stitching Media in Vantage", page 9, http://www.telestream.net/pdfs/app-notes/app_Vantage_Stitch.pdf, last accessed Dec. 27, 2018.

26. The video codecs in the '712 Accused Infringing Devices, such as the AVC/H.264 codec, control occupancy of the encoded bit stream buffer by feedback to DCT coefficient quantization as part of rate control and rate distortion optimization in the video encoders.



Source: https://www.researchgate.net/figure/Rate-control-structure-of-H264-AVC-JM-reference-model_fig1_260585793, last accessed Oct. 1, 2018.

27. Telestream has thus infringed at least claim 4 of the ’712 patent by making, using, testing, selling, offering for sale, importing and/or licensing the ’712 Accused Infringing Devices, and operating them such that all steps of at least claim 4 are performed.

28. Telestream’s acts of direct infringement have caused damage to Uniloc, and Uniloc is entitled to recover damages sustained as a result of Telestream’s wrongful acts in an amount subject to proof at trial.

COUNT II: INFRINGEMENT OF THE ’118 PATENT

29. The allegations of paragraphs 1-7 of this First Amended Complaint are incorporated by reference as though fully set forth herein.

30. The ’118 patent, titled “Method Of Coding Digital Image Based on Error Concealment,” issued on May 17, 2005. A copy of the ’118 patent is attached as Exhibit B. The priority date for the ’118 patent is March 6, 2001. The inventions of the ’118 patent were developed by inventors at Koninklijke Philips Electronics N.V.

31. Pursuant to 35 U.S.C. § 282, the ’118 patent is presumed valid.

32. Claim 1 of the ’118 patent addresses a technological problem indigenous to coding macroblocks in a binary digital stream where certain macroblocks have been excluded.

33. Claim 1 of the ’118 patent reads as follows:

> 1. A method of coding a digital image comprising macroblocks in a binary data stream, the method comprising:
>
> an estimation step, for macroblocks, of a capacity to be reconstructed via an error concealment method,
>
> a decision step for macroblocks to be excluded from the coding, a decision to exclude a macroblock from coding being made on the basis of the capacity of such macroblock to be reconstructed,
>
> characterized in that it also includes a step of inserting a resynchronization marker into the binary data stream after the exclusion of one or more

macroblocks.

34. The invention of claim 1 of the ’118 patent concerns a novel method for digital coding of macroblocks within a data stream.

35. Just prior to the invention of the ’118 patent, in June 1999, a then novel method for coding involved the exclusion of certain macroblocks in a digital image based upon the capacity of the macroblocks to be reconstructed via error concealment (“the June 1999 Method”). ’118 patent at 1:14-21. In the June 1999 Method, the excluded macroblocks were replaced with “uncoded blocks with constant blocks, black blocks for example, subsequently detected by the receiver.” ’118 patent at 1:21-25. Alternatively, the June 1999 Method provided for allocating bits to communicate the address of the excluded blocks in interceded macroblocks that were not excluded. ’118 patent at 1:26-32.

36. Both means of replacing the excluded blocks in the June 1999 Method suffered from significant drawbacks. For example, if constant blocks or black blocks were used as replacements for the excluded macroblocks there would be “graphical errors on most receivers.” ’118 patent at 1:62-67. Likewise, allocating bits to communicate the address of excluded blocks gave “rise to graphical ‘lag’ errors of image elements if macroblocks have been excluded.” ’118 patent at 1:56-62.

37. As demonstrated below, the claimed invention of claim 1 of the ’118 patent provides a technological solution to the problem faced by the inventors— using resynchronization markers after the exclusion of a macroblock rather than replacing macroblocks with constant blocks, black blocks or bits allocated to communicate the address of the excluded blocks. This technological solution resulted in reduction in lag and graphical errors and improved bandwidth because of a reduction in the binary data stream.

38. As detailed in the specification, the invention of claim 1 of the '118 patent provides a technological solution to the specific technological problems faced by the inventors that existed at the time of the invention. First, the specification describes the June 1999 Method and the drawbacks associated with that method.

> A coding method of such type is known from the document "Geometric-Structure-Based Error Concealment with Novel Applications in Block-Based Low-Bit-Rate Coding" by W. Zeng and B. Liu in IEEE Transactions on Circuits and Systems For Video Technology, Vol. 9, No. 4, Jun. 1999. That document describes exclusions of blocks belonging to macroblocks, block combination, said macroblocks being capable of being intercoded or intracoded. That document proposes harmonizing this block exclusion with video coding standards, either, in a **first solution**, by replacing uncoded blocks with constant blocks, black blocks for example, subsequently detected by the receiver, or, in a **second solution**, by modifying the word that defines which blocks are coded within a macroblock, such modification taking place at the same time as a modification of the address words of the macroblocks when all the blocks in a macroblock are excluded. A certain number of bits are allocated to communicate the address of the excluded blocks in the interceded macroblocks.

'118 patent at 1:14-31 (emphasis added).

39. Both of these means of dealing with the excluded macroblocks in the June 1999 Method were disadvantageous and suffered from serious drawbacks that thwarted the purpose of excluding macroblocks (i.e., to further compress the data stream):

> In this case it is therefore impossible to change the addresses of the macroblocks or indicate which blocks are not coded, according to the **second solution** proposed in the document cited in the foregoing. All macroblocks are thus decoded and placed sequentially, giving rise to graphical "lag" errors of image elements if macroblocks have been excluded. The **first solution** proposed in the document cited involves detection by the decoder of the constant blocks replacing the excluded blocks. No provision for such detection is made in the MPEG-4 syntax, and this will cause graphical errors on most receivers.

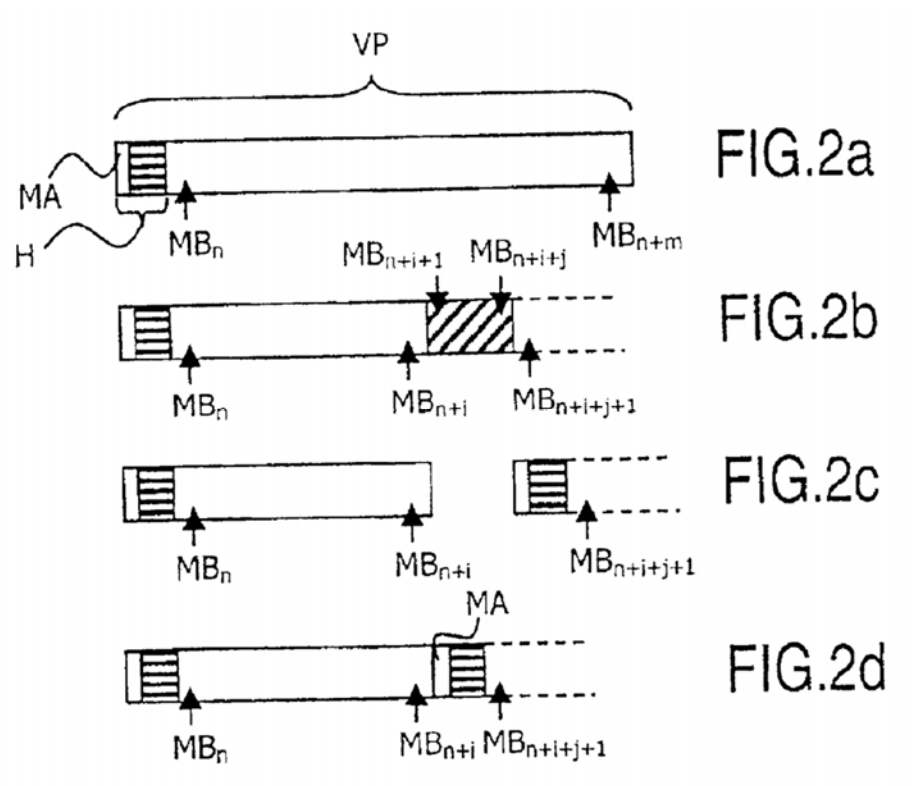
'118 patent at 1:56-67 (emphasis added).

40. In light of the drawbacks with the June 1999 Method, the inventors of the '118 patent claimed a new method where resynchronization markers included in header elements were used instead of constant blocks, black blocks and bits allocated to communicate the address of the excluded blocks:

> It is an object of the present invention to suggest a coding method that includes an exclusion of macroblocks having a certain capacity to be reconstructed from the coding compatible with coding standards which include point resynchronization means.
>
> Indeed, a coding method as defined in the introductory paragraph is characterized according to the invention in that it also includes a step of inserting a resynchronization marker into the binary data stream after the exclusion of one or more macroblocks.
>
> The resynchronization marker represents a certain number of bits in the data stream (at least between 17 and 23 bits). It is a further object of the present invention to reduce the binary data stream associated with the transmission of digital images by excluding macroblocks.

’118 patent at 2:1-15 (emphasis added).

41. The reduction in the data stream using the claimed method—as opposed to the June 1999 Method which added constant blocks, black blocks and other bits for excluded macroblocks—is depicted in Figure 2 and described in the specification:



> The resulting binary data stream in such case is shown in FIG. 2*d*. A resynchronization marker MA and the associated header element have been

> inserted in the stream at the point where the first one of the excluded macroblocks should have been, and before macroblock $MB_{n+i+j+1}$. Here, the reduction in the size of the binary data stream caused by the insertion of resynchronization marker MA and the associated header element is not zero according to FIG. **2**: the bloc representing excluded macroblocks MB_{n+i+1} to $MB_{n+i+j}$is larger than the size of the inserted header element.
>
> * * *
>
> Since the binary data stream includes coded data of a digital image comprising macroblocks, said binary data stream being such that macroblocks MB_{n+i+1} to MB_{n+i+j} are not coded in the binary data stream for at least one point in the binary data stream and since such uncoded macroblocks are capable of being reconstructed by an error concealment method, said binary data stream is thus characterized according to the invention in that a resynchronization marker MA is present in the binary data stream at the location in the binary data stream where the macroblocks are not coded.

’118 patent at 5:37-46.

42. The claimed invention of claim 1 of the ’118 patent improves the functionality of coding macroblocks in a binary digital stream where certain macroblocks have been excluded. The claimed invention of claim 1 of the ’118 patent also was not well-understood, routine or conventional at the time of invention. Rather, the claimed invention was a departure from the conventional way of performing coding macroblocks in a binary digital stream where certain macroblocks have been excluded.

43. A person of ordinary skill in the art reading claim 1 of the ’118 patent and the corresponding specification would understand that claim 1 improves the functionality of coding macroblocks in a binary digital stream where certain macroblocks have been excluded. This is because, as noted above, the June 1999 Method suffered from drawbacks including (1) lag errors; (2) graphical errors; and (3) no reduction in the size of the data stream because of the use of constant blocks, black blocks and allocating bits to communicate the address of the excluded blocks. A person of ordinary skill in the art would further understand that the claimed invention of claim 1 of the ’118 patent resolved these problems by using resynchronization markers in a way they had not been used before—as replacements for excluded blocks.

44. A person of ordinary skill in the art reading claim 1 of the ’118 patent and the corresponding specification would further understand that claim 1 of the ’118 patent represents a departure from convention by (1) coding a data stream with excluded macroblocks in a way that is different from the recent June 1999 Method and (2) using resynchronization markers in a manner that had not been used before—as replacements for excluded macroblocks.

45. In light of the foregoing, a person of ordinary skill in the art reading the ’118 patent and its claims would understand that the patent’s disclosure and claims are drawn to solving a specific, technical problem arising in achieving more efficient video compression. Moreover, a person of ordinary skill in the art would understand that the claimed subject matter of the ’118 patent presents advancements in the field of digital image coding.

46. In light of the foregoing, a person of ordinary skill in the art would understand that claim 1 of the ’118 patent is directed to a method of coding macroblocks in a binary digital stream where certain macroblocks have been excluded. Moreover, a person of ordinary skill in the art would understand that claim 1 of the ’118 patent contains the inventive concept of using resynchronization markers after the exclusion of a macroblock rather than replacing macroblocks with constant blocks, black blocks or bits allocated to communicate the address of the excluded blocks.

47. Upon information and belief, Telestream makes, uses, offers for sale, and/or sells in the United States and/or imports into the United States encoding products and services such as the Telestream Vantage IPTV VOD, Vantage Transcode Multiscreen and others that use H.264 (AVC) streams for coding video data (digital images) including macroblocks embedded in a binary stream (collectively the “’118 Accused Infringing Devices”).

48. Upon information and belief, the ’118 Accused Infringing Devices infringe at least claim 1 in the exemplary manner described below.

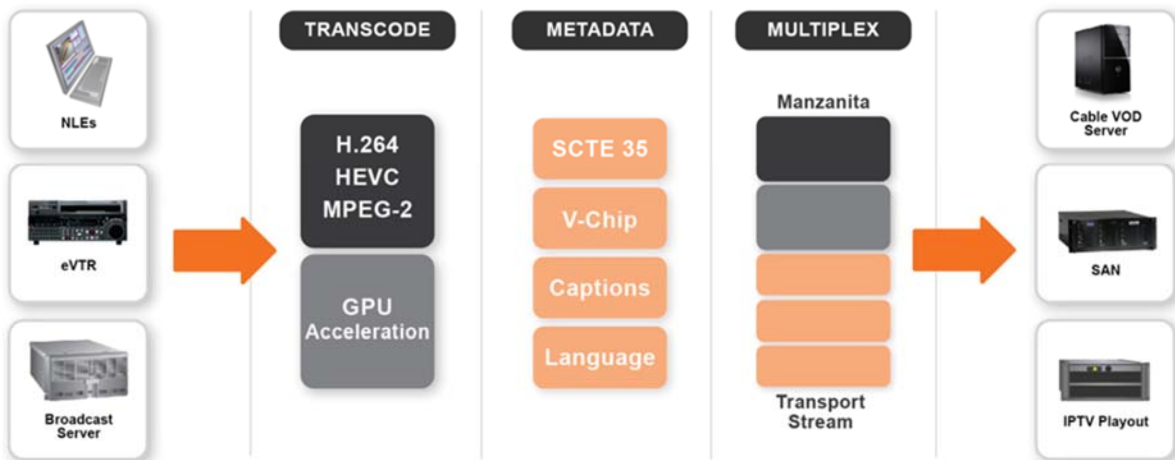
49. The ’118 Accused Infringing Devices use H.264 (AVC) streams for coding video data (digital images) including macroblocks embedded in a binary stream.

50. H.264 is a widely used video compression format with decoder support on web browsers, TVs and other consumer devices. Moreover, H.264 codes digital images comprising macroblock streams.

51. The ’118 Accused Infringing Devices receive input video streams which are then encoded and/or transcoded using at least the H.264 standard. This is a widely used video compression format with decoder support on web browsers, TVs and other consumer devices. Moreover, H.264 uses motion compressor and estimator for motion coding video streams.

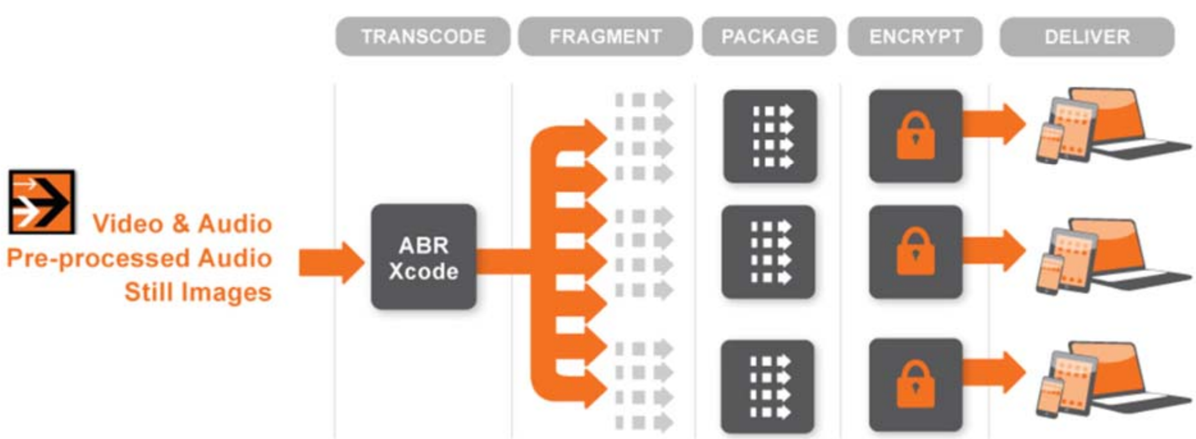
Telestream encodes video streams using H.264 encoders

Telestream Vantage Transcode IPTV VOD allows you to achieve the highest possible quality at the lowest bit rates. With GPU accelerated transcoding, integration of x264 H.264 and x265 HEVC encoding technology, and Manzanita Transport Stream multiplexing, Transcode IPTV VOD offers a complete solution to automate transcoding for IPTV and Cable VOD production.



Source: https://www.telestream.net/vantage/vantage-iptv-vod.htm

Vantage Transcode Multiscreen is the only transcoding solution which combines the quality of x264, GPU acceleration, and complete workflow automation for multiscreen encoding. Transcode Multiscreen can automate the entire process of creating adaptive bitrate packages, including content ingest, transcoding, packaging, encryption, delivery and notification.



Vantage Transcode Multiscreen allows you to:

- Convert directly from a wide variety of source formats
- Increase quality, reduce bit rate and CDN distribution costs with x264 H.264 encoding
- Achieve super-fast encoding with highly efficient multi-rate encoding and GPU acceleration
- Automatically package files for Apple HLS, Adobe Dynamic Streaming, Microsoft Smooth Streaming, MPEG DASH and Mp4 progressive downloads
- Deliver final files directly to CDN and on-premise origin servers
- Provide real-time visibility and hands-free publishing

Higher Quality, Lower Bit Rates with X264

x264 is widely regarded as the industry leading H.264 encoding technology. Independent studies have shown x264 capable of reducing bit rate requirements by 50%, without sacrificing quality, when compared with other H.264 encoders. Transcode Multiscreen allows GPU acceleration of x264 encoding for high quality with exceptional transcoding speed.

Source: https://www.telestream.net/vantage/vantage-multiscreen.htm

> This Recommendation | International Standard was developed in response to the growing need for higher compression of moving pictures for various applications such as videoconferencing, digital storage media, television broadcasting, internet streaming, and communication. It is also designed to enable the use of the coded video representation in a flexible manner for a wide variety of network environments. The use of this Recommendation | International Standard allows motion video to be manipulated as a form of computer data and to be stored on various storage media, transmitted and received over existing and future networks and distributed on existing and future broadcasting channels.

Source: https://www.itu.int/rec/T-REC-H.264-201704-I/en , p. i

> As in previous video coding Recommendations and International Standards, a macroblock, consisting of a 16x16 block of luma samples and two corresponding blocks of chroma samples, is used as the basic processing unit of the video decoding process.
>
> A macroblock can be further partitioned for inter prediction. The selection of the size of inter prediction partitions is a result of a trade-off between the coding gain provided by using motion compensation with smaller blocks and the quantity

Source: https://www.itu.int/rec/T-REC-H.264-201704-I/en, section 0.6.3

> **Annex B**
>
> **Byte stream format**
>
> (This annex forms an integral part of this Recommendation | International Standard.)
>
> This annex specifies syntax and semantics of a byte stream format specified for use by applications that deliver some or all of the NAL unit stream as an ordered stream of bytes or bits within which the locations of NAL unit boundaries need to be identifiable from patterns in the data, such as Rec. ITU-T H.222.0 | ISO/IEC 13818-1 systems or Rec. ITU-T H.320 systems. For bit-oriented delivery, the bit order for the byte stream format is specified to start with the MSB of the first byte, proceed to the LSB of the first byte, followed by the MSB of the second byte, etc.

Source: https://www.itu.int/rec/T-REC-H.264-201704-I/en, Annex B

52. H.264 coding in the '118 Accused Infringing Devices supports skipped macroblocks. Before a macroblock is coded, an estimation is made of whether that macroblock can be reconstructed with an error concealment method by examining its motion characteristics and checking to see that the resulting prediction contains no non-zero (i.e. all zero) quantized transform coefficients. This estimation provides an indication of the capacity for the macroblock to be reconstructed from properties of neighboring macroblocks, allowing the missing block to be concealed by inferring its properties.

Skipped Mode:
In addition to the macroblock modes described above, a P-slice macroblock can also be coded in the so-called skip mode. If a macroblock has motion characteristics that allow its motion to be effectively predicted from the motion of neighboring macroblocks, and it contains no non-zero quantized transform coefficients, then it is flagged as skipped. For this mode, neither a quantized prediction error signal nor a motion vector or reference index parameter are transmitted. The reconstructed signal is computed in a manner similar to the prediction of a macroblock with partition size 16 × 16 and fixed reference picture index equal to 0. In contrast to previous video coding standards, the motion vector used for reconstructing a skipped macroblock is inferred from motion properties of neighboring macroblocks rather than being inferred as zero (i.e., no motion).

Source: http://mrutyunjayahiremath.blogspot.com/2010/09/h264-inter-predn.html

53. The H.264 encoders in the ’118 Accused Infringing Devices perform a decision step to determine if a macroblock should be excluded from coding (skipped), with the decision to exclude made on the basis of its capacity to be reconstructing by inferring its motion properties from neighboring macroblocks and based on all zero quantized transform coefficients.

Skipped Mode:
In addition to the macroblock modes described above, a P-slice macroblock can also be coded in the so-called skip mode. If a macroblock has motion characteristics that allow its motion to be effectively predicted from the motion of neighboring macroblocks, and it contains no non-zero quantized transform coefficients, then it is flagged as skipped. For this mode, neither a quantized prediction error signal nor a motion vector or reference index parameter are transmitted. The reconstructed signal is computed in a manner similar to the prediction of a macroblock with partition size 16 × 16 and fixed reference picture index equal to 0. In contrast to previous video coding standards, the motion vector used for reconstructing a skipped macroblock is inferred from motion properties of neighboring macroblocks rather than being inferred as zero (i.e., no motion).

Source: http://mrutyunjayahiremath.blogspot.com/2010/09/h264-inter-predn.html

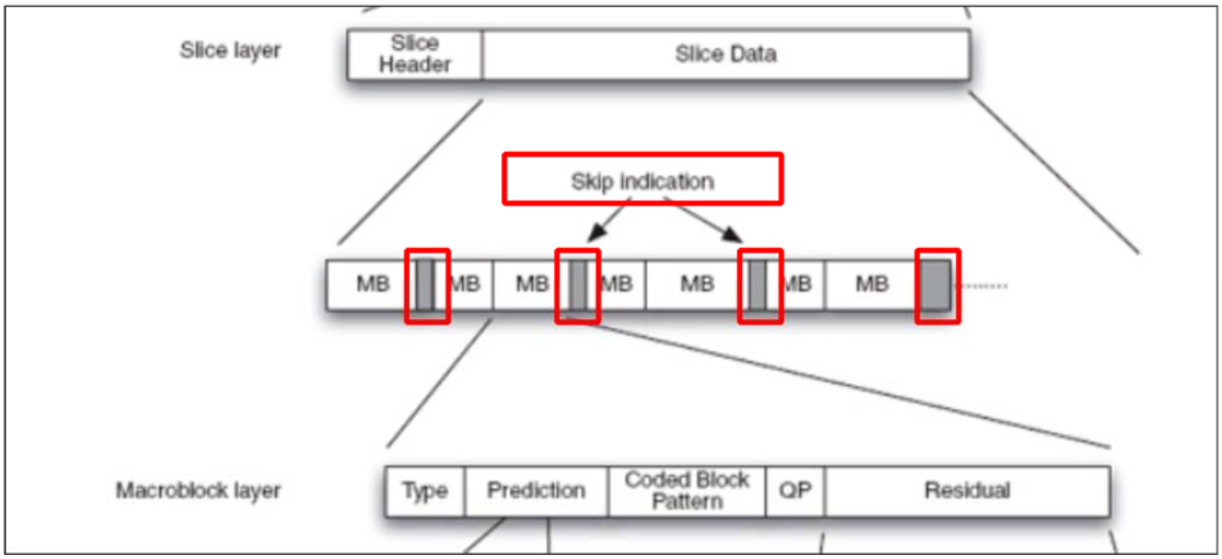
54. The skipped macroblocks are communicated with an mb_skip_flag = 1 (resynchronization marker at the point where the macroblocks are not coded (skipped)) in the binary data stream.

3.139 **skipped macroblock**: A *macroblock* for which no data is coded other than an indication that the *macroblock* is to be decoded as "skipped". This indication may be common to several *macroblocks*.

Source: https://www.itu.int/rec/T-REC-H.264-201704-I/en, p13

3.139	**skipped macroblock**: A *macroblock* for which no data is coded other than an indication that the *macroblock* is to be decoded as "skipped". This indication may be common to several *macroblocks*.

Source: https://www.itu.int/rec/T-REC-H.264-201704-I/en, p13



Source: https://www.safaribooksonline.com/library/view/the-h264
advanced/9780470516928/ch05.html#macroblock_layer

55. Telestream has thus infringed at least claim 1 of the ’118 patent by making, using, testing, selling, offering for sale, importing and/or licensing the ’118 Accused Infringing Devices, and operating them such that all steps of at least claim 1 are performed.

56. Telestream’s acts of direct infringement have caused damage to Uniloc, and Uniloc is entitled to recover damages sustained as a result of Telestream’s wrongful acts in an amount subject to proof at trial.

COUNT III: INFRINGEMENT OF THE ’005 PATENT

57. The allegations of paragraphs 1-7 of this First Amended Complaint are incorporated by reference as though fully set forth herein.

58. The ’005 patent, titled “Method of Concurrent Multiple-Mode Motion Estimation For Digital Video,” issued on February 11, 2003. A copy of the ’005 patent is

attached as Exhibit C. The priority date for ’005 patent is April 30, 1999. The inventions of the ’005 patent were developed by inventors at Koninklijke Philips Electronics N.V.

59. Pursuant to 35 U.S.C. § 282, the ’005 patent is presumed valid.

60. Claim 1 of the ’005 patent addresses a technological problem indigenous to motion coding in uncompressed digital video streams.

61. Claim 1 of the ’005 patent reads as follows:

> 1. A method for motion coding an uncompressed digital video data stream, including the steps of:
>
> comparing pixels of a first pixel array in a picture currently being coded with pixels of a plurality of second pixel arrays in at least one reference picture and concurrently performing motion estimation for each of a plurality of different prediction modes in order to determine which of the prediction modes is an optimum prediction mode;
>
> determining which of the second pixel arrays constitutes a best match with respect to the first pixel array for the optimum prediction mode; and,
>
> generating a motion vector for the first pixel array in response to the determining step.

62. The invention of claim 1 of the ’005 patent concerns “digital video compression” and, more particularly, “a motion estimation method and search engine for a digital video encoder that is simpler, faster, and less expensive than the presently available technology permits, and that permits concurrent motion estimation using multiple prediction modes.” ’005 patent at 1:6-11.

63. Data compression is the encoding of data using fewer “bits” than the original representation. Data compression is useful because it reduces the resources required to store and transmit data, and allows for faster retrieval and transmission of video data.

64. In the context of digital video with which the ’005 patent is concerned, a video codec is electronic circuitry or software that compresses and/or decompresses digital video for storage and/or transmission. Video codecs refer to video encoders and decoders.

65. Prior to digital video, video was typically stored as an analog signal on magnetic tape. Then, around the time of the development of compact discs (CDs), it became more feasible to store and convey video in digital form. However, a large amount of storage and communications bandwidth was needed to record and convey raw video. Thus, what was needed was a method to reduce the amount of data used to represent the raw video. Accordingly, numerous engineers and many companies worked to develop solutions for compressing digital video data.

66. "Practical digital video compression started with the ITU H.261 standard in 1990." *A Brief History of Video Coding*, ARC International, Marco Jacobs and Jonah Probell (2007). Numerous other video compression standards thereafter were created and evolved. The innovation in digital video compression continues to this day.

67. In April 1999, at the time of the invention of claim 1 of the '005 patent, "different compression algorithms ha[d] been developed for digitally encoding video and audio information (hereinafter referred to generically as the 'digital video data stream') in order to minimize the bandwidth required to transmit this digital video data stream for a given picture quality." '005 patent at 1:11-17.

68. At the time of the invention of claim 1 of the '005 patent, the "most widely accepted international standards [for compression of digital video for motion pictures and television were] proposed by the Moving Pictures Expert Group (MPEG)." '005 patent at 1:20-24. Two such standards that existed at the time of the invention were MPEG-1 and MPEG-2.

69. In accordance with MPEG-1 and MPEG-2—and other compression standards for digital video—the video stream is "encoded/compressed . . . using a compression technique generally known as 'motion coding.'" '005 patent at 1:40-44. More particularly, rather than transmitting each video frame in its entirety, the standards at the time used motion estimation for

only those parts of sequential pictures that varied due to motion, where possible. ’005 patent at 1:45-48.

70. In general, the picture elements or “pixels” within a block of a picture are specified relative to those of a previously transmitted reference or “anchor” picture using differential or “residual” video, as well as so-called “motion vectors” that specify the location of an array (e.g., 16-by-16) of pixels or “macroblock” within the current picture relative to its original location within the anchor picture. ’005 patent at 1:48-55. A macroblock is a unit in image and video compression that typically consists of 16x16 samples of pixels. A motion vector is used to represent a macroblock in a picture based on the position of that same or similar macroblock in another picture (known as the reference picture).

71. At the time of the invention, there were various “prediction modes” that could be used for each macroblock that was to be encoded. ’005 patent at 3:7-11. Prediction modes are techniques for predicting image pixels or groups of pixels, and examples of prediction modes in MPEG include frame and field prediction modes. ’005 patent at 4:64-67. Moreover, at that time, motion coding allowed for the use of different prediction modes within the same frame, but required one prediction mode to be specified for a macroblock in advance of performing the motion estimation that results in a motion vector. ’005 patent at 3:12-15. Given that there are multiple prediction modes, the optimum prediction mode could not be known prior to encoding unless multiple motion estimations were performed on each macroblock sequentially. ’005 patent at 3:15-20. Then, after determining the optimum prediction mode based on multiple and sequential motion estimations, the optimal prediction mode would be selected and only then would the motion estimation that results in the generation of a motion vector occur.

72. In this prior art method, numerous and sequential motion estimations would have to run to find the optimal prediction mode. Only after these sequential motion estimations have

been run and the optimal prediction mode selected could the motion estimation that results in the motion vector for the macroblock be carried out. Because "motion estimation usually consists of an exhaustive search procedure in which all 256 pixels of the two corresponding macroblocks are compared, and which is repeated for a large number of macroblocks," having to sequentially run numerous motion estimations to find the optimal prediction mode and only then performing the motion estimation using the optimal prediction mode to generate the motion vector is very computationally intensive, complex, inefficient, lengthy and cost ineffective. '005 patent at 3:20-43.

73. As demonstrated below, the claimed invention of claim 1 of the '005 patent provides a technological solution to the problem faced by the inventors, namely concurrently determining the optimal prediction mode while performing motion estimation along with generating the motion vector more simply, faster and in a less expensive way.

74. As detailed in the specification, the invention of claim 1 of the '005 patent provides a technological solution to the problems faced by the inventors:

> Based on the above and foregoing, it can be appreciated that there presently exists a need in the art that overcomes the disadvantages and shortcomings of the presently available technology. The present invention fulfills this need in the art by performing motion coding of an uncompressed digital video sequence in such a manner that the prediction mode for each individual macroblock is determined as part of the motion estimation process, along with the actual motion vector(s), and need not be specified in advance; only the type of picture currently being coded need be known. Since the latter must be determined at a higher level of video coding than the macroblock layer, this method makes possible a much more efficient, as well as optimal, degree of video compression than would otherwise be possible using conventional methods of motion estimation. Further, the present invention provides a novel scheme for concurrently searching for the optimum macroblock match within the appropriate anchor picture according to each of a plurality of motion prediction modes during the same search operation for the given macroblock, without the need for a separate search to be performed on the same macroblock for each such mode. Since this search procedure is the single most complex and expensive aspect of motion estimation, in both time and hardware, such a method as the present invention will clearly result in a more efficient video image coding and compression than would otherwise be possible given <u>the aforementioned practical limitations of the presently available technology</u>.

'005 patent at 3:40-67 (emphasis added).

75. The technological solution of claim 1 of the ’005 patent is further shown in Figure 3 which visually depicts a motion estimation process for concurrently performing motion estimation for frame prediction mode and field prediction modes for frame pictures:

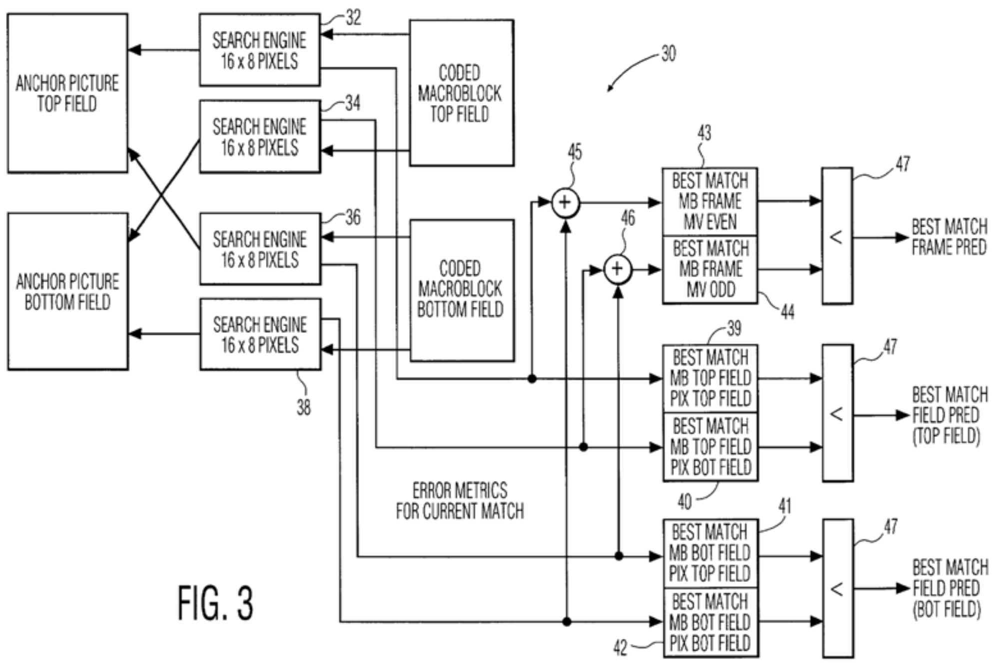


FIG. 3

76. Claim 1 of the ’005 patent improves the functionality of motion coding in video compression by performing the concurrent determination of the optimal prediction mode while performing motion estimation along with generating the motion vector. The claimed invention of claim 1 of the ’005 patent also was not well-understood, routine or conventional at the time of the invention. Rather, as set forth below, the claimed invention was a departure from the conventional ways of performing motion coding in video compression.

77. That the ’005 patent improves the functioning of motion coding in video compression and was a departure from conventional ways of carrying out this functionality cannot be disputed:

> Based on the above and foregoing, it can be appreciated that there presently exists a need in the art that overcomes the disadvantages and shortcomings of the presently available technology. The present invention fulfills this need in <u>the art by performing motion coding of an uncompressed digital video sequence</u>

> in such a manner that the prediction mode for each individual macroblock is determined as part of the motion estimation process, along with the actual motion vector(s), and need not be specified in advance; only the type of picture currently being coded need be known. Since the latter must be determined at a higher level of video coding than the macroblock layer, this method makes possible a much more efficient, as well as optimal, degree of video compression than would otherwise be possible using conventional methods of motion estimation. Further, the present invention provides a novel scheme for concurrently searching for the optimum macroblock match within the appropriate anchor picture according to each of a plurality of motion prediction modes during the same search operation for the given macroblock, without the need for a separate search to be performed on the same macroblock for each such mode. Since this search procedure is the single most complex and expensive aspect of motion estimation, in both time and hardware, such a method as the present invention will clearly result in a more efficient video image coding and compression than would otherwise be possible given the aforementioned practical limitations of the presently available technology.

’005 patent at 3:40-67 (emphasis added).

> The present invention relates generally to digital video compression, and, more particularly, to a motion estimation method and search engine for a digital video encoder that is simpler, faster, and less expensive than the presently available technology permits, and <u>that permits concurrent motion estimation using multiple prediction modes</u>.

’005 patent at 1:7-11 (emphasis added).

> In either case, the methods and architectures of the <u>present invention result in a means of significantly improving the video compression efficiency and, hence, the resulting picture quality, without the need for either greater hardware costs or higher computational complexity</u>.

’005 patent at 14:62-67 (emphasis added).

> In all known motion estimation methods, the prediction mode must be specified for every macroblock before the motion estimation, with its constituent search, is performed. However, <u>in accordance with the present invention, in one of its aspects, the motion estimation may be performed, in a frame picture, forth both frame and field prediction modes simultaneously, during the same search for the anchor picture</u>.

’005 patent at 8:6-13 (emphasis added).

78. In light of the foregoing, and the general knowledge of a person of ordinary skill in the art, a person of ordinary skill in the art reading the ’005 patent and its claims would understand that the patent’s disclosure and claims are drawn to solving a specific, technical problem arising in the field of digital video compression. Moreover, a person of ordinary skill in

the art would understand that the claimed subject matter of the ’005 patent presents advancements in the field of digital video compression, and more particularly to a motion estimation method and search engine for a digital video encoder that is simpler, faster, and less expensive than prior art technology, and that permits concurrent motion estimation using multiple prediction modes. A person of ordinary skill in the art would understand that claim 1 of the ’005 patent is directed to a method for motion coding an uncompressed digital video data stream, which provides concurrent motion estimation using multiple prediction modes along with the generation of motion vectors. Moreover, a person of ordinary skill in the art would understand that claim 1 of the ’005 patent contains that corresponding inventive concept.

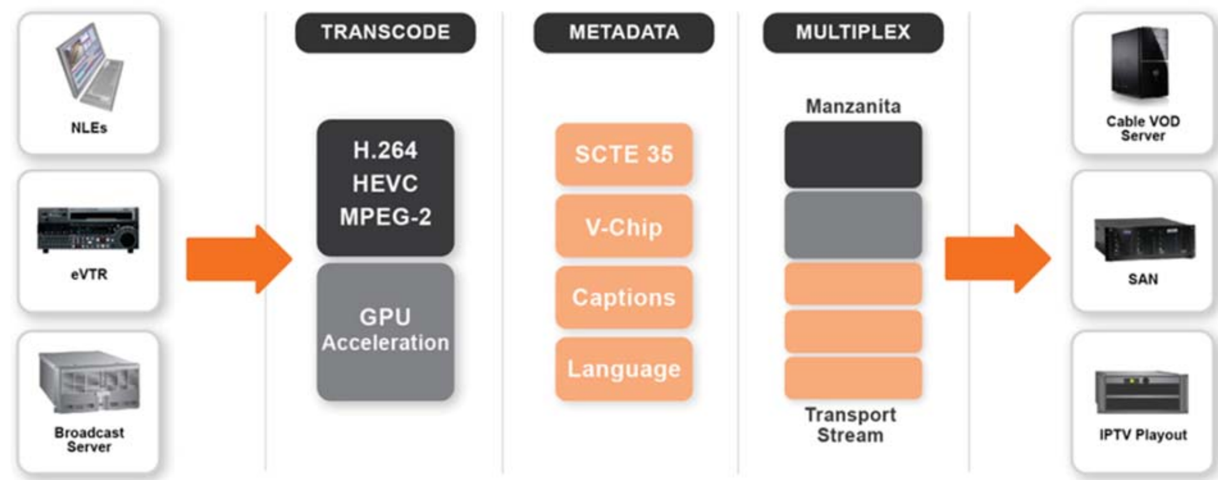
79. Upon information and belief, Telestream makes, uses, offers for sale, and/or sells in the United States and/or imports into the United States products and services such as its Telestream Vantage IPTV VOD, Vantage Transcode Multiscreen and others that practice a method for motion coding an uncompressed digital video data stream (collectively the “’005 Accused Infringing Devices”).

80. Upon information and belief, the ’005 Accused Infringing Devices infringe at least claim 1 in the exemplary manner described below.

81. The ’005 Accused Infringing Devices use H.264 (AVC) streams for coding uncompressed digital video data and provide a method for motion coding an uncompressed digital video data stream. The H.264 standard is a widely used video compression format with decoder support on web browsers, TVs and other consumer devices. Moreover, H.264 uses motion compressor and estimator for motion coding video streams.

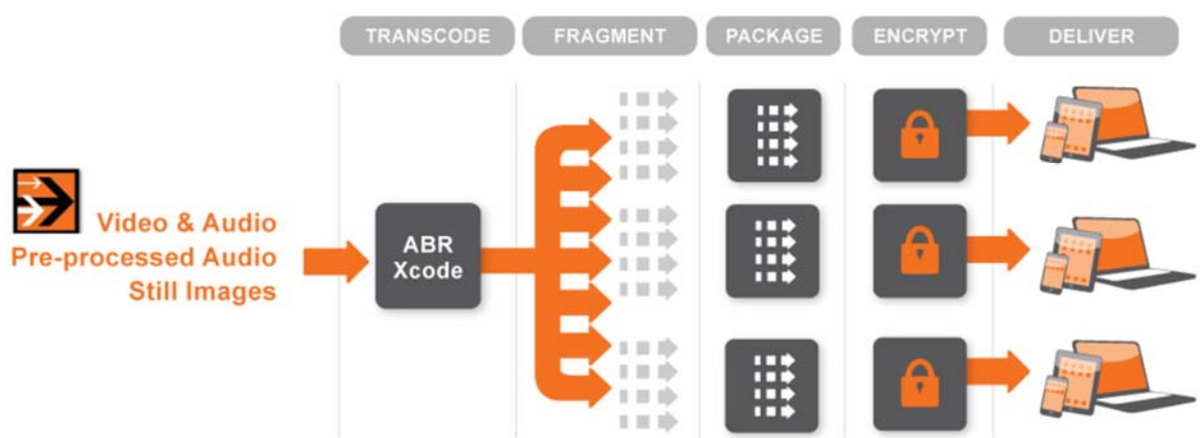
Telestream encodes video streams using H.264 encoders

Telestream Vantage Transcode IPTV VOD allows you to achieve the highest possible quality at the lowest bit rates. With GPU accelerated transcoding, integration of x264 H.264 and x265 HEVC encoding technology, and Manzanita Transport Stream multiplexing, Transcode IPTV VOD offers a complete solution to automate transcoding for IPTV and Cable VOD production.



Source: https://www.telestream.net/vantage/vantage-iptv-vod.htm

Vantage Transcode Multiscreen is the only transcoding solution which combines the quality of x264, GPU acceleration, and complete workflow automation for multiscreen encoding. Transcode Multiscreen can automate the entire process of creating adaptive bitrate packages, including content ingest, transcoding, packaging, encryption, delivery and notification.



Vantage Transcode Multiscreen allows you to:

- Convert directly from a wide variety of source formats
- Increase quality, reduce bit rate and CDN distribution costs with x264 H.264 encoding
- Achieve super-fast encoding with highly efficient multi-rate encoding and GPU acceleration
- Automatically package files for Apple HLS, Adobe Dynamic Streaming, Microsoft Smooth Streaming, MPEG DASH and Mp4 progressive downloads
- Deliver final files directly to CDN and on-premise origin servers
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x264 is widely regarded as the industry leading H.264 encoding technology. Independent studies have shown x264 capable of reducing bit rate requirements by 50%, without sacrificing quality, when compared with other H.264 encoders. Transcode Multiscreen allows GPU acceleration of x264 encoding for high quality with exceptional transcoding speed.

Source: https://www.telestream.net/vantage/vantage-multiscreen.htm

H.264 Uses Predictive Coding

0.6 Overview of the design characteristics

This subclause does not form an integral part of this Recommendation | International Standard.

The coded representation specified in the syntax is designed to enable a high compression capability for a desired image quality. With the exception of the transform bypass mode of operation for lossless coding in the High 4:4:4 Intra, CAVLC 4:4:4 Intra, and High 4:4:4 Predictive profiles, and the I_PCM mode of operation in all profiles, the algorithm is typically not lossless, as the exact source sample values are typically not preserved through the encoding and decoding processes. A number of techniques may be used to achieve highly efficient compression. Encoding algorithms (not specified in this Recommendation | International Standard) may select between inter and intra coding for block-shaped regions of each picture. Inter coding uses motion vectors for block-based inter prediction to exploit temporal statistical dependencies between different pictures. Intra coding uses various spatial prediction modes to exploit spatial statistical dependencies in the source signal for a single picture. Motion vectors and intra prediction modes may be specified for a variety of block sizes in the picture. The prediction residual is then further compressed using a transform to remove spatial correlation inside the transform block before it is quantised, producing an irreversible process that typically discards less important visual information while forming a close approximation to the source samples. Finally, the motion vectors or intra prediction modes are combined with the quantised transform coefficient information and encoded using either variable length coding or arithmetic coding.

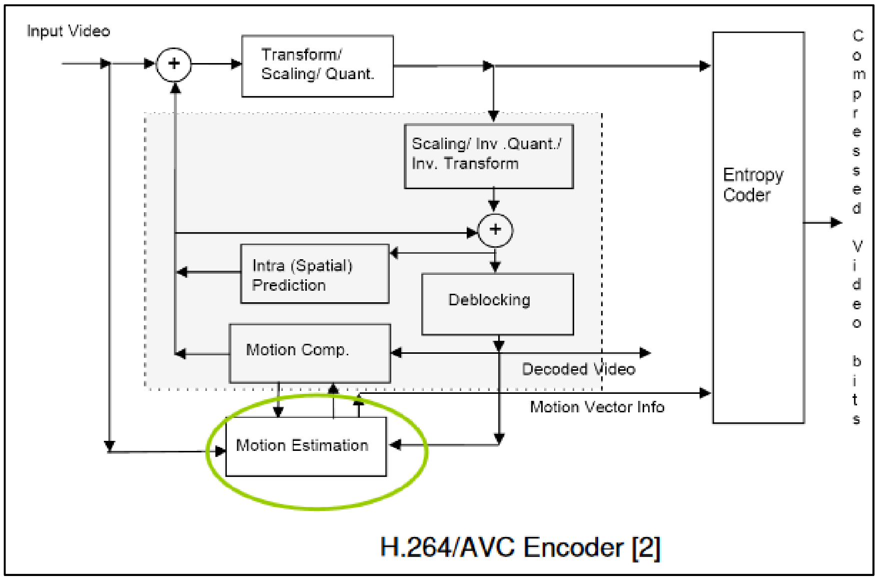
0.6.1 Predictive coding

This subclause does not form an integral part of this Recommendation | International Standard.

Because of the conflicting requirements of random access and highly efficient compression, two main coding types are specified. Intra coding is done without reference to other pictures. Intra coding may provide access points to the coded sequence where decoding can begin and continue correctly, but typically also shows only moderate compression efficiency. Inter coding (predictive or bi-predictive) is more efficient using inter prediction of each block of sample values from some previously decoded picture selected by the encoder. In contrast to some other video coding standards, pictures coded using bi-predictive inter prediction may also be used as references for inter coding of other pictures.

The application of the three coding types to pictures in a sequence is flexible, and the order of the decoding process is generally not the same as the order of the source picture capture process in the encoder or the output order from the decoder for display. The choice is left to the encoder and will depend on the requirements of the application. The decoding order is specified such that the decoding of pictures that use inter-picture prediction follows later in decoding order than other pictures that are referenced in the decoding process.

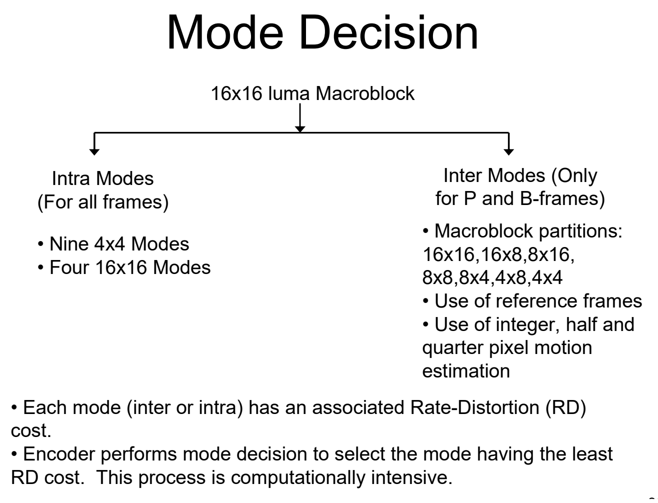
Source: H.264 Standard (03-2010) at pp. 3-4



Source: https://courses.cs.washington.edu/courses/csep590a/07au/lectures/rahullarge.pdf

82. The '005 Accused Infringing Devices provide a method for comparing pixels of a first pixel array (e.g., a macroblock) in a picture currently being coded with pixels of a plurality of second pixel arrays in at least one reference picture and concurrently performing motion estimation for each of a plurality of different prediction modes in order to determine which of the prediction modes is an optimum prediction mode.

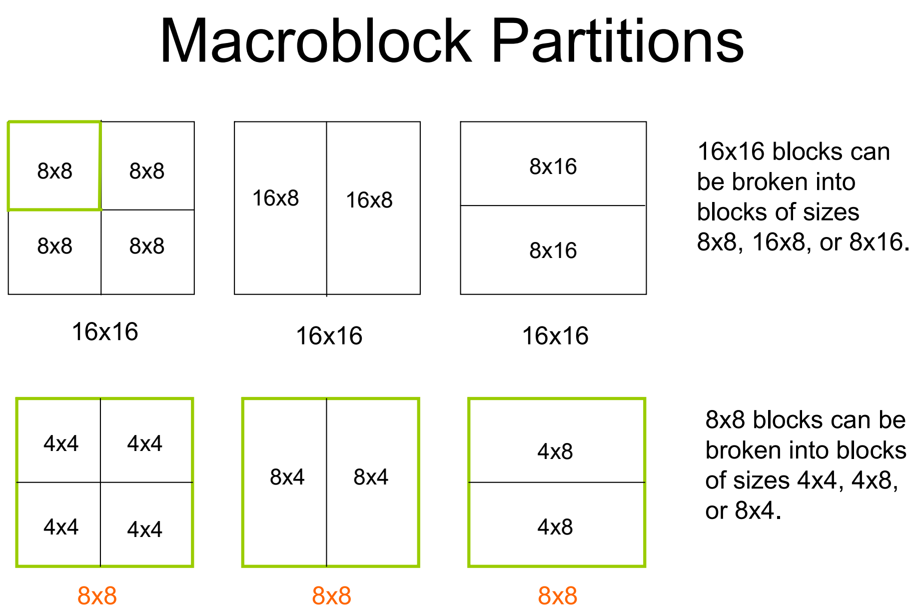
83. H.264 uses different motion estimation modes in inter-frame prediction. These modes are commonly referred to as inter-frame prediction modes or inter modes. Each inter mode involves partitioning the current macroblock into a different combination of sub blocks and selecting the optimum motion vector for the current macroblock based on the partition. The inter-frame prediction modes, or inter modes, can be further categorized by the number and position of the reference frames, as well as the choice of integer pixel, half pixel and quarter pixel values in motion estimation. The TeleStream H.264 encoders concurrently perform motion estimation of a macroblock for all inter-modes and select the most optimum prediction mode with least rate distortion cost.



Source: https://courses.cs.washington.edu/courses/csep590a/07au/lectures/rahullarge.pdf, p. 30

84. H.264 provides a hierarchical way to partition a macroblock, with the available partitions shown in the following two figures. An exemplary inter-frame prediction mode, or inter mode, can be for a macroblock to be partitioned to encompass a 16x8 sub block on the left, and two 8x8 sub blocks on the right.

Macroblock partitions for inter-frame prediction modes



Source: https://courses.cs.washington.edu/courses/csep590a/07au/lectures/rahullarge.pdf, p. 4

H.264 provides macroblock partitions for inter-frame prediction modes

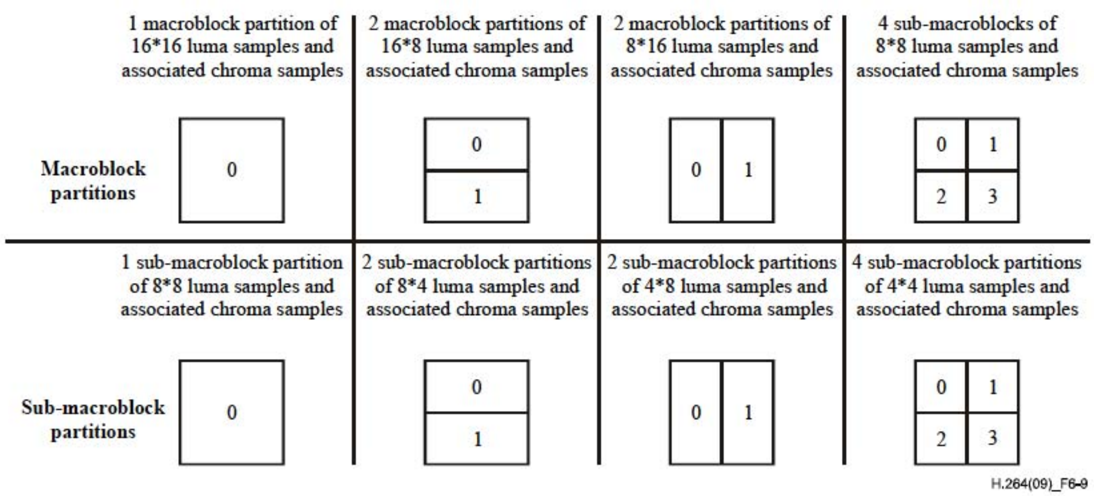


Figure 6-9 – Macroblock partitions, sub-macroblock partitions, macroblock partition scans, and sub-macroblock partition scans

Source: H.264 Standard (03-2010) at p. 26

85. The optimum prediction mode as chosen for the current macroblock is embedded in the compressed bit stream of H.264, as shown in the following two syntaxes.

Macroblock prediction syntax in H.264

7.3.5.1 Macroblock prediction syntax

mb_pred(mb_type) {	C	Descriptor
if(MbPartPredMode(mb_type, 0) = = Intra_4x4 || MbPartPredMode(mb_type, 0) = = Intra_16x16) {		
if(MbPartPredMode(mb_type, 0) = = Intra_4x4)		
for(luma4x4BlkIdx=0; luma4x4BlkIdx<16; luma4x4BlkIdx++) {		
prev_intra4x4_pred_mode_flag[luma4x4BlkIdx **]**	2	u(1) | ae(v)
if(!prev_intra4x4_pred_mode_flag[luma4x4BlkIdx])		
rem_intra4x4_pred_mode[luma4x4BlkIdx **]**	2	u(3) | ae(v)
}		
intra_chroma_pred_mode	2	ue(v) | ae(v)
} else if(MbPartPredMode(mb_type, 0) != Direct) {		
for(mbPartIdx = 0; mbPartIdx < NumMbPart(mb_type); mbPartIdx++)		
if((num_ref_idx_l0_active_minus1 > 0 || mb_field_decoding_flag) && MbPartPredMode(mb_type, mbPartIdx) != Pred_L1)		
ref_idx_l0[mbPartIdx **]**	2	te(v) | ae(v)
for(mbPartIdx = 0; mbPartIdx < NumMbPart(mb_type); mbPartIdx++)		
if((num_ref_idx_l1_active_minus1 > 0 || mb_field_decoding_flag) && MbPartPredMode(mb_type, mbPartIdx) != Pred_L0)		
ref_idx_l1[mbPartIdx **]**	2	te(v) | ae(v)
for(mbPartIdx = 0; mbPartIdx < NumMbPart(mb_type); mbPartIdx++)		
if(MbPartPredMode (mb_type, mbPartIdx) != Pred_L1)		
for(compIdx = 0; compIdx < 2; compIdx++)		
mvd_l0[mbPartIdx **][** 0 **][** compIdx **]**	2	se(v) | ae(v)
for(mbPartIdx = 0; mbPartIdx < NumMbPart(mb_type); mbPartIdx++)		
if(MbPartPredMode(mb_type, mbPartIdx) != Pred_L0)		
for(compIdx = 0; compIdx < 2; compIdx++)		
mvd_l1[mbPartIdx **][** 0 **][** compIdx **]**	2	se(v) | ae(v)
}		
}		

Source: H.264 Standard (03-2010) at p. 57

Sub-macroblock prediction syntax in H.264

7.3.5.2 Sub-macroblock prediction syntax

sub_mb_pred(mb_type) {	C	Descriptor
for(mbPartIdx = 0; mbPartIdx < 4; mbPartIdx++)		
sub_mb_type[mbPartIdx]	2	ue(v) | ae(v)
for(mbPartIdx = 0; mbPartIdx < 4; mbPartIdx++)		
if((num_ref_idx_l0_active_minus1 > 0 || mb_field_decoding_flag) && mb_type != P_8x8ref0 && sub_mb_type[mbPartIdx] != B_Direct_8x8 && SubMbPredMode(sub_mb_type[mbPartIdx]) != Pred_L1)		
ref_idx_l0[mbPartIdx]	2	te(v) | ae(v)
for(mbPartIdx = 0; mbPartIdx < 4; mbPartIdx++)		
if((num_ref_idx_l1_active_minus1 > 0 || mb_field_decoding_flag) && sub_mb_type[mbPartIdx] != B_Direct_8x8 && SubMbPredMode(sub_mb_type[mbPartIdx]) != Pred_L0)		
ref_idx_l1[mbPartIdx]	2	te(v) | ae(v)
for(mbPartIdx = 0; mbPartIdx < 4; mbPartIdx++)		
if(sub_mb_type[mbPartIdx] != B_Direct_8x8 && SubMbPredMode(sub_mb_type[mbPartIdx]) != Pred_L1)		
for(subMbPartIdx = 0; subMbPartIdx < NumSubMbPart(sub_mb_type[mbPartIdx]); subMbPartIdx++)		
for(compIdx = 0; compIdx < 2; compIdx++)		
mvd_l0[mbPartIdx][subMbPartIdx][compIdx]	2	se(v) | ae(v)
for(mbPartIdx = 0; mbPartIdx < 4; mbPartIdx++)		
if(sub_mb_type[mbPartIdx] != B_Direct_8x8 && SubMbPredMode(sub_mb_type[mbPartIdx]) != Pred_L0)		
for(subMbPartIdx = 0; subMbPartIdx < NumSubMbPart(sub_mb_type[mbPartIdx]); subMbPartIdx++)		
for(compIdx = 0; compIdx < 2; compIdx++)		
mvd_l1[mbPartIdx][subMbPartIdx][compIdx]	2	se(v) | ae(v)
}		

Source: H.264 Standard (03-2010) at p. 58

86. The ’005 Accused Infringing Devices provide a method for determining which of the second pixel arrays (e.g., macroblock) constitutes a best match with respect to the first pixel array (e.g., macroblock) for the optimum prediction mode.

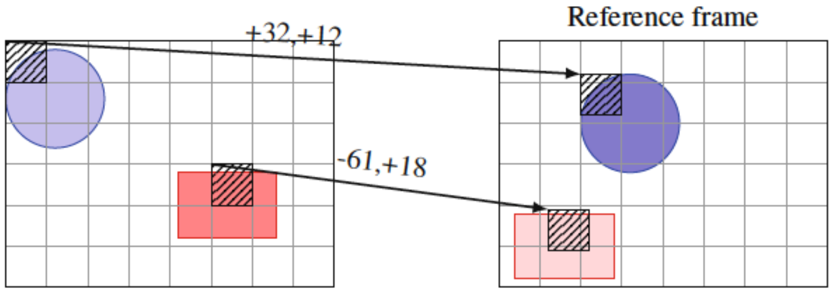


Fig. 2.4: Motion estimation. For each MB the best matching block in the reference frame is found. The encoder codes the differences (errors) between the MBs and their best matching blocks. Arrows indicate motion vectors and are labeled by the vector coordinates. In this example the shapes are identical but their colors are slightly larger/darker.

Source: B. Juurlink et al., Scalable Parallel Programming Applied to H.264, Chapter 2: Understanding the Application: An Overview of the H.264 Standard, p. 12

87. For example, the encoder performs mode decision to select the most optimum prediction mode with least rate distortion cost.

Macroblock layer semantics

The following semantics are assigned to the macroblock types in Table 7-13:

– P_L0_16x16: the samples of the macroblock are predicted with one luma macroblock partition of size 16x16 luma samples and associated chroma samples.

– P_L0_L0_MxN, with MxN being replaced by 16x8 or 8x16: the samples of the macroblock are predicted using two luma partitions of size MxN equal to 16x8, or two luma partitions of size MxN equal to 8x16, and associated chroma samples, respectively.

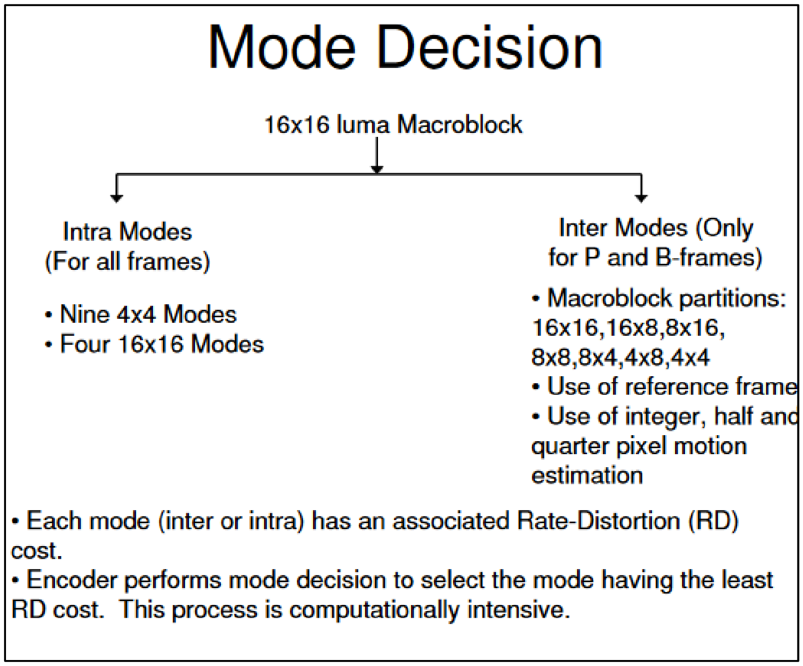
– P_8x8: for each sub-macroblock an additional syntax element (sub_mb_type[mbPartIdx] with mbPartIdx being the macroblock partition index for the corresponding sub-macroblock) is present in the bitstream that specifies the type of the corresponding sub-macroblock (see subclause 7.4.5.2).

– P_8x8ref0: has the same semantics as P_8x8 but no syntax element for the reference index (ref_idx_l0[mbPartIdx] with mbPartIdx = 0..3) is present in the bitstream and ref_idx_l0[mbPartIdx] shall be inferred to be equal to 0 for all sub-macroblocks of the macroblock (with indices mbPartIdx = 0..3).

– P_Skip: no further data is present for the macroblock in the bitstream.

Source: H.264 Standard (03-2010), p. 100

Mode Decision



Source: https://courses.cs.washington.edu/courses/csep590a/07au/lectures/rahullarge.pdf, p. 30

88. The ’005 Accused Infringing Devices provide a method for generating a motion vector for the first pixel array in response to the determining step. The encoder calculates the appropriate motion vectors and other data elements represented in the video data stream.

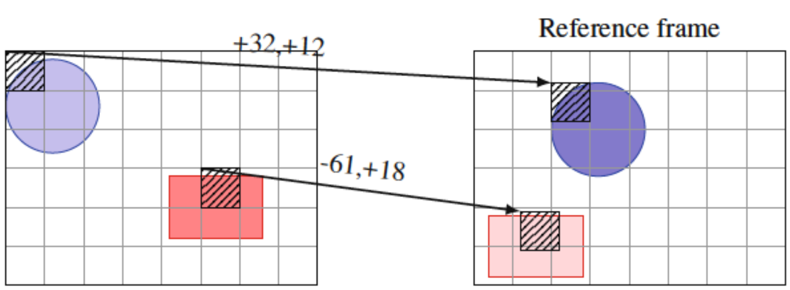


Fig. 2.4: Motion estimation. For each MB the best matching block in the reference frame is found. The encoder codes the differences (errors) between the MBs and their best matching blocks. Arrows indicate motion vectors and are labeled by the vector coordinates. In this example the shapes are identical but their colors are slightly larger/darker.

Source: B. Juurlink et al., Scalable Parallel Programming Applied to H.264, Chapter 2: Understanding the Application: An Overview of the H.264 Standard, p. 12

Motion Vector Derivation is described below

1. The derivation process for motion vector components and reference indices as specified in subclause 8.4.1 is invoked.

   Inputs to this process are:

   – a macroblock partition mbPartIdx,

   – a sub-macroblock partition subMbPartIdx.

   Outputs of this process are:

   – luma motion vectors mvL0 and mvL1 and when ChromaArrayType is not equal to 0, the chroma motion vectors mvCL0 and mvCL1

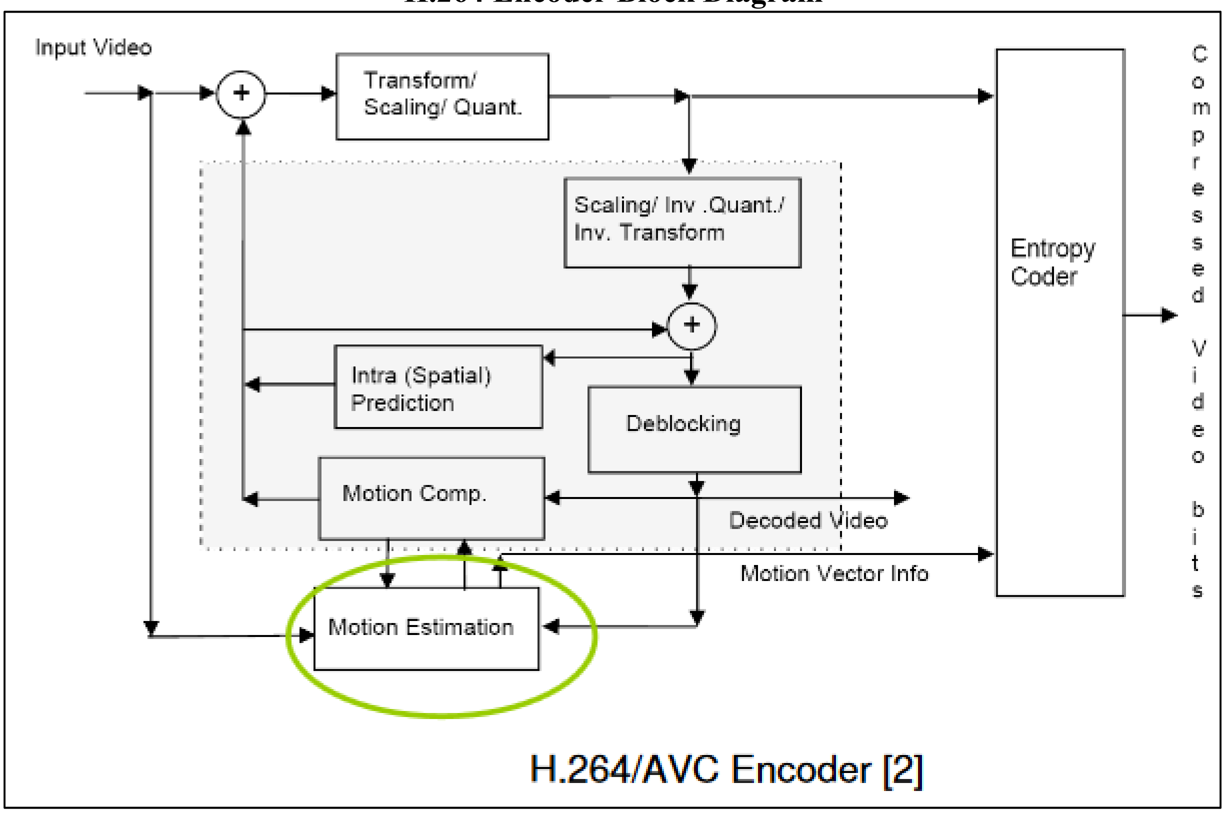
   – reference indices refIdxL0 and refIdxL1

   – prediction list utilization flags predFlagL0 and predFlagL1

   – the sub-macroblock partition motion vector count subMvCnt.

Source: H.264 Standard (03-2010), p. 151

H.264 Encoder Block Diagram



Source: https://courses.cs.washington.edu/courses/csep590a/07au/lectures/rahullarge.pdf, p. 2

89. Telestream has thus infringed at least claim 1 of the ’005 patent by making, using, testing, selling, offering for sale, importing and/or licensing the ’005 Accused Infringing Devices, and operating them such that all steps of at least claim 1 are performed.

90. Telestream’s acts of direct infringement have caused damage to Uniloc, and Uniloc is entitled to recover damages sustained as a result of Telestream’s wrongful acts in an amount subject to proof at trial.

PRAYER FOR RELIEF

WHEREFORE, Uniloc respectfully requests the following relief:

A. A judgment that Telestream has infringed the ’712 patent;

B. A judgment that Telestream has infringed the ’118 patent;

C. A judgment that Telestream has infringed the ’005 patent;

D. A judgment that Uniloc be awarded damages adequate to compensate it for Telestream’s past infringement and any continuing or future infringement of the ’712 patent, the ’118 patent and the ’005 patent, including pre-judgment and post-judgment interest costs and disbursements as justified under 35 U.S.C. § 284 and an accounting;

E. That this be determined to be an exceptional case under 35 U.S.C. § 285;

F. That Uniloc be granted its reasonable attorneys’ fees in this action;

G. That this Court award Uniloc its costs; and

H. That this Court award Uniloc such other and further relief as the Court deems proper.

DEMAND FOR JURY TRIAL

Uniloc demands trial by jury for all issues so triable.

DATED: April 9, 2019

Respectfully submitted,

FARNAN LLP

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