

Exhibit I-01 U.S. Patent No. 5,517,250 to Hoogenboom et al. (“Hoogenboom”)

This chart is subject to all reservations, objections, and disclaimers in Defendants’ Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety.

Hoogenboom was originally filed February 28, 1995, issued May 14, 1996, and thus is available as prior art under at least 35 U.S.C. § 102(b).

As described in detail below, Hoogenboom anticipates Asserted Claim 21 of U.S. Patent No. 7,095,945 to Kovacevic (the “’945 patent”). To the extent it is found Hoogenboom does not expressly disclose certain limitations in the asserted claims, such limitations are inherent. Moreover, to the extent it is found that Hoogenboom does not anticipate the asserted claims, Hoogenboom renders the asserted claims obvious, either alone or in combination with other prior art identified in the cover pleading or herein.

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
21. A system comprising:	Hoogenboom discloses a system comprising the invention of claim 21:
a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs;	<p>Hoogenboom discloses a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs based on at least the following exemplary citations:</p> <ul style="list-style-type: none"> FIG. 1 is a block diagram of a video decompression processor incorporating a memory manager 30 that addresses an external DRAM 22 to store and retrieve video data necessary to reconstruct a television program at a receiver. The processor, generally designated 20, is a pipelined processor designed to decode both the transport layer (i.e., control and other non-video information) and the video layer of the compressed bitstream input via terminal 10, sometimes referred to as the "transport packet interface" of the video processor. (col.5:60-6:2) The video decompression processor 20 receives a clock signal via terminal 12. The clock provides timing information that is used, e.g., to enable a transport syntax parser 32 to recover timing information and video information from transport packets contained in a packetized data stream input via terminal 10. An acquisition and error management circuit 34 utilizes a program clock reference (PCR) and decode time stamp (DTS) detected by a video syntax parser 40 to synchronize the start of picture decoding. This circuit sets vertical synchronization and provides global synchronization for all video decode and display functions. (col.6:23-34) In the MPEG-2 system (and the similar DigiCipher II system proprietary to General Instrument Corporation, the assignee hereof) a transport stream, or transport multiplex is made up of a contiguous set of fixed length packets. Each packet is 188 total bytes in length, with the first four of those bytes being defined as the packet header. The payload portion of each packet is thus normally 184 bytes.

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>However, a variable length adaptation field may be provided to extend the header, when required. When an adaptation field is present, the payload portion of the packet will be correspondingly shorter. (col.2:35-45)</p> <ul style="list-style-type: none"> • Various timing and identification information is provided in different portions of the transport stream. These include a packet identifier (PID) found in the transport header of each transport packet to provide a reference number for identifying the transport packets carrying a specific service component. This number is included in a service definition or "service map" used by the receiver to identify those transport packets required to reconstruct a television program signal. The PID may also be referenced for various grooming and remultiplexing functions. In the case of video, audio or isochronous data, the stream of packets labeled with a single PID represents a single video, audio or isochronous data service elementary stream, respectively. (col.2:46-59) • Timing information carried by the transport stream includes a program clock reference (PCR) which effectively represents a sample of the system time clock (STC) time base that underlies the service composed of the PIDs referenced in the service map. The PID carrying the packet with the PCR is also referenced in the service map. The video, audio and isochronous data components of a service are locked through a defined relationship to the system time clock. The PCR serves to define the transport rate, in the sense that between any two successive PCRs in one PID, the transport rate is constant and nominally equal to the system time clock rate times the ratio of the total number of transport bits between the PCRs divided by the difference in the PCRs in units of system time clock ticks.□(col.2:60-3:6) • See FIG. 1 <p>Even if AMD argues that Hoogenboom does not disclose this limitation expressly, U.S. Patent No. 6,233,389 to Barton et al. ("Barton '389") nonetheless expressly discloses this limitation:</p> <ul style="list-style-type: none"> • A preferred embodiment of the invention accepts television (TV) input streams in a multitude of forms, for example, analog forms such as National Television Standards Committee (NTSC) or PAL broadcast, and digital forms such as Digital Satellite System (DSS), Digital Broadcast Services (DBS), or Advanced Television Standards Committee (ATSC). Analog TV streams are converted to an Moving Pictures Experts Group (MPEG) formatted stream for internal transfer and manipulation, while pre-formatted MPEG streams are extracted from the digital TV signal and presented in a similar format to encoded analog streams. (col.2:4-14) • Referring to FIG. 1, a preferred embodiment of the invention has an Input Section 101, Media Switch 102, and an Output Section 103. The Input Section 101 takes television (TV) input streams in a

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p data-bbox="779 264 1900 444">multitude of forms, for example, National Television Standards Committee (NTSC) or PAL broadcast, and digital forms such as Digital Satellite System (DSS), Digital Broadcast Services (DBS), or Advanced Television Standards Committee (ATSC). DBS, DSS and ATSC are based on standards called Moving Pictures Experts Group 2 (MPEG2) and MPEG2 Transport. MPEG2 Transport is a standard for formatting the digital data stream from the TV source transmitter so that a TV receiver can disassemble the input stream to find programs in the multiplexed signal. (col.3:30-43)</p> <ul data-bbox="737 480 1900 1393" style="list-style-type: none"> <li data-bbox="737 480 1900 660">• The Input Section 101 produces MPEG streams. An MPEG2 transport multiplex supports multiple programs in the same broadcast channel, with multiple video and audio feeds and private data. The Input Section 101 tunes the channel to a particular program, extracts a specific MPEG program out of it, and feeds it to the rest of the system. Analog TV signals are encoded into a similar MPEG format using separate video and audio encoders, such that the remainder of the system is unaware of how the signal was obtained. (col.3:43-52) <li data-bbox="737 696 1900 876">• With respect to FIG. 2, the invention easily expands to accommodate multiple Input Sections (tuners) 201, 202, 203, 204, each can be tuned to different types of input. Multiple Output Modules (decoders) 206, 207, 208, 209 are added as well. Special effects such as picture in a picture can be implemented with multiple decoders. The Media Switch 205 records one program while the user is watching another. This means that a stream can be extracted off the disk while another stream is being stored onto the disk. (col.4:14-23) <li data-bbox="737 912 1900 1092">• Referring to FIG. 3, the incoming MPEG stream 301 has interleaved video 302, 305, 306 and audio 303, 304, 307 segments. These elements must be separated and recombined to create separate video 308 and audio 309 streams or buffers. This is necessary because separate decoders are used to convert MPEG elements back into audio or video analog components. Such separate delivery requires that time sequence information be generated so that the decoders may be properly synchronized for accurate playback of the signal. (col.4:24-33) <li data-bbox="737 1128 1900 1243">• If a digital TV signal is being processed instead, the MPEG encoder 703 is replaced with an MPEG2 Transport Demultiplexor, and the MPEG audio encoder 704 and VBI decoder 702 are deleted. The demultiplexor multiplexes the extracted audio, video and private data channel streams through the video input Media Switch port. (col.6:30-36) <li data-bbox="737 1279 1900 1395">• The parser 705 parses the input data stream from the MPEG encoder 703, audio encoder 704 and VBI decoder 702, or from the transport demultiplexor in the case of a digital TV stream. The parser 705 detects the beginning of all of the important events in a video or audio stream, the start of all of the frames, the start of sequence headers—all of the pieces of information that the program logic needs to

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>know about in order to both properly play back and perform special effects on the stream, e.g. fast forward, reverse, play, pause, fast/slow play, indexing, and fast/slow reverse play. (col.6:36-46)</p> <ul style="list-style-type: none"> • MPEG streams, whether extracted from an MPEG2 Transport or encoded from an analog TV signal, are typically encoded using a technique called Variable Bit Rate encoding (VBR). (col.7:32-36) • Referring to FIG. 11, a preferred embodiment that accomplishes multiple functions is shown. A source 1101 has a TV signal input. The source sends data to a PushSwitch 1102 which is a transform derived from TmkXfrm. The PushSwitch 1102 has multiple outputs that can be switched by the control object 1114. This means that one part of the pipeline can be stopped and another can be started at the users whim. The user can switch to different storage devices. The PushSwitch 1102 could output to a TmkClipWriter 1106, which goes onto a storage device 1107 or write to the cache transform 1103. (col.9:66 to col.10:9) • The derived class and resulting objects described here may be combined in an arbitrary way to create a number of different useful configurations for storing, retrieving, switching and viewing of TV streams. For example, if multiple input and output sections are available, one input is viewed while another is stored, and a picture-in-picture window generated by the second output is used to preview previously stored streams. Such configurations represent a unique and novel application of software transformations to achieve the functionality expected of expensive, sophisticated hardware solutions within a single cost-effective device. (col.11:27-38) • See FIGS. 1-7, 9, 11, 13 <p>Furthermore, The MPEG-2 Standard also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • The systems part of this Recommendation I International Standard addresses the combining of one or more elementary streams of video and audio, as well as other data, into single or multiple streams which are suitable for storage or transmission. Systems coding follows the syntactical and semantic rules imposed by this Specification and provides information to enable synchronized decoding of decoder buffers over a wide range of retrieval or receipt conditions. (p. viii) • The basic multiplexing approach for single video and audio elementary streams is illustrated in Figure Intro. 1. The video and audio data is encoded as described in ITU-T Rec. H.262 I ISO/IEC 13818-2 and ISO/IEC 13818-3. The resulting compressed elementary streams are packetized to produce PES packets. Information needed to use PES packets independently of either Transport Streams or Program Streams may be added when PES packets are formed. This information is not needed and need not be added

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>when PES packets are further combined with system level information to form Transport Streams or Program Streams. This systems standard covers those processes to the right of the vertical dashed line. (p. viii)</p> <ul style="list-style-type: none"> • See FIG. Intro. 1 (p. viii) • The Transport Stream combines one or more programs with one or more independent time bases into a single stream. □(p. ix) • See FIG. Intro. 2 “Prototypical transport demultiplexing and decoding example” (p. x) • On encoding, Program Streams are formed by multiplexing elementary streams, and Transport Streams are formed by multiplexing elementary streams, Program Streams, or the contents of other Transport Streams. Elementary streams may include private, reserved, and padding streams in addition to audio and video streams. The streams are temporally subdivided into packets, and the packets are serialized. A PES packet contains coded bytes from one and only one elementary stream. (p. xiii) • On decoding, demultiplexing is required to reconstitute elementary streams from the multiplexed Program Stream or Transport Stream. Stream_id codes in Program Stream packet headers, and Packet ID codes in the Transport Stream make this possible. (p. xiv) <p>Furthermore, U.S. Patent No. 6,397,000 to Hatanaka et al. (“Hatanaka”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • JP-A-8-98164 discloses a receiving system and a recording/playing back device for receiving/recording a transmitted multiplexed digital signal as a conventional technique for recording/playing back a digital signal. This prior art publication describes a receiving system which includes receiving means for receiving a transmitted multiplexed digital information signal and for selecting desired information, and recording means for recording the information received by the receiving means. (col.1:12-20) • a digital input means for inputting to the recording device a digital signal indicative of video, audio, data and so forth multiplexed in a predetermined packet form; an analog video signal input means for inputting an analog video signal to the recording device; an analog audio signal input means for inputting an analog audio signal to the recording device; a video A/D converter for converting the analog video signal inputted by the analog video signal input means to a digital signal; a video encoder for information-compressing the digital video signal to which the analog video signal is converted by the video A/D converter; an audio A/D converter for converting the analog audio signal inputted by the analog audio input means to an digital signal; an audio encoder for information-compressing the digital

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>audio signal to which the analog audio signal is converted by the audio A/D converter; a multiplexing means for multiplexing at least the video signal compressed by the video encoder and the audio signal compressed by the audio encoder into a multiplexed signal of a predetermined packet form; and a record selecting means for selecting one of the digital signal inputted by the digital input means and the multiplexed digital signal provided by the multiplexing means; and a recording means for recording the digital signal selected by the record selecting means. (col.1:37-67)</p> <ul style="list-style-type: none"> FIG. 1 is a block diagram of a receiving/recording/playing back device for a digital broadcasting signal in a first embodiment of the present invention. In FIG. 1, reference numeral 1 denotes a digital broadcasting receiving device (Integrated Receiver & Decoder: IRD), 2 a recording/playback device, 3 an encoder, 4 a digital broadcasting signal input terminal, 5 a tuner, 6 a QPSK demodulator, 7 a forward error correction (FEC) unit for correcting an error involved in the transmission of a signal, 8 a playback changeover switch, 9 a demultiplexer, 10 a MPEG decoder, 11 an NTSC encoder, 12 an interface between the devices 1 and 2, 13 a clock recovery unit, 14 a D/A converter, 15 a video output terminal, 16 an audio output terminal, 17 a recorded signal changeover switch, 18 a packet control circuit, 19 a recording/playback data processing, 20 a record amplifier, 21 a playback amplifier, 22 a magnetic tape, 23 a rotary head, 24 a clock generator, 25 a clock changeover switch, 26 a video input terminal, 27 an audio input terminal, 28 a video A/D converter, 29 an audio A/D converter, 30 a video encoder, 31 an audio encoder, 32 a multiplexer, and 47 a digital signal processor. (col.2:30-50) FIG. 2 shows a composition of a transmitted digital broadcasting signal. As shown in a packet composition of FIG. 2(A), the transmission signal has a packet composition of 204 bytes; a 4-byte header 50; a 184-byte data 51 representing information on a video, audio, added data, etc., compressed in a compression system called, for example, MPEG 2 (Moving Picture Expert Group 2) as an international standard, and a 16-byte parity 52. The packets of those video, audio, added data, etc., are received in a multiplexing manner on a time divisional basis on a transmission line, as shown in FIG. 2(B). Generally, not only one program, but also a plurality of programs of video, audio and added data is multiplexed on a time divisional basis. The header composition of FIG. 2(C) shows a content of the header 50. In FIG. 2(C), reference numeral 53 denotes a sync byte indicative of the head of the packet, 54 a transport error indicator, 55 a payload unit start indicator, 56 a transport priority, 57 a PID indicative of attributes of the packet, 58 a transport scrambling control, 59 an adaptation field control, and 60 continuity counter, each showing attributes and status of the packet, composed of 4 bytes in all. The numerals appearing on top of the packet each represent the number of bits of a respective subpacket. (col.2:51 to col.3:6) When the broadcasting signal is outputted from the present device, the playback changeover switch 8 is set at a contact to input the output from the FEC 7 to demultiplexer 9, which determines a type of a respective packet, using the PID 57, etc., of the header 50, separates only packets of a video, audio, etc., relating to a specified program, and then outputs these packets to the MPEG decoder 10. The

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p data-bbox="779 264 1871 354">multiplexed signal contains a packet called, for example, a PCR (Program Clock Reference) indicative of time information representing the time when compression took place in a broadcasting station concerned. (col.3:16-26)</p> <ul style="list-style-type: none"> <li data-bbox="737 391 1892 781"> <p>• When the received signal is recorded in the recording/playback device 2, the output from the FEC 7 is inputted to the interface 12, which separates packets of video and audio information and added information relating to a program to be recorded as in the demultiplexer 9. When the received signal is recorded and played back by the recording/playback device 2, it is required to also record and play back program information required for automatic selection of a broadcasting station. Thus, in addition to the packets selected by the demultiplexer 9, the interface 12 also selects a packet of program information relating to the program to be recorded and converts a part of the packet of program information. The signal separated by the interface 12 is inputted to the packet control circuit 18 by selecting a contact c by the recording signal changeover switch 17. As shown in the main data of FIG. 3A, the packet control circuit 18 divides 188-byte packet data into 92-byte packet data A 99 and 96-byte packet data B 100, and adds 4-byte packet header 98 to the packet data A 99. The packet control circuit 18 also produces in the packet header 98 a time stamp, shown in a hatched area 102, which is data on a time when the packet is received. (col.3:42-63)</p> <li data-bbox="737 818 1892 1182"> <p>• In reproduction, a signal 153 reproduced by the rotary head 23 is inputted via the playback amplifier 21 to the recording/playback data processing circuit 19, which detects the sync signal 92, signals ID1 (93), ID2 (94), etc., and corrects errors, using the CIP 101, C2P 76, etc., extracts packet data A 99 and packet data B 100, and then sends those data to the packet control circuit 18. The packet control circuit 18 outputs the respective packets at the same intervals of time as in the recording in accordance with the time stamp 102 added when the data was recorded, and then sends those packets via the interface 12 to the playback changeover switch 8. When a reproduced picture is to be obtained, the playback changeover switch 8 is set at the contact b to thereby send a reproduced packet to the demultiplexer 9. The demultiplexer 9 automatically selects a broadcasting station on the basis of the packet of program information which was selected and converted by the interface 12 when the data was recorded, and outputs only a packet required for the MPEG decoder 10. Video/audio signals are obtained in a manner similar to that in which an output is obtained from a broadcasting signal. (col.4:16-35)</p> <li data-bbox="737 1219 1892 1417"> <p>• When the analog broadcasting signal is recorded, an analog video signal 150 is inputted to the video input terminal 26 of the encoder 3 of FIG. 1. The video A/D converter 28 converts the analog video signal to a digital video signal. The video encoder 30 compresses the image, using the MPEG 2, etc., as in the compression of the digital broadcasting signal, and outputs the compressed signal to the multiplexer 32. An analog audio signal 151 is inputted to the audio input terminal 27, and converted by the audio A/D converter 29 to a digital audio signal. The audio encoder 31 compresses the digital audio signal, and also outputs this signal to the multiplexer 32, which multiplexes a video stream 42 produced</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>by the video encoder 30 and an audio stream 43 produced by the audio encoder 31. (col.5:1-14)</p> <ul style="list-style-type: none"> • As shown in FIGS. 5A-5E, the multiplexer 32 temporarily stores the video and audio streams 42 and 43, and outputs them as the video and audio packet streams 45 and 46 at the same transfer rate. The multiplexer 32 further outputs both the packets 45 and 46 in a time divisional manner onto a signal at a fixed transfer rate, which is generally higher than the sum of the transmission rates of the video and audio streams 42 and 43. (col.5:26-33) • As shown in FIGS. 5A-5E, the video stream 42, audio stream 43, other packets, and NULs are multiplexed on a time-divisional basis to form a single signal. The respective video packets VIs 1 (110), 2 (111), etc., on the video stream 42 are the same in content as the VIs 1 (116), 2 (112) etc., on the multiplexed stream 44. Similarly, the respective audio packets AUs 1 (113), 2 (114) etc., of the audio stream 43 are the same in content as the AUs 1 (122), 2 (124) etc., of the multiplexed stream 44. Thus, the multiplexed stream 44 has a stream composition similar to the output of the interface 12 of the digital broadcasting receiver 1. Thus, the recording signal changeover switch 17 selects a contact d and inputs the multiplexed stream 44 to the packet control circuit 18 to thereby record/playback the multiplexed stream 44 in the same manner as the digital broadcasting signal. (col.5:54 to col.6:2) • In recording, as shown in FIGS. 7A-7D, the respective broadcasting (BR), video (VI), and audio (AU) packets of the broadcasting stream 41, video stream 42, and audio stream 43 are multiplexed on a time divisional basis and PMT and PCR are added to the multiplexed packets to constitute a multiplexed stream. In this case, the PAT is already contained in the broadcasting stream 41 (shown by a packet 130 of FIG. 7A), but only contains information on a program contained in the broadcasting stream. Thus, the information should be converted so as to include information on the analog broadcasting. In FIG. 7D, reference numeral 131 denotes a PAT converted by the multiplexer 32. (col.6:28-40) • In playback, the user selects one of the digital and analog broadcasts, the demultiplexer 9 selects only one of the digital and analog broadcasts on the basis of the PAT converted in the recording, and inputs the selected program packet to the MPEG decoder 10 to obtain the video and audio of the desired program. (col.6:47-52) • While in the above the interface 12, multiplexer 32 and packet control circuit 18 are described as handling a one-way signal, these elements may be replaced with an input/output bus. FIG. 8 shows a signal line composition used in this case. Reference numerals 140, 143 and 144 each denote a tri(3)-state buffer whose output can have a high impedance and reference numerals 141 and 142 each denote an input buffer. (col.7:1-8)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • The video A/D converter 28, audio A/D converter 29, video encoder 30, audio encoder 31 and multiplexer 32 may be built either in the recording/playback device 2 or in the digital broadcasting receiver 1. Although not shown, the demultiplexer 9, MPEG decoder 10, NTSC encoder 11, and D/A converter 14 may also be provided in the recording/playback device 2 as well. Thus, even the recording/playback device is capable of providing a reproduced video signal by itself. Of course, the digital broadcasting receiver 1, recording/playback device 2 and encoder 3 may be all integrated in one unit. (col.7:21-31) • While in the above the magnetic tape is used as a recording medium, a magnetic disk, optical disk, semiconductor memory or other recording medium may be used. Although not shown in FIGS. 1 and 6, a deciphering circuit which decipheres a cipher signal may be provided between the QPSK demodulator 6 and the FEC 7. Selection of a packet and conversion of a packet on the program information by the interface 12 may be performed by the demultiplexer 9 or packet control circuit 18. (col.9:6-14) • <i>See also</i> FIGS. 1-7, 9, 10 <p>Furthermore, U.S. Patent No. 7,024,100 to Furuyama ("Furuyama") also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • In FIG. 1, recorded in storage section 10 is video data comprised of bitstreams conforming to MPEG (International Standard for Moving Picture Coding). Identification information indicative of the contents of the scene corresponding to the user area is inserted in the user data area in the bitstreams. MPEG decoder 20 has a user area code extraction section 28 that extracts the identification information inserted in the user data area. Retrieval section 30 is comprised of retrieval information input section 32 to which the contents of the scene a user desires are input, comparison section 31 which compares the contents input from retrieval information input section 32 to the extracted contents by the user area code extraction section 28. (col.1:19-31) • In various data streams including an MPEG stream, compressed coded video streams, audio streams, and private streams to store user data are multiplexed (hereinafter, the private stream is called retrieval data stream since identification information for retrieval is used as the user data in the present invention). Execution of the reproduction and retrieval from the above-mentioned data streams requires a demultiplexing function for demultiplexing the multiplexed data streams to the private streams, video streams and audio streams, a video decoding and audio decoding function for extending the compressed coded video and audio data to decode, and a retrieval function for executing the retrieval. Accordingly, to execute the reproduction and retrieval in parallel, it is necessary to concurrently process streams being reproduced and streams for retrieval, however the function requiring concurrent processing is only the demultiplexing function. (col.2:4-20)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • The present invention enables the concurrent execution of the reproduction of video and retrieval by providing a plurality of demultiplexing sections. (col.2:21-23) • The following description explains as an example of data stream the MPEG bitstream conforming to the MPEG that is the moving picture coding standard. However, it is obvious that the present invention is applicable to the data stream other than the MPEG stream conforming to the MPEG that is the moving picture coding standard. (col.3:12-18) • FIG. 2 is a block diagram of a video storage and retrieval apparatus according to the first embodiment of the present invention. The video storage and retrieval apparatus is comprised of MPEG stream input section 1 to which the MPEG stream is input, video output section 2 which outputs a decoded video signal, and audio output section 3 which outputs a decoded audio signal. The MPEG stream received in MPEG stream input section 1 is stored in storage section 11. Storage section 11 has a plurality of output ports, and the recorded plurality of MPEG streams can be accessed concurrently. Storage section 11 is controlled by control section 12. Control section 12 controls the read of the MPEG stream stored in storage section 11 according to the instruction from retrieval section 30. (col.3:21-35) • Two output ports of storage section 11 are coupled to respective first demultiplexing section 21 and second demultiplexing section 22 which can be accessed concurrently. First demultiplexing section 21 demultiplexes video streams and audio streams from the MPEG stream read from storage section 11 to reproduce. Second demultiplexing section 22 demultiplexes retrieval streams from the MPEG stream read from storage section 11 to retrieve. The video streams, audio streams and retrieval streams are multiplexed in the MPEG stream. First demultiplexing section 21 is connected to video decoding section 23 and audio decoding section 24 in parallel. (col.3:36-48) • Comparison section 31 compares the identification information in the retrieval data stream, which is read from storage section 11 and then demultiplexed in second demultiplexing section 22, to the retrieval scene from retrieval information input section 32, while instructing control section 12 on the read of the MPEG stream to retrieve. (col.3:58-64) • FIG. 3A illustrates an exemplary structure of the MPEG stream in this embodiment. As illustrated in FIG. 3A, the MPEG stream is comprised of stream header 101 to store stream information, a plurality of coded video streams (video stream (1) 102 to video stream (n) 105), a plurality of coded audio streams (audio stream (1) 103 to audio stream (n) 106), and a plurality of retrieval data streams (retrieval data stream (1) 104 to retrieval data stream (n) 106) as identification data with identification information for retrieval incorporated therein. The identification information indicative of the contents of the

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>corresponding scene is recorded in the retrieval data stream along with PTS (Presentation Time Stamp) that is information to synchronously reproduce the corresponding video data streams and audio data streams, or time code. And each of the video data streams, the audio data streams and the retrieval data streams is constructed in packets and multiplexed as PES (Packetized Elementary Stream). Further, it may be possible to insert the retrieval data streams as a private descriptor in the PAT (Program Association Table), PMT (Program Map Table) or CAT (Conditional Access Table) to multiplex with the video data and audio data. (col.3:65 to col.4:19)</p> <ul style="list-style-type: none"> • When control section 12 receives a reproduction instruction from a user interface, not shown in the figure, with a program address or program identification number designated, control section 12 provides the reproduction instruction to storage section 11 while specifying a header address of the MPEG stream of the instructed program. As a result of the instruction, the MPEG stream of the program instructed by control section 12 is provided from one of output ports of storage section 11 to first demultiplexing section 21. First demultiplexing section 21 demultiplexes the video streams and audio streams from the MPEG stream. (col.4:67 to col. 5:10.) • At this time, second demultiplexing section 22 accesses another output port other than the output port outputting the MPEG stream being reproduced. Second demultiplexing section 22 demultiplexes the retrieval data stream from the MPEG stream for retrieval. Then, the identification information inserted in the retrieval data stream is output from second demultiplexing section 22 to comparison section 31. (col.5:22-29) • As described above, according to this embodiment, since first demultiplexing section 21 and second demultiplexing section 22 are provided, it is possible to concurrently execute the reproduction and retrieval. (col.5:52-55) • In addition, it may be possible to provide a plurality of second demultiplexing sections 22 that execute the demultiplexing to extract the retrieval information and a plurality of retrieval sections 30 that search specific video and audio data based on the identification data so that the plurality of second demultiplexing sections 22 and retrieval sections 30 execute the retrieval processing in parallel on a plurality of data streams stored in storage section 11. Thereby, it is possible to speed up the retrieval processing. Further, it may be possible that the data stream is input to second demultiplexing section 22, which executes the demultiplexing to extract the retrieval information, at a rate higher than the data transfer rate at which the data stream is input to first demultiplexing section 21 which executes the demultiplexing to reproduce the video and audio, in order to speed up the retrieval processing. (col.5:56 to col.6:4)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • In the video storage and retrieval apparatus of this embodiment, third demultiplexing section 25 is provided between MPEG stream input section 1 and storage section 11. Third demultiplexing section 25 demultiplexes an input multiplexed MPEG stream to video streams, audio streams and retrieval data streams. The demultiplexed video streams, audio streams and retrieval data streams are recorded in storage section 11. (col.6:13-20) • The multiplexed MPEG stream is input to MPEG stream input section 1, and demultiplexed in third demultiplexing section 25 to video streams, audio streams and retrieval data streams, which are stored in storage section 11. (col.6:26-29) • As described above, the video streams, audio streams and retrieval data streams demultiplexed from the MPEG stream are stored in storage section 11, while the video streams, audio streams and searches data stream stored in storage section 11 are made independently accessible, and therefore it is possible to execute the reproduction of the video and audio, and the retrieval at the same time. (col.6:47-54) • In the video storage and retrieval apparatus of this embodiment, fourth demultiplexing section 26 is provided between MPEG stream input section 1 and storage section 11, and fifth demultiplexing section 27 is provided between storage section 11, and video decoding section 23 and audio decoding section 24. Fourth demultiplexing section 26 demultiplexes the multiplexed MPEG stream to a data stream in which video streams and audio streams are multiplexed, and retrieval data streams. Fifth demultiplexing section 27 demultiplexes the multiplexed video streams and audio streams to video streams and audio streams. FIG. 6A illustrates a structure of the MPEG stream input to fourth multiplexing section 26, and FIG. 6B illustrates structures of the MPEG streams output from fourth demultiplexing section 26. (col.6:61 to col.7:9) • The multiplexed MPEG stream, input to MPEG stream input section 1, is demultiplexed to video streams, audio streams and retrieval data streams in fourth demultiplexing section 26, which multiplexes again demultiplexed video streams and audio streams, while adding stream header 111 thereto, to output. The retrieval data streams and multiplexed video streams and audio streams are stored in storage section 11. At the time the video is reproduced, the multiplexed video streams and audio streams, stored in storage section 11, are demultiplexed to the video streams and audio streams by fifth demultiplexing section 27. (col.7:11-22) • In the video storage and retrieval apparatus of this embodiment, temporary storage section 40 is provided between storage section 11, and first demultiplexing section 21 and second demultiplexing section 22. At the time the reproduction or retrieval is executed, the MPEG date stored in storage section 11 is transferred to temporary storage section 40 at a data transfer rate higher than that necessary for the

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>ordinary video reproducing processing to be temporarily stored therein, and the stored data is provided to first demultiplexing section 21 and second demultiplexing section 22 at the same data transfer rate as in the ordinary reproducing processing. The operation of the video storage and retrieval apparatus in this embodiment is explained below. At the time of video reproduction, part of or entire MPEG stream to be reproduced is transferred to temporary storage section 40 from storage section 11 at the data transfer rate higher than that necessary for the ordinary video reproducing processing. Then, the data is transferred to first demultiplexing section 21 at the same data transfer rate as in the ordinary reproducing processing from temporary storage section 40. First demultiplexing section 21 demultiplexes video streams and audio streams to respectively output to video decoding section 23 and audio decoding section 24. (col.7:42-65)</p> <ul style="list-style-type: none"> • Second demultiplexing section 22 fetches the retrieval data streams from the MPEG stream for the retrieval stored in temporary storage section 40, and outputs the identification information in the retrieval data stream to retrieval section 30. (col.8:14-18) • In the video storage and retrieval apparatus of this embodiment, the MPEG stream, in which video streams, audio streams and retrieval data streams are multiplexed, is read from storage section 11, input to third demultiplexing section 25 to be demultiplexed to the video streams, audio streams and retrieval data streams. Then, the video streams and audio streams are stored in temporary storage 40, and at the time of retrieval, the retrieval data streams are input to retrieval section 30. The temporary storage section 40 outputs the video streams and audio streams in parallel respectively to video decoding section 23 and audio decoding section 24. (col.8:59 to col.9:3) • At the time of video reproduction, part of or entire MPEG stream to be reproduced is transferred to third demultiplexing section 25 from storage section 11 at the data transfer rate higher than that for the ordinary video reproducing processing. Third demultiplexing section 25 demultiplexes the multiplexed video streams, audio streams and retrieval data streams to the video streams and audio streams, and the retrieval data streams, and transfers the video streams and audio streams to temporary storage section 40 to temporarily store therein. (col.9:5-14) • Meanwhile, control section 12 controls storage section 11 so that storage section 11 transfers again the rest of the MPEG stream to be reproduced to temporary storage section 40 via third demultiplexing section 25 before the video streams and audio streams to be reproduced stored in temporary storage section 40 are all transferred respectively to video decoding section 23 and audio decoding section 24. When a user inputs the retrieval request to retrieval section 30, control section 12 judges whether the MPEG stream to be reproduced is being transferred from storage section 11 to temporary storage section 40, and when the MPEG stream is not being transferred, the MPEG stream for the retrieval is transferred from storage section 11 to third demultiplexing section 25. Third demultiplexing section 25

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>demultiplexes the retrieval data streams from the MPEG stream for the retrieval, and transfers the retrieval data stream to retrieval section 30 to be subjected to retrieve processing. (col.9:22-39)</p> <ul style="list-style-type: none"> • Then, the MPEG stream is transferred to first demultiplexing section 21 from temporary storage section 40 at the same data transfer rate as in the ordinary reproducing processing. First demultiplexing section 21 demultiplexes video streams and audio streams from the MPEG stream, and outputs video streams and audio streams respectively to video decoding section 23 and audio decoding section 24. Thereby, the decoded video signals and audio signals are output. (col.10:28-36) • When a user inputs the retrieval request to retrieval section 30, control section 12 judges whether the MPEG stream to be reproduced is being transferred from storage section 11 to temporary storage section 40, and when the MPEG stream is not being transferred, the MPEG stream for the retrieval is transferred from storage section 11 to second multiplexing section 22. Second demultiplexing section 22 demultiplexes the retrieval data streams (or identification information) from the MPEG stream to output to retrieval section 30. Retrieval section 30 executes the retrieval processing using the identification information and retrieval scene. (col.10:44-55) • The multiplexed MPEG stream input to MPEG stream input section 1 is demultiplexed in third demultiplexing section 25 to video streams, audio streams and retrieval data streams. The demultiplexed video streams and audio streams are stored in storage section 11, and the demultiplexed retrieval data streams are stored in second storage section 13. (col.11:18-24) • As described above, the multiplexed MPEG stream is demultiplexed to the video streams, audio streams and retrieval data streams before being stored in storage sections. (col.11:32-35) • Furthermore, in the above-mentioned embodiment, it may be possible to provide fourth demultiplexing section 26 illustrated in FIG. 5 before storage section 11 and second storage section 13 instead of third demultiplexing section 25, and further provide fifth demultiplexing section 27 illustrated in FIG. 5 between storage section 11, and video decoding section 23 and audio decoding section 24. Then, retrieval section 30 may execute the retrieval processing while fetching the identification data from second storage section 13, select a period matching the pre-registered retrieval condition registered, and store the streams of video data and audio data demultiplexed from the MPEG stream corresponding to the selected period in storage section 11. Otherwise, retrieval section 30 may execute the retrieval processing while fetching the identification data from fourth demultiplexing section 26 not through second storage section 13, select a period matching the per-registered retrieval condition, and store the video streams and audio streams demultiplexed from the MPEG stream corresponding to the selected period in storage section 11. (col.12:1-20)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • The video storage and retrieval system of this embodiment is comprised of video retrieval server 50, video reproducing terminal 51 and transmission media 52. Video retrieval server 50 is comprised of MPEG stream input section 1, fourth demultiplexing section 25, storage section 11, control section 12, comparison section 31, MPEG stream transmission section 4 which transmits the MPEG stream comprised of multiplexed video data streams and audio data streams, and retrieval information reception section 6 which receives the retrieval information (scene contents). Video reproducing terminal 51 is comprised of fifth demultiplexing section 27, video decoding section 23, audio decoding section 24, retrieval information input section 32, video output section 2, audio output section 3, MPEG stream reception section 5 which receives the MPEG stream comprised of multiplexed video data streams and audio data streams, and retrieval information transmission section 7 which transmits the retrieval information. Further, transmission media 52 between video retrieval server 50 and video reproducing terminal 51 are comprised of communication networks, broadcasting networks, or a combination of the communication networks and broadcasting networks. (col.13:17-43) • The video matching the retrieval information is transmitted as multiplexed video and audio streams from MPEG stream transmission section 4 through transmission media 52 to video reproducing terminal 51. In video reproducing terminal 51, MPEG stream reception section 5 receives the retrieved video and audio streams. The received video and audio streams are demultiplexed in fifth demultiplexing section 27, and the demultiplexed video streams and audio streams are respectively expanded in video decoding section 23 and audio decoding section 24, thus outputting the videos and audios. (col.13:56-67) • <i>See also</i> FIGs. 2-12. <p>Furthermore, U.S. Patent No. 5,881,245 to Thompson ("Thompson") also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • A bit stream, multiplexed in accordance with the MPEG-2 standard, is either a "transport stream" or a "program stream". Both program and transport streams are constructed from "packetized elementary stream" (or PES) packets and packets containing other necessary information. A "packetized elementary stream" (or PES) packet is a data structure used to carry "elementary stream data". An "elementary stream" is a generic term for one of (a) coded video, (b) coded audio, or (c) other coded bit streams carried in a sequence of PES packets with one and only stream identifier (or "ID"). Both program and transport streams support multiplexing of video and audio compressed streams from one program with a common time base. (col.1:42-55) • Transport streams permit one or more programs with one or more independent time bases to be combined into a single stream. Transport streams are useful in instances where data storage and/or

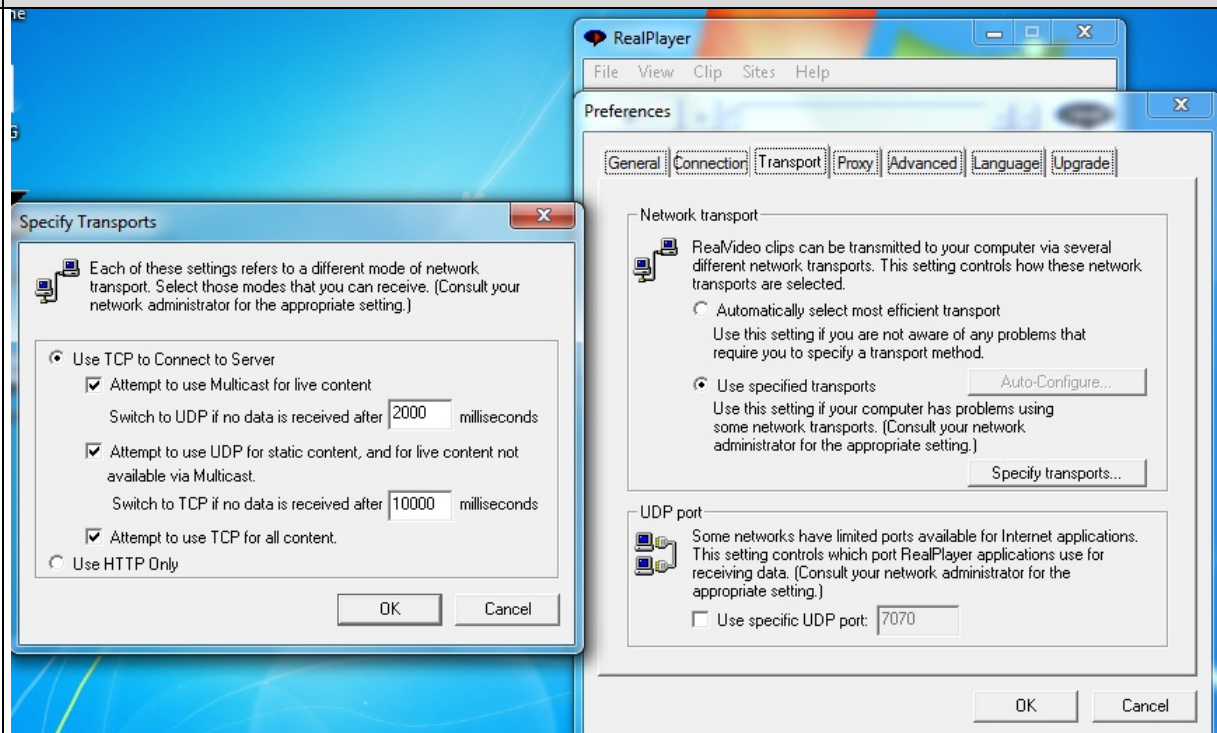
Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>transport means are lossy or noisy. The rate of transport streams, and their constituent packetized elementary streams (PESs) may be fixed or variable. This rate is defined by values and locations of program clock reference (or PCR) fields within the transport stream. (col.1:56-63)</p> <ul style="list-style-type: none"> Each header 114 includes an eight (8) bit synch byte field 218 and a packet identification (or PID) field 220. The synch byte field 218 has a value of "01000111" (or 47 hex) and identifies the start of a 188 byte transport stream packet 200. The PID field 220 indicates the type of data (e.g., audio, video, secondary audio program (or "SAP"), private, etc.) stored in the payload 216 of the 188 byte transport stream packet. Certain PID values are reserved. The payloads 216 of one or more transport stream packets 200 may carry "packetized elementary stream" (or PES) packets 300. To reiterate, a "packetized elementary stream" (or PES) packet 300 is a data structure used to carry "elementary stream data" and an "elementary stream" is a generic term for one of (a) coded video, (b) coded audio, or (c) other coded bit streams carried in a sequence of PES packets with one and only stream ID. (col.2:18-35) At a remote end of the communications link 406, the MPEG decoder 404 includes a transport stream demultiplexer 416, a video decoder 418, an audio decoder 420, and clock control unit 422. The transport stream demultiplexer 416 receives the output of the stream server 402 in the form of a transport stream 112. Based on the packet identification (or PID) number 220 of a particular transport stream packet 200, the transport stream demultiplexer 416 separates the encoded audio and video packets and provides the video packets to the video decoder 418 and the audio packets to an audio decoder 420. The transport stream demultiplexer 416 also provides timing information to a clock control unit 422. The clock control unit 422 provides timing signals to both the video decoder 418 and the audio decoder 420 based on the timing information provided by the transport stream demultiplexer 416. The video decoder 418 provides decoded video data which corresponds to the video data originally encoded. Similarly, the audio decoder 420 provides decoded audio data which corresponds to the audio data originally encoded. (col.3:16-35) The multiplexed packets of encoded audio and video data may tend to arrive at a particular playback card 504 in bursts. The FIFO memory device 602 buffers such bursty data and provides the buffered transport stream to the transport stream demultiplexer 604. The transport stream demultiplexer 604, inter alia, separates the packets of encoded audio data from the packets of encoded video data based on the PID number 220 of the header 114 of the transport stream packets 200. Private data packets, which are similarly identified with a unique PID(s) 220, may be provided to memory 606. From there, the private data may be provided to other portions of the playback card 504 via the microprocessor bus 616 under the control of the microprocessor 614. (col.16:28-41) FIG. 12 is a graph which illustrates the buffer (or "queue") states and buffer (or "queue") level trajectories monitored by the method and device of the present invention. The buffer has a low state 1210, a medium state 1212, and a high state 1214. The boundary 1202 between the low state 1210 and

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>the medium state 1212 shall be referred to as "the low-water mark 1202". The boundary 1204 between the medium state 1212 and the high state 1214 shall be referred to as "the high water mark 1204". Buffer level 1206 shall be referred to as "empty" and buffer level 1208 shall be referred to as "full". In the above described embodiment, in which each playback card 504 is assigned a two MByte portion of the buffer memory 710, the low state 1210 may include buffer levels between zero (0.0) and 0.5 MBytes, the medium state 1212 may include buffer levels between 0.5 MBytes and 1.5 MBytes, and the high state 1214 may include buffer levels between 1.5 MBytes and two (2.0) MBytes. (col.21:12-29)</p> <ul style="list-style-type: none"> • As with the forward channel of the first communications means 532, the back channel transport may be any of a number which are well known in the art. For example, Ethernet, FDDI, Fibre Channel, Token-Ring, and ATM or their equivalents all provide characteristics suitable for back channel implementation. TCP/IP may be advantageously used in conjunction with any of the above and is particularly useful because it is standardized, routable, and readily accessible via standard programming interfaces, i.e., sockets. (col. 11:66-12:8) • With respect to the back channel communication of control and status information between the system interface card 530 and the stream server 502, an Ethernet link may be used. Thus, the first communications means 532 may include this separate Ethernet link. The protocol used over the Ethernet link is the standard TCP/IP protocol. Alternatively, and preferably, the system interface card 530 communicates control information over the same SCSI-2 fast and wide connections used to communicate data from the stream server 502 to the system interface card 530. (col.17:24-34) <p>Furthermore, NetShow also discloses this limitation expressly:</p> <p>For example, NetShow discloses that multiplexed packetized data can be received via Hypertext Transfer Protocol (HTTP), Internet Protocol (IP), Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Multicast.</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<div data-bbox="1018 261 1566 833" data-label="Image"> <p>The screenshot shows the 'Microsoft NetShow Player Properties' dialog box with the 'Advanced' tab selected. Under the 'Buffering' section, the 'Buffer 3 seconds of data' radio button is selected. Under the 'Protocols' section, 'Multicast', 'TCP', and 'HTTP' are checked. Under 'HTTP', the 'Use browser proxy settings' radio button is selected. The 'Use port' field is empty, and the 'port' field contains '0'.</p> </div> <p>Furthermore, RealPlayer 5.0 also discloses this limitation expressly:</p> <p>For example, RealPlayer 5.0 discloses that multiplexed packetized data can be received via Internet Protocol (IP), Transmission Control Protocol (TCP), and User Datagram Protocol (UDP).</p>

**Asserted Claims of U.S.
Patent No. 7,095,945**

Exemplary citations to Hoogenboom



Furthermore, the admitted prior art also discloses this limitation expressly:

- Systems for time shifting a viewed program are known in the industry. For example, if a viewer is interrupted by a phone call during a television program, the program can be recorded for a few minutes and then played back from the point of interruption while additional video information is continually recorded. One prior art method of accomplishing time shifting is to capture the rendered video signal. When the rendered signal is an analog signal it is digitized and stored. When the rendered signal is a digital signal it can be captured directly. Once captured, the rendered digital data can be stored directly. (col.1:12-22)
- One method of transporting large amounts of various types of transport stream data is to use a multiplexed packetized data stream capable of carrying real-time multimedia programs. One example of a multiplexed packetized data stream is described in the standard ISO/IEC 13818-1 and will be referred

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>to as a transport stream. Transport streams generally offer robustness for noisy channels and can carry multiple programs (like multiple TV services) within the same multiplex. The transport stream is based on 188 byte long packets that are well suited for hardware error correction and processing schemes needed in noisy environments, such as coaxial cable television networks and satellite transponders. Such a transport stream facilitates fast program access, channel hopping and synchronization between multiple programs within the transport stream. (col.1:46-60)</p> <ul style="list-style-type: none"> • Each TS packet consists of a TS Packet header with optional Adaptation Field followed by useful data payload containing portion of a PES packet. The TS header consists of a sync byte, flags, indicators information for error detection and timing and Packet_ID (PID) field used to identify elementary stream carried underneath of a PES packet. In addition to identifying specific elementary streams, one PID is used to identify a program specific Information (PSI) table data. (col.2:18-26) • <i>See also</i> FIGs. 1-4. • Prior art FIG. 4 illustrates a prior art system for parsing a transport stream. The transport parser of the prior art would receive individual packets from the framer. Based upon the PID value, the transport parser would store the TSP data to be used by the system or the graphics engine in a local buffer. When the transport parser's local buffer was filled, the transport parser would cause a bus request to the appropriate controller (system or video) to initialize a transfer of at least some of the buffered data. ('533 Patent col.4:32-38) <p>One of skill in the art would combine Hoogenboom with Barton '389, The MPEG-2 Standard, Hatanaka, Furuyama, Thompson, NetShow, RealPlayer 5.0, and/or the admitted prior art with a reasonable expectation of success because, for example, all of the references relate to storing and playing back multiplexed packetized video data such as MPEG-2 streams.</p>
<p>a first transport stream demultiplexer having an input coupled to the first input node to select packets of data having a predefined packet identifier and an output to provide the select packets of data;</p>	<p>Hoogenboom discloses a first transport stream demultiplexer having an input coupled to the first input node to select packets of data having a predefined packet identifier and an output to provide the select packets of data based on at least the following exemplary citations:</p> <ul style="list-style-type: none"> • A video decompression processor acquires video data for a desired service from a packetized data stream. The data stream includes transport packets carrying different components of the desired service. Each component is identified by a unique packet identifier (PID). One of the components includes a program clock reference (PCR) providing timing information for the desired service. The PIDs of the transport packets are monitored to recover video packets. Header information from the recovered packets is processed to recover packetized elementary stream (PES) packets having a PES header and picture

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>information. (Abstract)</p> <ul style="list-style-type: none"> • The video decompression processor 20 receives a clock signal via terminal 12. The clock provides timing information that is used, e.g., to enable a transport syntax parser 32 to recover timing information and video information from transport packets contained in a packetized data stream input via terminal 10. An acquisition and error management circuit 34 utilizes a program clock reference (PCR) and decode time stamp (DTS) detected by a video syntax parser 40 to synchronize the start of picture decoding. This circuit sets vertical synchronization and provides global synchronization for all video decode and display functions. (col.6:23-34) • As indicated in FIG. 2b, the transport header of each transport packet includes the PID which identifies the particular service component carried by the transport packet. The PCR will be carried by an adaptation field to provide timing information for a desired service. At a receiver, the PCRs for the desired service are detected from the adaptation fields. Transport packets of a specific PID will then be monitored to recover a particular component of the service being processed. Since the video decompression processor of FIG. 1 processes video information, it will monitor the transport packets to locate all of those with the PID indicative of the video component being processed. The processing of the video component is explained in further detail below in connection with FIG. 3. (col.8:66-9:12) • Transport packets from various service components are multiplexed into a transport multiplex 90 as illustrated in FIG. 2c. The transport multiplex will carry interspersed packets from each of the different components (e.g, video, audio and control) necessary to reconstruct a service at the receiver. In the illustrative transport multiplex shown in FIG. 2c, video transport packets 80 (A1, A2, A3 ...) are followed by audio transport packets 92 (B1, B2, B3 ...) which, in turn, are followed by other component packets 94 (C1, C2, C3...), which can be other services or data carried by the transport packet stream. (col. 9:12-22) • FIG. 3 illustrates the processing of video transport packets by a video decompression processor, such as that illustrated in FIG. 1. A plurality of transport packets 80 are received by the transport syntax parser 32, which strips the payload information that is necessary from successive transport packets to reconstruct a PES payload 74. The information in the transport headers 82 is used to identify the payload information 84 and enables the reconstruction of the PES payload data 74 as well as the PES header 72. As indicated above, the PES packets are aligned such that when they are divided into transport payloads, the first byte of every PES header is located in the first payload position of some transport packet. Upon detecting a payload unit start indicator in the transport header, the transport syntax parser will know that the first portion of the payload in that transport packet will contain the PES header. (col. 9:23-38)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> One of the items contained in the PES header 72 (or inferred from a PTS in the PES header) is the decode time stamp (DTS) 104 which is required by the video syntax parser 40 in order to properly decode the picture data. Thus, in accordance with the present invention, the DTS is extracted from the PES header 72 and reinserted following the picture header 100 in the video information (picture data) 102 stored in the FIFO portion of DRAM 22. The insertion of the DTS in the video information stored in DRAM 22 enables the decompression processor to process the video information without having to retrieve the DTS from a source outside the DRAM. It should be noted that the PTS is also stored in DRAM 22 if it differs from the DTS. (col. 9:39-51) See FIGS. 1, 2B, and 2C <p>Even if AMD argues that Hoogenboom does not disclose this limitation expressly, U.S. Patent No. 6,233,389 to Barton et al. (“Barton ’389”) nonetheless expressly discloses this limitation:</p> <ul style="list-style-type: none"> A preferred embodiment of the invention accepts television (TV) input streams in a multitude of forms, for example, analog forms such as National Television Standards Committee (NTSC) or PAL broadcast, and digital forms such as Digital Satellite System (DSS), Digital Broadcast Services (DBS), or Advanced Television Standards Committee (ATSC). Analog TV streams are converted to an Moving Pictures Experts Group (MPEG) formatted stream for internal transfer and manipulation, while pre-formatted MPEG streams are extracted from the digital TV signal and presented in a similar format to encoded analog streams. (col.2:4-14) The invention parses the resulting MPEG stream and separates it into its video and audio components. It then stores the components into temporary buffers. Events are recorded that indicate the type of component that has been found, where it is located, and when it occurred. The program logic is notified that an event has occurred and the data is extracted from the buffers. (col.2:15-21) Referring to FIG. 1, a preferred embodiment of the invention has an Input Section 101, Media Switch 102, and an Output Section 103. The Input Section 101 takes television (TV) input streams in a multitude of forms, for example, National Television Standards Committee (NTSC) or PAL broadcast, and digital forms such as Digital Satellite System (DSS), Digital Broadcast Services (DBS), or Advanced Television Standards Committee (ATSC). DBS, DSS and ATSC are based on standards called Moving Pictures Experts Group 2 (MPEG2) and MPEG2 Transport. MPEG2 Transport is a standard for formatting the digital data stream from the TV source transmitter so that a TV receiver can disassemble the input stream to find programs in the multiplexed signal. (col.3:30-43) The Input Section 101 produces MPEG streams. An MPEG2 transport multiplex supports multiple

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>programs in the same broadcast channel, with multiple video and audio feeds and private data. The Input Section 101 tunes the channel to a particular program, extracts a specific MPEG program out of it, and feeds it to the rest of the system. Analog TV signals are encoded into a similar MPEG format using separate video and audio encoders, such that the remainder of the system is unaware of how the signal was obtained. (col.3:43-52)</p> <ul style="list-style-type: none"> • The Media Switch 102 mediates between a microprocessor CPU 106, hard disk or storage device 105, and memory 104. Input streams are converted to an MPEG stream and sent to the Media Switch 102. The Media Switch 102 buffers the MPEG stream into memory. It then performs two operations if the user is watching real time TV: the stream is sent to the Output Section 103 and it is written simultaneously to the hard disk or storage device 105. (col.3:62 to col.4:2) • With respect to FIG. 2, the invention easily expands to accommodate multiple Input Sections (tuners) 201, 202, 203, 204, each can be tuned to different types of input. Multiple Output Modules (decoders) 206, 207, 208, 209 are added as well. Special effects such as picture in a picture can be implemented with multiple decoders. The Media Switch 205 records one program while the user is watching another. This means that a stream can be extracted off the disk while another stream is being stored onto the disk. (col.4:14-23) • Referring to FIG. 3, the incoming MPEG stream 301 has interleaved video 302, 305, 306 and audio 303, 304, 307 segments. These elements must be separated and recombined to create separate video 308 and audio 309 streams or buffers. This is necessary because separate decoders are used to convert MPEG elements back into audio or video analog components. Such separate delivery requires that time sequence information be generated so that the decoders may be properly synchronized for accurate playback of the signal. (col.4:24-33) • The input stream flows through a parser 401. The parser 401 parses the stream looking for MPEG distinguished events indicating the start of video, audio or private data segments. For example, when the parser 401 finds a video event, it directs the stream to the video DMA engine 402. The parser 401 buffers up data and DMAs it into the video buffer 410 through the video DMA engine 402. At the same time, the parser 401 directs an event to the event DMA engine 405 which generates an event into the event buffer 413. When the parser 401 sees an audio event, it redirects the byte stream to the audio DMA engine 403 and generates an event into the event buffer 413. Similarly, when the parser 401 sees a private data event, it directs the byte stream to the private data DMA engine 404 and directs an event to the event buffer 413. The Media Switch notifies the program logic via an interrupt mechanism when events are placed in the event buffer. (col.5:3-19)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • If a digital TV signal is being processed instead, the MPEG encoder 703 is replaced with an MPEG2 Transport Demultiplexor, and the MPEG audio encoder 704 and VBI decoder 702 are deleted. The demultiplexor multiplexes the extracted audio, video and private data channel streams through the video input Media Switch port. (col.6:30-36) • The parser 705 parses the input data stream from the MPEG encoder 703, audio encoder 704 and VBI decoder 702, or from the transport demultiplexor in the case of a digital TV stream. The parser 705 detects the beginning of all of the important events in a video or audio stream, the start of all of the frames, the start of sequence headers—all of the pieces of information that the program logic needs to know about in order to both properly play back and perform special effects on the stream, e.g. fast forward, reverse, play, pause, fast/slow play, indexing, and fast/slow reverse play. (col.6:36-46) • A hard disk or storage device 710 is connected to one of the ports of the Media Switch 701. The Media Switch 701 outputs streams to an MPEG video decoder 715 and a separate audio decoder 717. (col.6:62-65) • MPEG streams, whether extracted from an MPEG2 Transport or encoded from an analog TV signal, are typically encoded using a technique called Variable Bit Rate encoding (VBR). (col.7:32-36) • Referring to FIG. 11, a preferred embodiment that accomplishes multiple functions is shown. A source 1101 has a TV signal input. The source sends data to a PushSwitch 1102 which is a transform derived from TmkXfrm. The PushSwitch 1102 has multiple outputs that can be switched by the control object 1114. This means that one part of the pipeline can be stopped and another can be started at the users whim. The user can switch to different storage devices. The PushSwitch 1102 could output to a TmkClipWriter 1106, which goes onto a storage device 1107 or write to the cache transform 1103. (col.9:66 to col.10:9) • The derived class and resulting objects described here may be combined in an arbitrary way to create a number of different useful configurations for storing, retrieving, switching and viewing of TV streams. For example, if multiple input and output sections are available, one input is viewed while another is stored, and a picture-in-picture window generated by the second output is used to preview previously stored streams. Such configurations represent a unique and novel application of software transformations to achieve the functionality expected of expensive, sophisticated hardware solutions within a single cost-effective device. (col.11:27-38) • <i>See</i> FIGS. 1-7, 9, 11, 13

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>Furthermore, The MPEG-2 Standard also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • Figure Intro. 2 and Figure Intro. 3 illustrate prototypical demultiplexing and decoding systems which take as input a Transport Stream. Figure Intro. 2 illustrates the first case, where a Transport Stream is directly demultiplexed and decoded. Transport Streams are constructed in two layers: - a system layer; and - a compression layer. (p. x) • See FIG. Intro. 2 “Prototypical transport demultiplexing and decoding example” (p. x) • The Transport Stream is designed in such a way that several operations on a Transport Stream are possible with minimum effort. Among these are: <ul style="list-style-type: none"> 1) Retrieve the coded data from one program within the Transport Stream, decode it and present the decoded results as shown in Figure Intro. 2. 2) Extract the Transport Stream packets from one program within the Transport Stream and produce as output a different Transport Stream with only that one program as shown in Figure Intro. 3. 3) Extract the Transport Stream packets of one or more programs from one or more Transport Streams and produce as output a different Transport Stream (not illustrated). 4) Extract the contents of one program from the Transport Stream and produce as output a Program Stream containing that one program as shown in Figure Intro. 4. 5) Take a Program Stream, convert it into a Transport Stream to carry it over a lossy environment, and then recover a valid, and in certain cases, identical Program Stream. (p. x) • On encoding, Program Streams are formed by multiplexing elementary streams, and Transport Streams are formed by multiplexing elementary streams, Program Streams, or the contents of other Transport Streams. Elementary streams may include private, reserved, and padding streams in addition to audio and video streams. The streams are temporally subdivided into packets, and the packets are serialized. A PES packet contains coded bytes from one and only one elementary stream. (p. xiii) • On decoding, demultiplexing is required to reconstitute elementary streams from the multiplexed Program Stream or Transport Stream. Stream_id codes in Program Stream packet headers, and Packet ID codes in the Transport Stream make this possible. (p. xiv)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • Transport Stream packets begin with a 4-byte prefix, which contains a 13-bit Packet ID (PID), defined in Table 2-2. The PID identifies, via the Program Specific Information (PSI) tables, the contents of the data contained in the Transport Stream packet. Transport Stream packets of one PID value carry data of one and only one elementary stream. (p. 8) • PID - The PID is a 13-bit field, indicating the type of the data stored in the packet payload. (p. 19) • [PID value] May be assigned as network_PID, Programming_PID, elementary_PID, or for other purposes (Table 2-3, p. 19) • See FIG. D.1 (p.93) • The incoming network packets are reassembled into MPEG-2 transport stream data by the NXP and NDP decode functions. The jittered ITU-T Rec. H.222.0 I ISO/IEC 13818-1 Transport Stream packets are then filtered to extract packets with the desired PID. (p.116) • See FIG. J.3 “Integrated dejittering and MPEG-2 decoding” (p.115) <p>Furthermore, U.S. Patent No. 6,397,000 to Hatanaka et al. (“Hatanaka”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • JP-A-8-98164 discloses a receiving system and a recording/playing back device for receiving/recording a transmitted multiplexed digital signal as a conventional technique for recording/playing back a digital signal. This prior art publication describes a receiving system which includes receiving means for receiving a transmitted multiplexed digital information signal and for selecting desired information, and recording means for recording the information received by the receiving means. (col.1:12-20) • a digital input means for inputting to the recording device a digital signal indicative of video, audio, data and so forth multiplexed in a predetermined packet form; an analog video signal input means for inputting an analog video signal to the recording device; an analog audio signal input means for inputting an analog audio signal to the recording device; a video A/D converter for converting the analog video signal inputted by the analog video signal input means to a digital signal; a video encoder for information-compressing the digital video signal to which the analog video signal is converted by the video A/D converter; an audio A/D converter for converting the analog audio signal inputted by the analog audio input means to a digital signal; an audio encoder for information-compressing the digital audio signal to which the analog audio signal is converted by the audio A/D converter; a multiplexing means for multiplexing at least the video signal compressed by the video encoder and the audio signal compressed by the audio encoder into a multiplexed signal of a predetermined packet form; and a record

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>selecting means for selecting one of the digital signal inputted by the digital input means and the multiplexed digital signal provided by the multiplexing means; and a recording means for recording the digital signal selected by the record selecting means. (col.1:37-67)</p> <ul style="list-style-type: none"> FIG. 1 is a block diagram of a receiving/recording/playing back device for a digital broadcasting signal in a first embodiment of the present invention. In FIG. 1, reference numeral 1 denotes a digital broadcasting receiving device (Integrated Receiver & Decoder: IRD), 2 a recording/playback device, 3 an encoder, 4 a digital broadcasting signal input terminal, 5 a tuner, 6 a QPSK demodulator, 7 a forward error correction (FEC) unit for correcting an error involved in the transmission of a signal, 8 a playback changeover switch, 9 a demultiplexer, 10 a MPEG decoder, 11 an NTSC encoder, 12 an interface between the devices 1 and 2, 13 a clock recovery unit, 14 a D/A converter, 15 a video output terminal, 16 an audio output terminal, 17 a recorded signal changeover switch, 18 a packet control circuit, 19 a recording/playback data processing, 20 a record amplifier, 21 a playback amplifier, 22 a magnetic tape, 23 a rotary head, 24 a clock generator, 25 a clock changeover switch, 26 a video input terminal, 27 an audio input terminal, 28 a video A/D converter, 29 an audio A/D converter, 30 a video encoder, 31 an audio encoder, 32 a multiplexer, and 47 a digital signal processor. (col.2:30-50) FIG. 2 shows a composition of a transmitted digital broadcasting signal. As shown in a packet composition of FIG. 2(A), the transmission signal has a packet composition of 204 bytes; a 4-byte header 50; a 184-byte data 51 representing information on a video, audio, added data, etc., compressed in a compression system called, for example, MPEG 2 (Moving Picture Expert Group 2) as an international standard, and a 16-byte parity 52. The packets of those video, audio, added data, etc., are received in a multiplexing manner on a time divisional basis on a transmission line, as shown in FIG. 2(B). Generally, not only one program, but also a plurality of programs of video, audio and added data is multiplexed on a time divisional basis. The header composition of FIG. 2(C) shows a content of the header 50. In FIG. 2(C), reference numeral 53 denotes a sync byte indicative of the head of the packet, 54 a transport error indicator, 55 a payload unit start indicator, 56 a transport priority, 57 a PID indicative of attributes of the packet, 58 a transport scrambling control, 59 an adaptation field control, and 60 continuity counter, each showing attributes and status of the packet, composed of 4 bytes in all. The numerals appearing on top of the packet each represent the number of bits of a respective subpacket. (col.2:51 to col.3:6) A digital broadcasting signal sent from a satellite is received at the digital broadcasting signal input terminal 4, and inputted to the tuner 5 which selects and outputs a desired signal. The output from the tuner 5 is demodulated by the QPSK demodulator 6 and then inputted to the FEC 7, which corrects an error involved in the received digital signal in the transmission. The output from the FEC 7 is delivered to the playback changeover switch 8 and the interface 12. (col.3:6-15) When the broadcasting signal is outputted from the present device, the playback changeover switch 8 is

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>set at a contact to input the output from the FEC 7 to demultiplexer 9, which determines a type of a respective packet, using the PID 57, etc., of the header 50, separates only packets of a video, audio, etc., relating to a specified program, and then outputs these packets to the MPEG decoder 10. The multiplexed signal contains a packet called, for example, a PCR (Program Clock Reference) indicative of time information representing the time when compression took place in a broadcasting station concerned. (col.3:16-26)</p> <ul style="list-style-type: none"> • When the received signal is recorded in the recording/playback device 2, the output from the FEC 7 is inputted to the interface 12, which separates packets of video and audio information and added information relating to a program to be recorded as in the demultiplexer 9. When the received signal is recorded and played back by the recording/playback device 2, it is required to also record and play back program information required for automatic selection of a broadcasting station. Thus, in addition to the packets selected by the demultiplexer 9, the interface 12 also selects a packet of program information relating to the program to be recorded and converts a part of the packet of program information. The signal separated by the interface 12 is inputted to the packet control circuit 18 by selecting a contact c by the recording signal changeover switch 17. As shown in the main data of FIG. 3A, the packet control circuit 18 divides 188-byte packet data into 92-byte packet data A 99 and 96-byte packet data B 100, and adds 4-byte packet header 98 to the packet data A 99. The packet control circuit 18 also produces in the packet header 98 a time stamp, shown in a hatched area 102, which is data on a time when the packet is received. (col.3:42-63) • In reproduction, a signal 153 reproduced by the rotary head 23 is inputted via the playback amplifier 21 to the recording/playback data processing circuit 19, which detects the sync signal 92, signals ID1 (93), ID2 (94), etc., and corrects errors, using the CIP 101, C2P 76, etc., extracts packet data A 99 and packet data B 100, and then sends those data to the packet control circuit 18. The packet control circuit 18 outputs the respective packets at the same intervals of time as in the recording in accordance with the time stamp 102 added when the data was recorded, and then sends those packets via the interface 12 to the playback changeover switch 8. When a reproduced picture is to be obtained, the playback changeover switch 8 is set at the contact b to thereby send a reproduced packet to the demultiplexer 9. The demultiplexer 9 automatically selects a broadcasting station on the basis of the packet of program information which was selected and converted by the interface 12 when the data was recorded, and outputs only a packet required for the MPEG decoder 10. Video/audio signals are obtained in a manner similar to that in which an output is obtained from a broadcasting signal. (col.4:16-35) • When the analog broadcasting signal is recorded, an analog video signal 150 is inputted to the video input terminal 26 of the encoder 3 of FIG. 1. The video A/D converter 28 converts the analog video signal to a digital video signal. The video encoder 30 compresses the image, using the MPEG 2, etc., as in the compression of the digital broadcasting signal, and outputs the compressed signal to the

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p data-bbox="779 266 1885 386">multiplexer 32. An analog audio signal 151 is inputted to the audio input terminal 27, and converted by the audio A/D converter 29 to a digital audio signal. The audio encoder 31 compresses the digital audio signal, and also outputs this signal to the multiplexer 32, which multiplexes a video stream 42 produced by the video encoder 30 and an audio stream 43 produced by the audio encoder 31. (col.5:1-14)</p> <ul style="list-style-type: none"> <li data-bbox="737 418 1892 570">• As shown in FIGS. 5A-5E, the multiplexer 32 temporarily stores the video and audio streams 42 and 43, and outputs them as the video and audio packet streams 45 and 46 at the same transfer rate. The multiplexer 32 further outputs both the packets 45 and 46 in a time divisional manner onto a signal at a fixed transfer rate, which is generally higher than the sum of the transmission rates of the video and audio streams 42 and 43. (col.5:26-33) <li data-bbox="737 602 1892 878">• As shown in FIGS. 5A-5E, the video stream 42, audio stream 43, other packets, and NULs are multiplexed on a time-divisional basis to form a single signal. The respective video packets VIs 1 (110), 2 (111), etc., on the video stream 42 are the same in content as the VIs 1 (116), 2 (112) etc., on the multiplexed stream 44. Similarly, the respective audio packets AUs 1 (113), 2 (114) etc., of the audio stream 43 are the same in content as the AUs 1 (122), 2 (124) etc., of the multiplexed stream 44. Thus, the multiplexed stream 44 has a stream composition similar to the output of the interface 12 of the digital broadcasting receiver 1. Thus, the recording signal changeover switch 17 selects a contact d and inputs the multiplexed stream 44 to the packet control circuit 18 to thereby record/playback the multiplexed stream 44 in the same manner as the digital broadcasting signal. (col.5:54 to col.6:2) <li data-bbox="737 911 1892 1122">• In recording, as shown in FIGS. 7A-7D, the respective broadcasting (BR), video (VI), and audio (AU) packets of the broadcasting stream 41, video stream 42, and audio stream 43 are multiplexed on a time divisional basis and PMT and PCR are added to the multiplexed packets to constitute a multiplexed stream. In this case, the PAT is already contained in the broadcasting stream 41 (shown by a packet 130 of FIG. 7A), but only contains information on a program contained in the broadcasting stream. Thus, the information should be converted so as to include information on the analog broadcasting. In FIG. 7D, reference numeral 131 denotes a PAT converted by the multiplexer 32. (col.6:28-40) <li data-bbox="737 1154 1892 1276">• In playback, the user selects one of the digital and analog broadcasts, the demultiplexer 9 selects only one of the digital and analog broadcasts on the basis of the PAT converted in the recording, and inputs the selected program packet to the MPEG decoder 10 to obtain the video and audio of the desired program. (col.6:47-52) <li data-bbox="737 1308 1892 1393">• Thus, the digital broadcasting signal and the digital signal to which the analog broadcasting signal is converted are easily recorded simultaneously in a multichannel. If the video and audio streams 42 and 43 alone are multiplexed in a mode in which no broadcasting stream 41 is outputted in the multiplexer 32 of

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>the FIG. 6 device, an operational mode similar to that described in FIG. 1 is obtained. In this case, the clock changeover switch 25 is required to be set at the contact f in the recording operation. Alternatively, the video and audio signals may be selected from separate sources. For example, only the video signal may be selected from the broadcasting stream 41 and the audio signal may be selected from the audio stream 43. Conversely, only the audio signal may be selected from the broadcasting stream 41 and only the video signal may be selected from the audio stream 43. (col.6:47-67)</p> <ul style="list-style-type: none"> • While in the above the interface 12, multiplexer 32 and packet control circuit 18 are described as handling a one-way signal, these elements may be replaced with an input/output bus. FIG. 8 shows a signal line composition used in this case. Reference numerals 140, 143 and 144 each denote a tri(3)-state buffer whose output can have a high impedance and reference numerals 141 and 142 each denote an input buffer. (col.7:1-8) • The video A/D converter 28, audio A/D converter 29, video encoder 30, audio encoder 31 and multiplexer 32 may be built either in the recording/playback device 2 or in the digital broadcasting receiver 1. Although not shown, the demultiplexer 9, MPEG decoder 10, NTSC encoder 11, and D/A converter 14 may also be provided in the recording/playback device 2 as well. Thus, even the recording/playback device is capable of providing a reproduced video signal by itself. Of course, the digital broadcasting receiver 1, recording/playback device 2 and encoder 3 may be all integrated in one unit. (col.7:21-31) • When a digital signal is recorded in the device of FIG. 9, the digital recording changeover switch 210 is set at a contact i, so that the output from the digital signal processor 47 is recorded via the playback amplifier 20 onto the magnetic tape 22 by the audio head 221 of the rotary head 23. Simultaneously, a servo tracking signal is recorded by the system controller 206 in synchronism with the rotation of the rotary head 22. In this case, the output from the analog video record amplifier 204 is stopped by the system controller 206. In playback, a video signal 230 and an audio signal 231 are reproduced by the digital broadcasting receiver 1, and selected by the output selector 270 under the control of the system controller 206, and outputted from the external video and audio output terminals 209 and 208. (col.7:52-65) • While in the above the magnetic tape is used as a recording medium, a magnetic disk, optical disk, semiconductor memory or other recording medium may be used. Although not shown in FIGS. 1 and 6, a deciphering circuit which decipheres a cipher signal may be provided between the QPSK demodulator 6 and the FEC 7. Selection of a packet and conversion of a packet on the program information by the interface 12 may be performed by the demultiplexer 9 or packet control circuit 18. (col.9:6-14)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • <i>See also</i> FIGS. 1-7, 9, 10 <p>Furthermore, U.S. Patent No. 7,024,100 to Furuyama (“Furuyama”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • In FIG. 1, recorded in storage section 10 is video data comprised of bitstreams conforming to MPEG (International Standard for Moving Picture Coding). Identification information indicative of the contents of the scene corresponding to the user area is inserted in the user data area in the bitstreams. MPEG decoder 20 has a user area code extraction section 28 that extracts the identification information inserted in the user data area. Retrieval section 30 is comprised of retrieval information input section 32 to which the contents of the scene a user desires are input, comparison section 31 which compares the contents input from retrieval information input section 32 to the extracted contents by the user area code extraction section 28. (col.1:19-31) • In various data streams including an MPEG stream, compressed coded video streams, audio streams, and private streams to store user data are multiplexed (hereinafter, the private stream is called retrieval data stream since identification information for retrieval is used as the user data in the present invention). Execution of the reproduction and retrieval from the above-mentioned data streams requires a demultiplexing function for demultiplexing the multiplexed data streams to the private streams, video streams and audio streams, a video decoding and audio decoding function for extending the compressed coded video and audio data to decode, and a retrieval function for executing the retrieval. Accordingly, to execute the reproduction and retrieval in parallel, it is necessary to concurrently process streams being reproduced and streams for retrieval, however the function requiring concurrent processing is only the demultiplexing function. (col.2:4-20) • The present invention enables the concurrent execution of the reproduction of video and retrieval by providing a plurality of demultiplexing sections. (col.2:21-23) • The following description explains as an example of data stream the MPEG bitstream conforming to the MPEG that is the moving picture coding standard. However, it is obvious that the present invention is applicable to the data stream other than the MPEG stream conforming to the MPEG that is the moving picture coding standard. (col.3:12-18) • FIG. 2 is a block diagram of a video storage and retrieval apparatus according to the first embodiment of the present invention. The video storage and retrieval apparatus is comprised of MPEG stream input section 1 to which the MPEG stream is input, video output section 2 which outputs a decoded video signal, and audio output section 3 which outputs a decoded audio signal. The MPEG stream received in MPEG stream input section 1 is stored in storage section 11. Storage section 11 has a plurality of output

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>ports, and the recorded plurality of MPEG streams can be accessed concurrently. Storage section 11 is controlled by control section 12. Control section 12 controls the read of the MPEG stream stored in storage section 11 according to the instruction from retrieval section 30. (col.3:21-35)</p> <ul style="list-style-type: none"> • Two output ports of storage section 11 are coupled to respective first demultiplexing section 21 and second demultiplexing section 22 which can be accessed concurrently. First demultiplexing section 21 demultiplexes video streams and audio streams from the MPEG stream read from storage section 11 to reproduce. Second demultiplexing section 22 demultiplexes retrieval streams from the MPEG stream read from storage section 11 to retrieve. The video streams, audio streams and retrieval streams are multiplexed in the MPEG stream. First demultiplexing section 21 is connected to video decoding section 23 and audio decoding section 24 in parallel. (col.3:36-48) • Comparison section 31 compares the identification information in the retrieval data stream, which is read from storage section 11 and then demultiplexed in second demultiplexing section 22, to the retrieval scene from retrieval information input section 32, while instructing control section 12 on the read of the MPEG stream to retrieve. (col.3:58-64) • FIG. 3A illustrates an exemplary structure of the MPEG stream in this embodiment. As illustrated in FIG. 3A, the MPEG stream is comprised of stream header 101 to store stream information, a plurality of coded video streams (video stream (1) 102 to video stream (n) 105), a plurality of coded audio streams (audio stream (1) 103 to audio stream (n) 106), and a plurality of retrieval data streams (retrieval data stream (1) 104 to retrieval data stream (n) 106) as identification data with identification information for retrieval incorporated therein. The identification information indicative of the contents of the corresponding scene is recorded in the retrieval data stream along with PTS (Presentation Time Stamp) that is information to synchronously reproduce the corresponding video data streams and audio data streams, or time code. And each of the video data streams, the audio data streams and the retrieval data streams is constructed in packets and multiplexed as PES (Packetized Elementary Stream). Further, it may be possible to insert the retrieval data streams as a private descriptor in the PAT (Program Association Table), PMT (Program Map Table) or CAT (Conditional Access Table) to multiplex with the video data and audio data. (col.3:65 to col.4:19) • When control section 12 receives a reproduction instruction from a user interface, not shown in the figure, with a program address or program identification number designated, control section 12 provides the reproduction instruction to storage section 11 while specifying a header address of the MPEG stream of the instructed program. As a result of the instruction, the MPEG stream of the program instructed by control section 12 is provided from one of output ports of storage section 11 to first demultiplexing section 21. First demultiplexing section 21 demultiplexes the video streams and audio streams from the MPEG stream. (col.4:67 to col. 5:10.)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • At this time, second demultiplexing section 22 accesses another output port other than the output port outputting the MPEG stream being reproduced. Second demultiplexing section 22 demultiplexes the retrieval data stream from the MPEG stream for retrieval. Then, the identification information inserted in the retrieval data stream is output from second demultiplexing section 22 to comparison section 31. (col.5:22-29) • As described above, according to this embodiment, since first demultiplexing section 21 and second demultiplexing section 22 are provided, it is possible to concurrently execute the reproduction and retrieval. (col.5:52-55) • In addition, it may be possible to provide a plurality of second demultiplexing sections 22 that execute the demultiplexing to extract the retrieval information and a plurality of retrieval sections 30 that search specific video and audio data based on the identification data so that the plurality of second demultiplexing sections 22 and retrieval sections 30 execute the retrieval processing in parallel on a plurality of data streams stored in storage section 11. Thereby, it is possible to speed up the retrieval processing. Further, it may be possible that the data stream is input to second demultiplexing section 22, which executes the demultiplexing to extract the retrieval information, at a rate higher than the data transfer rate at which the data stream is input to first demultiplexing section 21 which executes the demultiplexing to reproduce the video and audio, in order to speed up the retrieval processing. (col.5:56 to col.6:4) • In the video storage and retrieval apparatus of this embodiment, third demultiplexing section 25 is provided between MPEG stream input section 1 and storage section 11. Third demultiplexing section 25 demultiplexes an input multiplexed MPEG stream to video streams, audio streams and retrieval data streams. The demultiplexed video streams, audio streams and retrieval data streams are recorded in storage section 11. (col.6:13-20) • The multiplexed MPEG stream is input to MPEG stream input section 1, and demultiplexed in third demultiplexing section 25 to video streams, audio streams and retrieval data streams, which are stored in storage section 11. (col.6:26-29) • As described above, the video streams, audio streams and retrieval data streams demultiplexed from the MPEG stream are stored in storage section 11, while the video streams, audio streams and searches data stream stored in storage section 11 are made independently accessible, and therefore it is possible to execute the reproduction of the video and audio, and the retrieval at the same time. (col.6:47-54)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • In the video storage and retrieval apparatus of this embodiment, fourth demultiplexing section 26 is provided between MPEG stream input section 1 and storage section 11, and fifth demultiplexing section 27 is provided between storage section 11, and video decoding section 23 and audio decoding section 24. Fourth demultiplexing section 26 demultiplexes the multiplexed MPEG stream to a data stream in which video streams and audio streams are multiplexed, and retrieval data streams. Fifth demultiplexing section 27 demultiplexes the multiplexed video streams and audio streams to video streams and audio streams. FIG. 6A illustrates a structure of the MPEG stream input to fourth multiplexing section 26, and FIG. 6B illustrates structures of the MPEG streams output from fourth demultiplexing section 26. (col.6:61 to col.7:9) • The multiplexed MPEG stream, input to MPEG stream input section 1, is demultiplexed to video streams, audio streams and retrieval data streams in fourth demultiplexing section 26, which multiplexes again demultiplexed video streams and audio streams, while adding stream header 111 thereto, to output. The retrieval data streams and multiplexed video streams and audio streams are stored in storage section 11. At the time the video is reproduced, the multiplexed video streams and audio streams, stored in storage section 11, are demultiplexed to the video streams and audio streams by fifth demultiplexing section 27. (col.7:11-22) • In the video storage and retrieval apparatus of this embodiment, temporary storage section 40 is provided between storage section 11, and first demultiplexing section 21 and second demultiplexing section 22. At the time the reproduction or retrieval is executed, the MPEG data stored in storage section 11 is transferred to temporary storage section 40 at a data transfer rate higher than that necessary for the ordinary video reproducing processing to be temporarily stored therein, and the stored data is provided to first demultiplexing section 21 and second demultiplexing section 22 at the same data transfer rate as in the ordinary reproducing processing. The operation of the video storage and retrieval apparatus in this embodiment is explained below. At the time of video reproduction, part of or entire MPEG stream to be reproduced is transferred to temporary storage section 40 from storage section 11 at the data transfer rate higher than that necessary for the ordinary video reproducing processing. Then, the data is transferred to first demultiplexing section 21 at the same data transfer rate as in the ordinary reproducing processing from temporary storage section 40. First demultiplexing section 21 demultiplexes video streams and audio streams to respectively output to video decoding section 23 and audio decoding section 24. (col.7:42-65) • Second demultiplexing section 22 fetches the retrieval data streams from the MPEG stream for the retrieval stored in temporary storage section 40, and outputs the identification information in the retrieval data stream to retrieval section 30. (col.8:14-18)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • In the video storage and retrieval apparatus of this embodiment, the MPEG stream, in which video streams, audio streams and retrieval data streams are multiplexed, is read from storage section 11, input to third demultiplexing section 25 to be demultiplexed to the video streams, audio streams and retrieval data streams. Then, the video streams and audio streams are stored in temporary storage 40, and at the time of retrieval, the retrieval data streams are input to retrieval section 30. The temporary storage section 40 outputs the video streams and audio streams in parallel respectively to video decoding section 23 and audio decoding section 24. (col.8:59 to col.9:3) • At the time of video reproduction, part of or entire MPEG stream to be reproduced is transferred to third demultiplexing section 25 from storage section 11 at the data transfer rate higher than that for the ordinary video reproducing processing. Third demultiplexing section 25 demultiplexes the multiplexed video streams, audio streams and retrieval data streams to the video streams and audio streams, and the retrieval data streams, and transfers the video streams and audio streams to temporary storage section 40 to temporarily store therein. (col.9:5-14) • Meanwhile, control section 12 controls storage section 11 so that storage section 11 transfers again the rest of the MPEG stream to be reproduced to temporary storage section 40 via third demultiplexing section 25 before the video streams and audio streams to be reproduced stored in temporary storage section 40 are all transferred respectively to video decoding section 23 and audio decoding section 24. When a user inputs the retrieval request to retrieval section 30, control section 12 judges whether the MPEG stream to be reproduced is being transferred from storage section 11 to temporary storage section 40, and when the MPEG stream is not being transferred, the MPEG stream for the retrieval is transferred from storage section 11 to third demultiplexing section 25. Third demultiplexing section 25 demultiplexes the retrieval data streams from the MPEG stream for the retrieval, and transfers the retrieval data stream to retrieval section 30 to be subjected to retrieve processing. (col.9:22-39) • Then, the MPEG stream is transferred to first demultiplexing section 21 from temporary storage section 40 at the same data transfer rate as in the ordinary reproducing processing. First demultiplexing section 21 demultiplexes video streams and audio streams from the MPEG stream, and outputs video streams and audio streams respectively to video decoding section 23 and audio decoding section 24. Thereby, the decoded video signals and audio signals are output. (col.10:28-36) • When a user inputs the retrieval request to retrieval section 30, control section 12 judges whether the MPEG stream to be reproduced is being transferred from storage section 11 to temporary storage section 40, and when the MPEG stream is not being transferred, the MPEG stream for the retrieval is transferred from storage section 11 to second multiplexing section 22. Second demultiplexing section 22 demultiplexes the retrieval data streams (or identification information) from the MPEG stream to output

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>to retrieval section 30. Retrieval section 30 executes the retrieval processing using the identification information and retrieval scene. (col.10:44-55)</p> <ul style="list-style-type: none"> • The multiplexed MPEG stream input to MPEG stream input section 1 is demultiplexed in third demultiplexing section 25 to video streams, audio streams and retrieval data streams. The demultiplexed video streams and audio streams are stored in storage section 11, and the demultiplexed retrieval data streams are stored in second storage section 13. (col.11:18-24) • As described above, the multiplexed MPEG stream is demultiplexed to the video streams, audio streams and retrieval data streams before being stored in storage sections. (col.11:32-35) • Furthermore, in the above-mentioned embodiment, it may be possible to provide fourth demultiplexing section 26 illustrated in FIG. 5 before storage section 11 and second storage section 13 instead of third demultiplexing section 25, and further provide fifth demultiplexing section 27 illustrated in FIG. 5 between storage section 11, and video decoding section 23 and audio decoding section 24. Then, retrieval section 30 may execute the retrieval processing while fetching the identification data from second storage section 13, select a period matching the pre-registered retrieval condition registered, and store the streams of video data and audio data demultiplexed from the MPEG stream corresponding to the selected period in storage section 11. Otherwise, retrieval section 30 may execute the retrieval processing while fetching the identification data from fourth demultiplexing section 26 not through second storage section 13, select a period matching the per-registered retrieval condition, and store the video streams and audio streams demultiplexed from the MPEG stream corresponding to the selected period in storage section 11. (col.12:1-20) • The video storage and retrieval system of this embodiment is comprised of video retrieval server 50, video reproducing terminal 51 and transmission media 52. Video retrieval server 50 is comprised of MPEG stream input section 1, fourth demultiplexing section 25, storage section 11, control section 12, comparison section 31, MPEG stream transmission section 4 which transmits the MPEG stream comprised of multiplexed video data streams and audio data streams, and retrieval information reception section 6 which receives the retrieval information (scene contents). Video reproducing terminal 51 is comprised of fifth demultiplexing section 27, video decoding section 23, audio decoding section 24, retrieval information input section 32, video output section 2, audio output section 3, MPEG stream reception section 5 which receives the MPEG stream comprised of multiplexed video data streams and audio data streams, and retrieval information transmission section 7 which transmits the retrieval information. Further, transmission media 52 between video retrieval server 50 and video reproducing terminal 51 are comprised of communication networks, broadcasting networks, or a combination of the communication networks and broadcasting networks. (col.13:17-43)

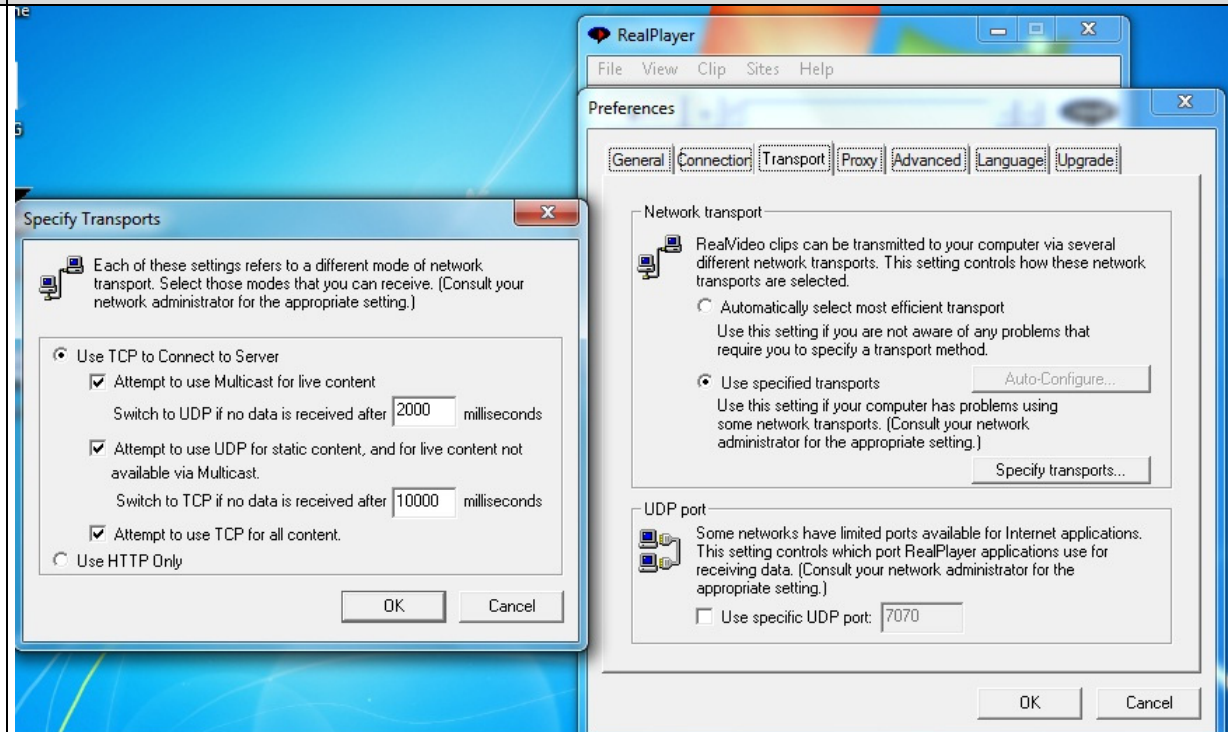
Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • The video matching the retrieval information is transmitted as multiplexed video and audio streams from MPEG stream transmission section 4 through transmission media 52 to video reproducing terminal 51. In video reproducing terminal 51, MPEG stream reception section 5 receives the retrieved video and audio streams. The received video and audio streams are demultiplexed in fifth demultiplexing section 27, and the demultiplexed video streams and audio streams are respectively expanded in video decoding section 23 and audio decoding section 24, thus outputting the videos and audios. (col.13:56-67) • <i>See also</i> FIGs. 2-12. <p>Furthermore, U.S. Patent No. 5,881,245 to Thompson ("Thompson") also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • the multiplexed packets of encoded audio and video data may tend to arrive at a particular playback card 504 in bursts. The FIFO memory device 602 buffers such bursty data and provides the buffered transport stream to the transport stream demultiplexer 604. The transport stream demultiplexer 604, inter alia, separates the packets of encoded audio data from the packets of encoded video data based on the PID number 220 of the header 114 of the transport stream packets 200. Private data packets, which are similarly identified with a unique PID(s) 220, may be provided to memory 606. From there, the private data may be provided to other portions of the playback card 504 via the microprocessor bus 616 under the control of the microprocessor 614. (col.16:28-41) • The International Organisation for Standardisation (or the Organisation Internationale De Normalisation) (hereinafter referred to as "the ISO/IEC") has produced drafts of the MPEG-2 standard for the coding of moving pictures and associated audio. This standard is set forth in four documents. The document ISO/IEC 13818-1 (systems) specifies the system coding of the specification. It defines a multiplexed structure for combining audio and video data and means of representing the timing information needed to replay synchronized audio and video sequences in real-time. The document ISO/IEC 13818-2 (video) specifies the coded representation of video data and the decoding process required to reconstruct pictures. The document ISO/IEC 13818-3 (audio) specifies the coded representation of audio data and the decoding process required to reconstruct the audio data. Lastly, the document ISO/IEC 13818-4 (conformance) specifies procedures for determining the characteristics of coded bitstreams and for testing compliance with the requirements set forth in the ISO/IEC documents 13818-1, 13818-2, and 13818-3. These four documents, hereinafter referred to, collectively, as "the MPEG-2 standard" or simply "the MPEG standard", are incorporated herein by reference. (col.1:19-41) • A bit stream, multiplexed in accordance with the MPEG-2 standard, is either a "transport stream" or a "program stream". Both program and transport streams are constructed from "packetized elementary stream" (or PES) packets and packets containing other necessary information. A "packetized elementary

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>stream" (or PES) packet is a data structure used to carry "elementary stream data". An "elementary stream" is a generic term for one of (a) coded video, (b) coded audio, or (c) other coded bit streams carried in a sequence of PES packets with one and only stream identifier (or "ID"). Both program and transport streams support multiplexing of video and audio compressed streams from one program with a common time base. (col.1:42-55)</p> <ul style="list-style-type: none"> • Transport streams permit one or more programs with one or more independent time bases to be combined into a single stream. Transport streams are useful in instances where data storage and/or transport means are lossy or noisy. The rate of transport streams, and their constituent packetized elementary streams (PESs) may be fixed or variable. This rate is defined by values and locations of program clock reference (or PCR) fields within the transport stream. (col.1:56-63) • See FIGS 4, 6 <p>Furthermore, NetShow also discloses this limitation expressly:</p> <p>For example, NetShow discloses that multiplexed packetized data can be received via Hypertext Transfer Protocol (HTTP), Internet Protocol (IP), Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Multicast.</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<div data-bbox="1018 261 1566 833" data-label="Image"> <p>The screenshot shows the 'Microsoft NetShow Player Properties' dialog box with the 'Advanced' tab selected. Under the 'Buffering' section, the 'Buffer 3 seconds of data' option is selected. Under the 'Protocols' section, 'Multicast', 'TCP', and 'HTTP' are checked. Under 'HTTP', 'Use browser proxy settings' is selected.</p> </div> <p>Furthermore, RealPlayer 5.0 also discloses this limitation expressly:</p> <p>For example, RealPlayer 5.0 discloses that multiplexed packetized data can be received via Internet Protocol (IP), Transmission Control Protocol (TCP), and User Datagram Protocol (UDP).</p>

**Asserted Claims of U.S.
Patent No. 7,095,945**

Exemplary citations to Hoogenboom



Furthermore, the admitted prior art also discloses this limitation expressly:

- Systems for time shifting a viewed program are known in the industry. For example, if a viewer is interrupted by a phone call during a television program, the program can be recorded for a few minutes and then played back from the point of interruption while additional video information is continually recorded. One prior art method of accomplishing time shifting is to capture the rendered video signal. When the rendered signal is an analog signal it is digitized and stored. When the rendered signal is a digital signal it can be captured directly. Once captured, the rendered digital data can be stored directly. (col.1:12-22)
- One known method to provide digital video data is to provide the data using a specific protocol that has the ability to transmit the digital video data in a compressed format. An example of one such format is known as MPEG-2, and has been approved by the International Organization for Standards (ISO)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>Moving Pictures Experts Group (MPEG group). MPEG-2 is a versatile communication standard that gives theoretical explanations needed to implement an MPEG-2 decoder through the syntax and semantics of coded bit-streams. MPEG-2 is an open standard and continues to evolve and be applied to a wide variety of applications ranging from video conferencing to High Definition Television (HDTV). The MPEG-2 standard, as a generic and open standard, is intended for variety of audio/video coding applications. (col.1:31-45)</p> <ul style="list-style-type: none"> • One method of transporting large amounts of various types of transport stream data is to use a multiplexed packetized data stream capable of carrying real-time multimedia programs. One example of a multiplexed packetized data stream is described in the standard ISO/IEC 13818-1 and will be referred to as a transport stream. Transport streams generally offer robustness for noisy channels and can carry multiple programs (like multiple TV services) within the same multiplex. The transport stream is based on 188 byte long packets that are well suited for hardware error correction and processing schemes needed in noisy environments, such as coaxial cable television networks and satellite transponders. Such a transport stream facilitates fast program access, channel hopping and synchronization between multiple programs within the transport stream. (col.1:46-60) • Each TS packet consists of a TS Packet header with optional Adaptation Field followed by useful data payload containing portion of a PES packet. The TS header consists of a sync byte, flags, indicators information for error detection and timing and Packet_ID (PID) field used to identify elementary stream carried underneath of a PES packet. In addition to identifying specific elementary streams, one PID is used to identify a program specific Information (PSI) table data. (col.2:18-26) • <i>See also</i> FIGs. 1-4. • The international organization for standards (ISO) moving pictures experts group (MPEG group), approved an audio video digital compression standard known as MPEG-2 in an effort to provide a versatile compression standard capable of being utilized for a wide variety of data. The MPEG-2 standard provides explanations needed to implement an MPEG-2 decoder through the use of syntax and semantics of a coded bit stream. MPEG-2 is an open standard which continues to evolve and be applied to a variety of applications ranging from video conferencing to high definition television. As a generic standard, MPEG-2 is intended to be used for variety of audio and video coding applications. Part one of the MPEG-2 standard (ISO 13818-1), was designated to improve error resilience and carry multiple programs simultaneously without a common time base between programs. ('533 Patent col.1:66 to col.2:14) • The transport stream (TS) specified by the MPEG-2 standard, offers a high degree of robustness for

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>noisy channels, and can be used to carry multiple programs, such as multiple TV services. The transport stream is based on a 188 byte long packet suited for hardware error correction and processing schemes. The use of a robust protocol, such as the transport stream, allows for reception over noisy environments such as terrestrial and satellite transmissions. Even in these environments it is possible to obtain fast program access, channel hopping, and synchronization between multiple elementary streams carried within the packetized elementary streams which are subdivided into transport packets. ('533 Patent col.2:14-28)</p> <ul style="list-style-type: none"> • Prior art FIG. 1 illustrates a Transport Packet Stream defined by the MPEG-2 standard. The transport stream, based on a 188 byte long packet, is well suited for hardware error correction and processing schemes. Such a configuration can carry multiple programs within the same multiplex, even when the transmission environment is noisy. For example, MPEG-2 data can be transferred successfully over coaxial cable networks and satellite transponders with asynchronous multiplexing of constant or variable bit-rate programs to allow fast program access, channel hopping and synchronization between services. ('533 Patent col.2:28-39) • As illustrated further in FIG. 1, MPEG-2 transport stream consists of fixed length Transport Stream Packets (TSP or packets) based on 4 bytes of header followed by 184 bytes of TSP payload. TSP payload carries Packetized Elementary Stream (PES) data obtained by chopping up an Elementary Stream (ES), which consists of data of a common type and program. For example, audio for a specific program would form one elementary stream, while video for the same program would form a second elementary stream. The TS header consists of a synchronization byte (SyncByte), flags, information indicators for error detection and timing, an adaptation field indicator, and a Packet_ID (PID) field used to identify Elementary Streams carried in the payload. The adaptation field, when present, contains flags, and timing information. The PID Field is used not only to distinguish separate Elementary Streams, but also separate Program Specific Information (PSI) tables. Prior art FIG. 2 illustrates two types of PSI tables—a Program Association Table 210 (PAT), and a Program Map Table 220 (PMT). The PAT table lists unique program numbers as identifiers for each program, or elementary stream, in a multiplex, and the PID number associated with each program number. A fixed PID number of 0×0000 is assigned to the PAT table, making it possible for the system to download the PAT table on startup by retrieving PID 0×0000 packets. ('533 Patent col.2:39-65) • In order to provide multiple services over the same multiplex, data associated with different multimedia services are transmitted, with packet multiplexing, such that data packets from several Elementary Streams of audio, video, data, and others are interleaved on a packet by packet basis into a single MPEG-2 transport stream. Synchronization between Elementary Streams forming a common program is achieved using presentation time stamps and program clock references which can be transmitted as part of the adaptation field specified in the header. ('533 Patent col.3:8-18)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • Service provider broadcast would include broadcast to the home provided by cable television providers, telephone company providers, or other independent providers. In this configuration, the service provider first receives the number of signals which can be ultimately provided to the end user. Examples of such received signals include satellite feeds, terrestrial feeds, switched video sources, local video sources such as tapes, or laser disk DVD's, as well as traditional table feeds. Based upon the end users demands, the received information can be selectively provided to the end user. In one manner, the selected feed by the service provider can be provided directly to an end user through a twisted pair connection, which may include a high speed digital subscriber link (DSL) capable of providing data at higher rates than traditionally associated with plain old telephone system (POTS) connections. In another implementation, the service provider would provide information from a central office or a head-end to a fiber node. A specific fiber node is generally used to support more than one end user. Examples of the use of such fiber nodes includes a fiber coaxial bus (FCB) whereby a fiber link provides the signal containing a large amount of data to a fiber node which in turn drives coaxial cable having a taps. A decoding device attached to taps at user side can receive the appropriate broadcasting signal. Another example of a fiber node is bi-directional fiber coaxial bus. While similar to the FCB bus, the bi-directional FCB bus is also capable of transmitting data back to the central office or the head-end as well as receiving it. Yet another fiber node example is a hybrid fiber coax, which uses coaxial cable and branch topology toward network interface units. Yet another example associated with service providers is known as fiber to the curb, whereby digital signaling is carried from the central office to the optical network unit which serves only a few dozen homes. Locally, a hybrid twisted pair coaxial pairs will connect to the optical network unit with the consumer's decoder. Twist repair cable carries digital video in the 5 to 40 megahertz range to no more than 500 feet from the fiber connection. Therefore, the number of homes capable of being served by a single optical network unit is limited. Analog television signals are carried in a coaxial cable from the fiber node. ('533 Patent col.3:40 to col.4:15) • Prior art FIG. 4 illustrates a prior art system for parsing a transport stream. The transport parser of the prior art would receive individual packets from the framer. Based upon the PID value, the transport parser would store the TSP data to be used by the system or the graphics engine in a local buffer. When the transport parser's local buffer was filled, the transport parser would cause a bus request to the appropriate controller (system or video) to initialize a transfer of at least some of the buffered data. ('533 Patent col.4:32-38) <p>One of skill in the art would combine Hoogenboom with Barton '389, The MPEG-2 Standard, Hatanaka, Furuyama, Thompson, NetShow, RealPlayer 5.0, and/or the admitted prior art with a reasonable expectation of success because, for example, all of the references relate to storing and playing back multiplexed packetized video data such as MPEG-2 streams.</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
<p>a storage device having a data port coupled to the output of the first transport stream demultiplexer to receive the select packets, wherein the storage device is to store the select packets;</p>	<p>Hoogenboom discloses a storage device having a data port coupled to the output of the first transport stream demultiplexer to receive the select packets, wherein the storage device is to store the select packets based on at least the following exemplary citations:</p> <ul style="list-style-type: none"> • The video layer is buffered in an input buffer (FIFO) configured in the external DRAM 22 by memory manager 30. The video syntax parser 40 receives the compressed video data output from the DRAM FIFO via memory manager 30, and separates the motion vector information from the coefficients describing the video information. The coefficients are processed by a Huffman decoder 52, inverse quantizer 54, and inverse discrete cosine transform (IDCT) processor 56. (col.6:35-43) • Memory manager 30 schedules all activity on the external DRAM address and data buses 24, 26 and efficiently addresses DRAM 22. The memory manager insures that the data transfer requirements of the input FIFO portion of DRAM 22, the video syntax parser 40 and the video reconstruction circuit 36 (as well as prediction calculator 46 and differential decoder 48) are all met. The video reconstruction circuit 36 builds a current picture and inserts closed captions, a vertical interval test signal (VITS) and/or test pattern data for output on video output line 38. The decode process for a compressed frame of video data is synchronized by comparing the time specified by the decoder time clock to a decode time stamp (DTS), which indicates when the video frame is to be decoded. The display process for the decompressed frame is synchronized by comparing the time specified by the decoder time clock to a presentation time stamp (PTS), which indicates when the video frame is to be presented for display. (col.6:64-7:14) • One of the items contained in the PES header 72 (or inferred from a PTS in the PES header) is the decode time stamp (DTS) 104 which is required by the video syntax parser 40 in order to properly decode the picture data. Thus, in accordance with the present invention, the DTS is extracted from the PES header 72 and reinserted following the picture header 100 in the video information (picture data) 102 stored in the FIFO portion of DRAM 22. The insertion of the DTS in the video information stored in DRAM 22 enables the decompression processor to process the video information without having to retrieve the DTS from a source outside the DRAM. It should be noted that the PTS is also stored in DRAM 22 if it differs from the DTS. (col.9:38-51) • See FIGS. 1 and 3 <p>Even if AMD argues that Hoogenboom does not disclose this limitation expressly, U.S. Patent No. 6,233,389 to Barton et al. ("Barton '389") nonetheless expressly discloses this limitation:</p> <ul style="list-style-type: none"> • The invention parses the resulting MPEG stream and separates it into its video and audio components. It

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>then stores the components into temporary buffers. Events are recorded that indicate the type of component that has been found, where it is located, and when it occurred. The program logic is notified that an event has occurred and the data is extracted from the buffers. (col.2:15-21)</p> <ul style="list-style-type: none"> • The video and audio components are stored on a storage device. When the program is requested for display, the video and audio components are extracted from the storage device and reassembled into an MPEG stream. (col.2:26-29) • User control commands are accepted and sent through the system. These commands affect the flow of said MPEG stream and allow the user to view stored programs with at least the following functions: reverse, fast forward, play, pause, index, fast/slow reverse play, and fast/slow play. (col.2:33-38) • The invention additionally provides the user with the ability to store selected television broadcast programs while simultaneously watching or reviewing another program and to view stored programs with at least the following functions: reverse, fast forward, play, pause, index, fast/slow reverse play, and fast/slow play. (col.3:23-29) • The Input Section 101 produces MPEG streams. An MPEG2 transport multiplex supports multiple programs in the same broadcast channel, with multiple video and audio feeds and private data. The Input Section 101 tunes the channel to a particular program, extracts a specific MPEG program out of it, and feeds it to the rest of the system. Analog TV signals are encoded into a similar MPEG format using separate video and audio encoders, such that the remainder of the system is unaware of how the signal was obtained. (col.3:43-52) • The Media Switch 102 mediates between a microprocessor CPU 106, hard disk or storage device 105, and memory 104. Input streams are converted to an MPEG stream and sent to the Media Switch 102. The Media Switch 102 buffers the MPEG stream into memory. It then performs two operations if the user is watching real time TV: the stream is sent to the Output Section 103 and it is written simultaneously to the hard disk or storage device 105. (col.3:62 to col.4:2) • With respect to FIG. 2, the invention easily expands to accommodate multiple Input Sections (tuners) 201, 202, 203, 204, each can be tuned to different types of input. Multiple Output Modules (decoders) 206, 207, 208, 209 are added as well. Special effects such as picture in a picture can be implemented with multiple decoders. The Media Switch 205 records one program while the user is watching another. This means that a stream can be extracted off the disk while another stream is being stored onto the disk. (col.4:14-23)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> Referring to FIG. 3, the incoming MPEG stream 301 has interleaved video 302, 305, 306 and audio 303, 304, 307 segments. These elements must be separated and recombined to create separate video 308 and audio 309 streams or buffers. This is necessary because separate decoders are used to convert MPEG elements back into audio or video analog components. Such separate delivery requires that time sequence information be generated so that the decoders may be properly synchronized for accurate playback of the signal. (col.4:24-33) The Media Switch enables the program logic to associate proper time sequence information with each segment, possibly embedding it directly into the stream. The time sequence information for each segment is called a time stamp. These time stamps are monotonically increasing and start at zero each time the system boots up. This allows the invention to find any particular spot in any particular video segment. For example, if the system needs to read five seconds into an incoming contiguous video stream that is being cached, the system simply has to start reading forward into the stream and look for the appropriate time stamp. (col.4:34-44) A binary search can be performed on a stored file to index into a stream. Each stream is stored as a sequence of fixed-size segments enabling fast binary searches because of the uniform time stamping. If the user wants to start in the middle of the program, the system performs a binary search of the stored segments until it finds the appropriate spot, obtaining the desired results with a minimal amount of information. If the signal were instead stored as an MPEG stream, it would be necessary to linearly parse the stream from the beginning to find the desired location. (col.4:45-54) The input stream flows through a parser 401. The parser 401 parses the stream looking for MPEG distinguished events indicating the start of video, audio or private data segments. For example, when the parser 401 finds a video event, it directs the stream to the video DMA engine 402. The parser 401 buffers up data and DMAs it into the video buffer 410 through the video DMA engine 402. At the same time, the parser 401 directs an event to the event DMA engine 405 which generates an event into the event buffer 413. When the parser 401 sees an audio event, it redirects the byte stream to the audio DMA engine 403 and generates an event into the event buffer 413. Similarly, when the parser 401 sees a private data event, it directs the byte stream to the private data DMA engine 404 and directs an event to the event buffer 413. The Media Switch notifies the program logic via an interrupt mechanism when events are placed in the event buffer. (col.5:3-19) The program logic continues collecting logical segments 603 until it reaches the fixed buffer size. When this occurs, the program logic generates a new buffer, called a Packetized Elementary Stream (PES) 605 buffer containing these logical segments 603 in order, plus ancillary control information. Each logical segment points 604 directly to the circular buffer, e.g., the video buffer 613, filled by the Media Switch

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>601. This new buffer is then passed to other logic components, which may further process the stream in the buffer in some way, such as presenting it for decoding or writing it to the storage media. (col.5:51-61)</p> <ul style="list-style-type: none"> • The parser 705 parses the input data stream from the MPEG encoder 703, audio encoder 704 and VBI decoder 702, or from the transport demultiplexor in the case of a digital TV stream. The parser 705 detects the beginning of all of the important events in a video or audio stream, the start of all of the frames, the start of sequence headers—all of the pieces of information that the program logic needs to know about in order to both properly play back and perform special effects on the stream, e.g. fast forward, reverse, play, pause, fast/slow play, indexing, and fast/slow reverse play. (col.6:36-46) • A hard disk or storage device 710 is connected to one of the ports of the Media Switch 701. The Media Switch 701 outputs streams to an MPEG video decoder 715 and a separate audio decoder 717. (col.6:62-65) • The Media Switch 701 takes in 8-bit data and sends it to the disk, while at the same time extracts another stream of data off of the disk and sends it to the MPEG decoder 715. All of the DMA engines described above can be working at the same time. (col.7:5-9) • Referring to FIG. 11, a preferred embodiment that accomplishes multiple functions is shown. A source 1101 has a TV signal input. The source sends data to a PushSwitch 1102 which is a transform derived from TmkXfrm. The PushSwitch 1102 has multiple outputs that can be switched by the control object 1114. This means that one part of the pipeline can be stopped and another can be started at the users whim. The user can switch to different storage devices. The PushSwitch 1102 could output to a TmkClipWriter 1106, which goes onto a storage device 1107 or write to the cache transform 1103. (col.9:66 to col.10:9) • The derived class and resulting objects described here may be combined in an arbitrary way to create a number of different useful configurations for storing, retrieving, switching and viewing of TV streams. For example, if multiple input and output sections are available, one input is viewed while another is stored, and a picture-in-picture window generated by the second output is used to preview previously stored streams. Such configurations represent a unique and novel application of software transformations to achieve the functionality expected of expensive, sophisticated hardware solutions within a single cost-effective device. (col.11:27-38) • The input section of the invention is connected to the casino's video surveillance system. Recorded video is cached and simultaneously output to external VCRs. The user can switch to any video feed and

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>examine (i.e., rewind, play, slow play, fast forward, etc.) a specific segment of the recorded video while the external VCRs are being loaded with the real-time input video. (col.12:26-33)</p> <ul style="list-style-type: none"> • See FIGS. 1, 4-5, 7-11, 13 <p>Furthermore, The MPEG-2 Standard also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • 2.4.2.3 Buffering Complete Transport Stream packets containing data from elementary stream n, as indicated by its PID, are passed to the transport buffer for stream n, TBn. This includes duplicate Transport Stream packets and packets with no payload. Transfer of the i-th byte from the system target decoder input to TBn is instantaneous, so that the i-th byte enters the buffer for stream n, of size TBSn at time t(i). (p.12) • See FIG. 2-1 “Transport Stream system target decoder notation” (p. 9). (See, for example, transport buffer (TB), multiplexing buffer (MB), elementary stream buffer (ESB), and/or re-order buffer (O).) • As indicated in Figure D.1, the delay from the input to the encoder to the output or presentation from the decoder is constant in this model, while the delay through each of the encoder and decoder buffers is variable. Not only is the delay through each of these buffers variable within the path of one elementary stream, the individual buffer delays in the video and audio paths differ as well. Therefore the relative location of coded bits representing audio or video in the combined stream does not indicate synchronization information. The relative location of coded audio and video is constrained only by the System Target Decoder (STD) model such that the decoder buffers must behave properly; therefore coded audio and video that represent sound and pictures that are to be presented simultaneously may be separated in time within the coded bit stream by as much as one second, which is the maximum decoder buffer delay that is allowed in the STD model. (pp.93-94) • See FIG. D.1 (p.93) • J.2 Network specification for jitter smoothing <p>In the case of constant bit rate system streams, jitter smoothing can be accomplished with a FIFO. Additional data that provides specific support for dejittering is not required in the network adaptation layer. After the bytes added by the network encoding are removed, the system stream data is placed in a FIFO. A PLL keeps the buffer approximately half full by adjusting the output rate in response to changes in buffer fullness. In this example the amount of jitter-smoothing achieved will depend on the size of the FIFO and the characteristics of the PLL.</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>Figure 1.2 illustrates a second way to accomplish jitter smoothing. In this example timestamp support from a network adaptation layer is assumed. Using this technique, both constant bit rate and variable bit rate system streams can be dejittered.</p> <p>Assume the network adapter is designed to compensate for a peak-to-peak jitter of J seconds. The intended byte delivery schedule is reconstructed using Clock Reference (CRs) samples taken from a Time Clock (TC). The CRs and the TC are analogous to PCRs and the STC. The Network Data Packet (NOP) encode converts each system stream packet into a Network Data Packet (NOP). The network data packets contain a field for carrying CR values, and the current value of the TC is inserted into this field as the NOP leaves the NOP encoder. The Network Transport Packetization (NXP) function encapsulates the NOPs into network transport packets. After transmission across the network, the CRs are extracted by the NDP decoder as the NDPs enter the NDP decoder. The CRs are used to reconstruct the TC, for example by using a PLL. The first MPEG-2 packet is removed from the dejittering buffer when the delayed TC (Ted) is equal to the first MPEG-2 packet's CR. Subsequent MPEG-2 packets are removed when their CR values equal the value of the TCd. (pp.114-115)</p> <ul style="list-style-type: none"> • See FIG. J.2 “Jitter-smoothing using network-layer timestamps” (p.114) • See FIG. J.3 “Integrated dejittering and MPEG-2 decoding” (p.115) <p>Furthermore, U.S. Patent No. 6,397,000 to Hatanaka et al. (“Hatanaka”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • JP-A-8-98164 discloses a receiving system and a recording/playing back device for receiving/recording a transmitted multiplexed digital signal as a conventional technique for recording/playing back a digital signal. This prior art publication describes a receiving system which includes receiving means for receiving a transmitted multiplexed digital information signal and for selecting desired information, and recording means for recording the information received by the receiving means. (col.1:12-21) • a digital input means for inputting to the recording device a digital signal indicative of video, audio, data and so forth multiplexed in a predetermined packet form; an analog video signal input means for inputting an analog video signal to the recording device; an analog audio signal input means for inputting an analog audio signal to the recording device; a video A/D converter for converting the analog video signal inputted by the analog video signal input means to a digital signal; a video encoder for information-compressing the digital video signal to which the analog video signal is converted by the video A/D converter; an audio A/D converter for converting the analog audio signal inputted by the analog audio input means to a digital signal; an audio encoder for information-compressing the digital audio signal to which the analog audio signal is converted by the audio A/D converter; a multiplexing

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>means for multiplexing at least the video signal compressed by the video encoder and the audio signal compressed by the audio encoder into a multiplexed signal of a predetermined packet form; and a record selecting means for selecting one of the digital signal inputted by the digital input means and the multiplexed digital signal provided by the multiplexing means; and a recording means for recording the digital signal selected by the record selecting means. (col.1:37-67)</p> <ul style="list-style-type: none"> FIG. 1 is a block diagram of a receiving/recording/playing back device for a digital broadcasting signal in a first embodiment of the present invention. In FIG. 1, reference numeral 1 denotes a digital broadcasting receiving device (Integrated Receiver & Decoder: IRD), 2 a recording/playback device, 3 an encoder, 4 a digital broadcasting signal input terminal, 5 a tuner, 6 a QPSK demodulator, 7 a forward error correction (FEC) unit for correcting an error involved in the transmission of a signal, 8 a playback changeover switch, 9 a demultiplexer, 10 a MPEG decoder, 11 an NTSC encoder, 12 an interface between the devices 1 and 2, 13 a clock recovery unit, 14 a D/A converter, 15 a video output terminal, 16 an audio output terminal, 17 a recorded signal changeover switch, 18 a packet control circuit, 19 a recording/playback data processing, 20 a record amplifier, 21 a playback amplifier, 22 a magnetic tape, 23 a rotary head, 24 a clock generator, 25 a clock changeover switch, 26 a video input terminal, 27 an audio input terminal, 28 a video A/D converter, 29 an audio A/D converter, 30 a video encoder, 31 an audio encoder, 32 a multiplexer, and 47 a digital signal processor. (col.2:30-50) When the received signal is recorded in the recording/playback device 2, the output from the FEC 7 is inputted to the interface 12, which separates packets of video and audio information and added information relating to a program to be recorded as in the demultiplexer 9. When the received signal is recorded and played back by the recording/playback device 2, it is required to also record and play back program information required for automatic selection of a broadcasting station. Thus, in addition to the packets selected by the demultiplexer 9, the interface 12 also selects a packet of program information relating to the program to be recorded and converts a part of the packet of program information. The signal separated by the interface 12 is inputted to the packet control circuit 18 by selecting a contact c by the recording signal changeover switch 17. As shown in the main data of FIG. 3A, the packet control circuit 18 divides 188-byte packet data into 92-byte packet data A 99 and 96-byte packet data B 100, and adds 4-byte packet header 98 to the packet data A 99. The packet control circuit 18 also produces in the packet header 98 a time stamp, shown in a hatched area 102, which is data on a time when the packet is received. (col.3:42-63) As shown in FIGS. 5A-5E, the multiplexer 32 temporarily stores the video and audio streams 42 and 43, and outputs them as the video and audio packet streams 45 and 46 at the same transfer rate. (col.5:26-29) When the multiplexed stream 44 is recorded, the clock frequency used for producing the time stamp 102 in the packet control circuit 18 is required to have the same frequency as the clock used in the video and

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>audio encoders 30 and 31, as described with respect to the recording of the digital broadcasting. Thus, as shown in FIG. 1, the video encoder 30, audio encoder 31, and multiplexer 32 are operated at the fixed clock 46 generated by the clock generator 24, the clock changeover switch 25 is set at a contact f so that the fixed clock 46 is inputted to the packet control circuit 18. (col.6:3-13)</p> <ul style="list-style-type: none"> • Thus, the digital broadcasting signal and the digital signal to which the analog broadcasting signal is converted are easily recorded simultaneously in a multichannel. If the video and audio streams 42 and 43 alone are multiplexed in a mode in which no broadcasting stream 41 is outputted in the multiplexer 32 of the FIG. 6 device, an operational mode similar to that described in FIG. 1 is obtained. In this case, the clock changeover switch 25 is required to be set at the contact f in the recording operation. (col.6:53-61) • In the arrangement of FIG. 8, when the digital broadcasting signal is recorded, the buffers 143 and 144 are each set at high impedance such that the digital broadcasting signal is inputted from the buffer 140 via the input buffer 142 to the packet control circuit 18. When the analog broadcasting signal is recorded, the buffers 140 and 143 are set at high impedance so that the analog broadcasting signal is inputted from the buffer 144 via the input buffer 142 to the packet control circuit 18. In playback, the buffers 140 and 144 are set at high impedance so that the signal of interest is inputted from the buffer 143 via the input buffer 141 to the interface 12. This serves to reduce the number of signal lines between the interface 12 and the packet control circuit 18. (col.7:8-21) • While in the above description the recording/playback of a digital signal alone has been described, the present device may have the function of recording/reproducing an analog signal as in a VHS and a VTR available at present. (col.7:32-36) • When the analog broadcasting signal is analog-recorded using a VHS system available at present, the analog broadcasting signal is similarly received at the analog broadcasting signal input terminal 200, and then inputted to the analog tuner 201 to produce analog video and audio signals 150 and 151 of the desired program. The analog video signal 150 is processed by the analog video recording/playback circuit 203 so as to be a signal, for example, conforming to VHS standards, which signal is then recorded via the analog video record amplifier 204 by the video head 220 of the rotary head 23. Simultaneously, the analog signal. 151 is produced by the analog audio recording/playback circuit 202 so as to be a signal, for example, conforming to the VHS standards, and then recorded via the digital recording changeover switch 210 set at a contact h and the record amplifier 20 by the audio head 221 of the rotary head 23. A servo tracking signal is recorded as in the digital recording. The video and audio heads 220 and 221 are different in azimuth angle and azimuth-record the video and audio signals. (col.8:4-22) • While in the above the magnetic tape is used as a recording medium, a magnetic disk, optical disk,

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>semiconductor memory or other recording medium may be used. Although not shown in FIGS. 1 and 6, a deciphering circuit which decipheres a cipher signal may be provided between the QPSK demodulator 6 and the FEC 7. Selection of a packet and conversion of a packet on the program information by the interface 12 may be performed by the demultiplexer 9 or packet control circuit 18. (col.9:6-13)</p> <ul style="list-style-type: none"> • <i>See also</i> FIGS. 1-7, 9, 10 <p>Furthermore, U.S. Patent No. 6,591,058 to O'Connor et al. ("O'Connor") also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • This present invention relates to the recording and playing back of a video stream. A video stream includes any combination of audio and/or video data streams. (col.1:12-16) • In accordance with another embodiment, a method of storing and playing digital video information includes receiving a plurality of programs on a single channel. Each of said programs is stored in association with an identifier. A first program is played and then stopped. The identifier and the point when the play is stopped is stored. A second program is played. (col.1:56-63) • The digital video stream from the video input port 102 is optionally compressed at compression unit 104. In one embodiment, the video is already compressed and no further compression is needed. The video stream is then stored in the storage unit 108. A buffer unit 106 may be used as temporary storage for providing larger sequential blocks of video data to the storage unit 108. In one embodiment, the buffer unit 106 comprises a random access memory that allows relatively quick access to any portion of the stored video stream. (col.3:23-33) • The video stream is played back by reading the video stream from the storage unit 108. If the video stream was compressed in compression unit 104, then a decompression unit 110 decompresses the retrieved video stream. The video stream is provided from a video output port 120, to a monitor or other display device such as a TV to provide sound and/or video to a user. (col.3:33-40) • A removable storage unit 122 may also be included in video record and playback system 100, Examples of removable storage units include a writeable compact disk read only memory (CD-ROM), writeable digital video disk (DVD), a flash memory, or another hard disk. The availability of a removable storage unit 122 allows a user to transfer a recording of a video stream stored in storage unit 108 to the removable storage unit 122 and then to transfer the unit 122 to another system at a different location. (col.3:41-49) • The recording of the video stream begins at block 204. At block 206, playback of the recorded video

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>stream is performed by retrieving a portion of the video stream from the random access storage unit while the recording of the incoming video stream continues. The retrieved portion of the video stream may be time-shifted from the incoming video stream by a time delay. At block 208, the portion of the video stream retrieved from the random access storage unit is retrieved for display by a television or other display device. (col.3:62 to col.4:4)</p> <ul style="list-style-type: none"> FIG. 3 shows an embodiment of a method for retrieving a portion of the video stream from the random access storage unit while continuing to record the incoming video stream in accordance with the invention, although the invention is not restricted to this embodiment. In the disclosed embodiment, the substantially simultaneous recording and playback of the video stream is performed by multiplexing or alternately storing the video stream to the random access storage unit and reading of the video stream from the random access storage unit. The multiplexed or alternated stores and reads may occur quickly enough that the user does not notice an appreciable delay in the playback of the video stream, and the incoming video stream is not lost, e.g., all of the video stream is recorded. Thus, the record and playback are substantially simultaneous from the user's point of view. (col.4:9-24) In one embodiment, the random access storage unit comprises a hard disk. The retrieval of the time-shifted video signal from the hard disk is performed at a first physical location (or sector) of the hard disk, and the storing to the hard disk of the incoming video stream is performed at a different physical location (or sector) on the hard disk. Because it takes more time to jump back and forth between different sectors of the hard disk than to read and write to sequential locations in the same sector, data may be buffered to reduce the number of accesses to and from the hard disk using buffer 106. This increases the amount of data transferred per access. (col.4:24-36) In block 302, the video stream is stored in a random access storage unit. The video stream is optionally compressed and/or buffered prior to storage. In block 304, the video stream is retrieved from the random access storage unit. Buffering and/or decompression may be performed before providing the retrieved video stream to the video output port 120. (col.4:40-46) The next portion of the video stream is stored (block 306) as described in block 302. At block 308, the next portion of the video stream is retrieved as described in block 304. This process is repeated until either the recording or playback cycle is terminated. (col.4:47-51) FIG. 4 shows one embodiment of an apparatus for storing the video stream in the storage unit 108 in accordance with the invention. Again, the invention is not restricted in scope to the illustrated embodiments. In this embodiment, the video stream is stored as separate files 001 and 009 on a hard disk, for example. The processor 130 keeps track of the file and offset into the file of the data being

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>played back, as well as the file and offset into the file of the data being recorded. If the random access storage unit is fast enough, more than one video stream may be recorded and played back at the same time. (col.4:48-62)</p> <ul style="list-style-type: none"> • Due to the nature of the random access storage unit being capable of easily recording over itself, the random access storage unit may act as a temporary buffer for recording the latest portion, or X number of minutes, of an incoming video stream, where X is set up based upon the size of the storage unit in this particular embodiment. In one embodiment, X could be set up to be the entire storage unit. As newer portions of the video stream are received, they overwrite the older portions of the video stream saved in the random access storage unit. In this manner, the temporary buffering of the video stream acts as a circular buffer. In one embodiment, the processor 130 maintains pointers to the beginning and ending points of the temporary buffer. The processor 130 reassigns the pointers as newer portions of the video stream are received and/or older portions of the video stream are overwritten. (col.4:63 to col.5:11) • FIG. 5 shows a flow chart 500 of an embodiment of one method for using a temporary buffer in accordance with the invention. At block 502, the video stream is received at an input. Recording of the video stream to the storage unit begins at block 504. At block 506, older portions of the video stream are deleted as newer portions of the video stream are stored to the storage unit. (col.5:12-18) • A user may initiate a playback cycle following block 506. For example, this may occur when the user wishes to re-view a video clip that he just saw. In one embodiment, the user stops recording to the temporary buffer and plays back the last portion of the temporary buffer. However, it may be more desirable to the user to be able to continue recording as shown at block 508. A record and playback cycle (as described with respect to FIG. 2) is started, in which the incoming video stream is recorded while the user re-views the last portion of the temporary buffer. In this manner, after re-viewing the desired video clip, the user can resume sequentially watching the video stream from the current point of the incoming video for substantially simultaneous playback and record. (col.4:19-33) • At block 510, after the record and playback cycle is completed, all or part of the temporary buffer may be saved. Since the temporary buffer stores the latest X minutes of the video stream prior to the record and playback cycle, all or part of the temporary buffer may be allocated to the portion of the video stream saved during the record and playback cycle. Other portions of the video stream may then be deleted from the storage unit, or they may be marked as overwriteable and used as a new temporary buffer. (col.5:33-42) • At block 704 the incoming video stream is recorded but is not displayed to the monitor. Instead the playback is paused at the point at which the user indicated that the incoming video stream be suspended.

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>When the user is ready to view the video stream again, he can signal the video record and playback system 100 to un-suspend the video stream so that it plays back from the point at which the video stream was suspended, as shown in block 706. (col.6:11-19)</p> <ul style="list-style-type: none"> • The user may then view the video stream time shifted by the amount of time that he suspended the incoming video stream, or he may fast forward (or rewind) through the time-shifted video stream. When playback of the time-shifted video stream catches up to the point at which the incoming video stream is being recorded, the record and playback system 100 may display the incoming video stream directly from incoming video stream without retrieving the video stream from the storage unit, as described with respect to FIG. 6. The recording of the video stream may then be terminated by the user, if desired. (col.6:19-30) • Employing a random access storage unit for storage of the video stream facilitates jumping to various points within the video stream. One way of jumping is by retrieving different time slices of the video stream. For example, an image frame from the video stream can be retrieved from the storage unit at 1 minute intervals from a current position of the video stream. In one embodiment, an image frame at the current playback position+1 minute, current playback position+2 minutes, and so forth are retrieved and displayed on the TV screen in a mosaic pattern. (col.6:30 -40) • Referring now to the embodiment shown in FIG. 9, a flow chart 900 for digitally recording a video stream in accordance with an embodiment of the invention begins by capturing the video stream as indicated in block 902. If the stream is an analog stream, it may be digitized in an analog-to-digital conversion process as indicated at block 904. Next the digital stream may be encoded and compressed, for example using the MPEG2 compression scheme, as indicated in block 906. The stream is alternately read, as indicated at block 910, and stored, as indicated in block 908, in a conventional storage device such as a hard disk drive, a digital video disk or a flash memory. Data that is read from the storage device may be decoded and decompressed using conventional technology, for example, as indicated in block 912, for display as indicated in block 914. (col.7:5-19) • The bus 1012 couples to TV tuner/capture card 1014 which is coupled to an antenna 1015 or other video input port, such as a cable input port, a satellite receiver/antenna or the like. The TV tuner and capture card 1014 selects a desired television channel and also performs the video capture function (block 902, FIG. 9). One example of video capture card is the ISVR-III video capture card available from Intel Corporation. (col.7:32-39) • If a particular television program is selected (even if the program is only selected for viewing) on the EPG, an identifier for that particular program may be stored, in one embodiment, as indicated at block

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>1202, and automatic recording of the program begins (block 1204). In this way the stored version of the program is available to implement the various features described herein even if the storage function was not particularly requested. Because the information is stored in an overwriting fashion, no harm is done by recording the information even if the information turns out not to be useful. (col.8:14-24)</p> <ul style="list-style-type: none"> • Referring to FIG. 17, an electronic program guide user interface 1700 may be deployed on the television 1010. When the user mouse clicks a box image 1702, representing a given television program, using the cursor 1116, that program is automatically recorded. (col.8:25-29) • Next, a query is made at diamond 1212 to determine whether a pause function has been selected. If so, the playback is stopped as indicated at block 1214 but recording continues unabated as shown in block 1216. (col.8:53-56) • Techniques for storing the video stream onto the storage device 1410 and for reading the information out of the storage device are summarized in Table 1 below and illustrated in FIGS. 14, 15, and 16. In FIG. 14, a schematic depiction of the storage system 1400 includes a digital storage device such as a hard disk drive 1410. The digitized video 1402 is initially stored in a buffer which is designated as being currently on the top of the memory stack. The transfer of information between the buffers and the storage device 1410 may be done in discrete time periods referred to herein as time steps. (col.10:3-14) • The received video information, stored on the receiver 1804, may have the file 1900 format shown in FIG. 19. Namely, the video information 1904 may be stored in a file 1900 together with time tag information 1906 and a channel identifier 1902. Thus, the video information is identifiable both by the channel identifier of the channel on which it was received and the local time when it was received, in one embodiment of the present invention. (col.12:34-41) • The video information received by the receiver 1804 may be in analog or digital formats in accordance with modem video transmission protocols. For example, digital format television broadcasts are available under a variety of different digital standard including the Advanced Television Systems Committee (ATSC) Digital Television Standard, issued on Sep. 15, 1995, as one example. Thus, it is advantageous to detect whether incoming video is in one of the digital formats. For example, if the information is already in digital format, compression is not necessary before storage. However, if the information is in an analog format, it may be desirable to convert the information to a digital format and then to compress the information. (col.14:19-31) • Thus, in one embodiment of the present invention, it is possible to jump between viewing any of the programs in a given channel since all four programs may be stored automatically. Referring to FIG. 27,

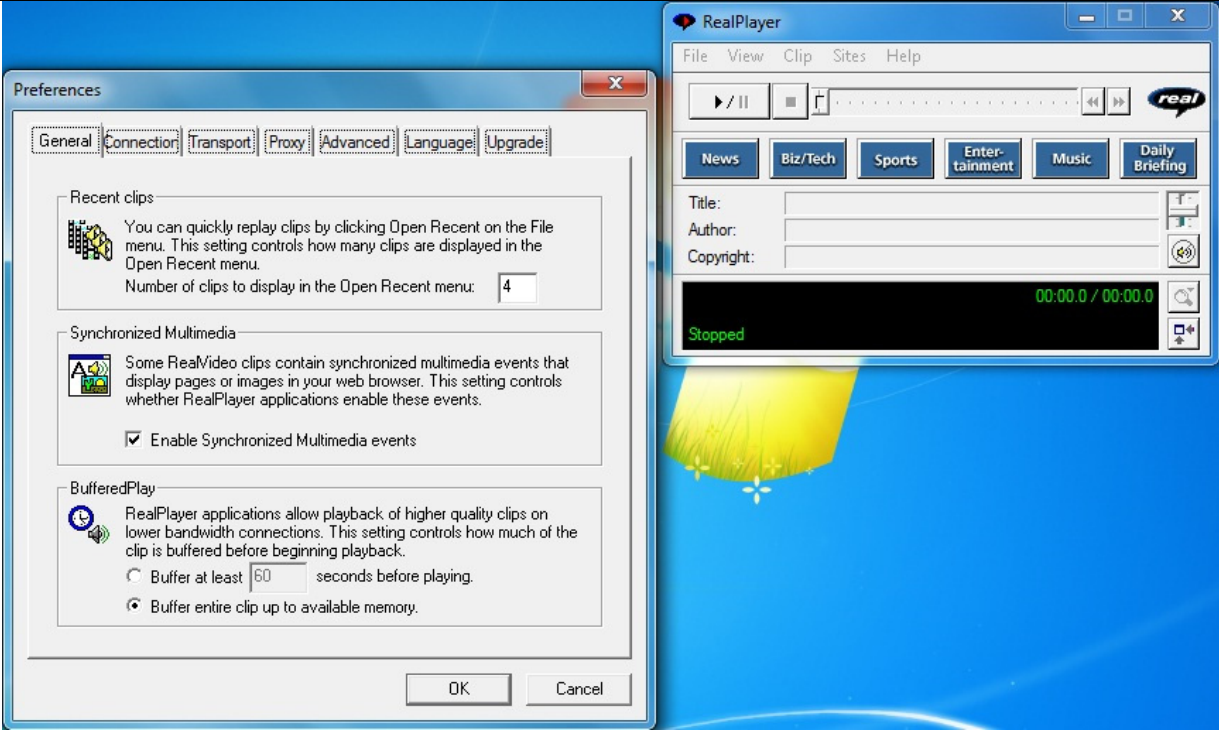
Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>the software 2700 initially determines whether a given transmission is a digital transmission (diamond 2702). If not, it can be assumed that there is only one program per channel. Otherwise, a determination is made a diamond 2704 whether there are actually multiple programs in a given channel. If so, a check at diamond 2706 determines whether the user has indicated a desire to implement a program switch from one program to another. A program switch may be entered using a graphical user interface as one example. When a program switch command is received, the switch time may be stored as indicated in block 2708. Next, the program is switched within the same channel by feeding the appropriate stored information such as the program identifier 2606 of the desired program 2604. (col.14:55 to col.15:4)</p> <ul style="list-style-type: none"> • <i>See also</i> FIGS. 1, 3-7, 9, 10-12A, 14-16, 25 <p>Furthermore, U.S. Patent No. 6,226,447 to Sasaki et al. (“Sasaki”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • In still another embodiment, the display means simultaneously displays a received video signal and an output of the decoding means which was previously recorded, reproduced and decoded. (col.2:39-44) • The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal, thereby reading out predetermined video and audio signals at a predetermined time. (col.2:52-67) • The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; display means for displaying the restored video signal; and sound recognition means for recognizing an audio signal. In the video signal recording and reproducing apparatus, predetermined video and audio signals are read out at a point of time when the sound recognition means recognizes a predetermined sound. (col.3:1-18) • The video signal recording and reproducing apparatus includes: image compression means for digitizing

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal. In the video signal recording and reproducing apparatus, a video signal at an arbitrary point of time is retrieved for an arbitrary time period by an operation of a viewer from video signals which are being received or video signals which were previously recorded, and information for prohibiting overwriting data of the retrieved video signal is added to the retrieved video signal so as to be stored into the hard disk apparatus. (col.3:21-39)</p> <ul style="list-style-type: none"> • In one embodiment, when a video signal retrieved by an operation of a viewer is saved, search information required for the viewer to search for a desired video signal later is added to the video signal to be saved, and after the video signal which was previously retrieved and saved has been searched for and read out based on the search information, the read compressed video signal is decoded to be displayed on the display means. (col.3:39-47) • In the video signal recording and reproducing apparatus, while compressing a video signal which is being received and writing the compressed video signal onto the hard disk apparatus, a video signal which was previously recorded is read out and decoded into an original video signal, and after an amount of data of the decoded video signal has been reduced, the video signal is subjected to an image compression again and written onto the hard disk apparatus. (col.4:2-9) • In the video signal recording and reproducing apparatus, while compressing video signals from the plurality of channels which are being received and writing the compressed video signals onto the hard disk apparatus, a video signal which was previously recorded from a particular channel is read out. (col.4:25-30) • FIG. 1 is a block diagram illustrating a configuration for a video signal recording and reproducing apparatus in a first example of the present invention. In FIG. 1, the reference numeral 1 denotes an antenna; 2 denotes a tuner; 3 denotes a demodulator; 4 denotes an MPEG1 encoder; 5 and 6 denote recording buffer memories; 7 denotes a first switch; 8 denotes a hard disk apparatus; 9 and 10 denote reproducing buffer memories; 11 denotes a second switch; 12 denotes an MPEG1 decoder; 13 denotes a TV monitor; 14 denotes a hard disk controller; 15 denotes a table RAM; 16 denotes a system controller; 17 denotes a timer; and 18 denotes an operator panel. (col.6:2-13) • The hard disk controller 14 controls the hard disk apparatus 8 in accordance with the information

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>supplied from the table RAM 15, so that the compressed video signals recorded on the hard disk apparatus 8 are reproduced via the reproducing buffer memories 9 and 10 and the second switch 11. This operation will be described in detail later with reference to FIG. 3. The reproduced compressed video signals are decoded by the MPEG1 decoder 12 so as to be video signals which are displayed on the TV monitor 13. (col.7:3-12)</p> <ul style="list-style-type: none"> • A time difference between the time when the video which is now being reproduced was recorded (hereinafter, such a time will be referred to as a “video recording time”) and the current time, can be calculated by subtracting the video recording time, obtained by using the time information supplied from the table RAM 15, from the current time. If the time difference is displayed on the TV monitor 13, the time difference can be monitored. Before this time difference becomes zero, any arbitrary part of the video which has already been recorded can be reproduced. In addition, it is also possible to simultaneously display on the TV monitor 13 both the time corresponding to the output of the demodulator 3 and the time corresponding to the output of the MPEG1 decoder 12 by dividing the screen into two parts. Then, a video which is now being broadcast (and corresponds to the output of the demodulator 3) and a video which is now being reproduced (and corresponds to the output of the MPEG1 decoder 12) can be simultaneously watched on the same screen. (col.7:63 to col.8:14) • In addition, by additionally providing a second tuner and a second demodulator (though not shown in FIG. 1), a channel to be watched and a channel to be recorded can be independently designated. For example, a case where a second program to be watched by a viewer starts on another channel while the viewer is watching a first program to be recorded will be assumed. In such a case, if the viewer starts to record the second program on the second channel, the viewer can watch the second program from the beginning thereof from the point of time when the first program which the viewer is watching ends. (col.11:44-54) • <i>See also</i> FIGS. 1, 5, 6 <p>Furthermore, U.S. Patent No. 6,490,000 to Schaefer et al. (“Schaefer”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • Buffer 22 is a storage device that may be organized as a queue having a head 21 and a tail 23. The queue stores the signals in a first-in/first-out scheme, such that demodulated audio and video signals are passed from the tuner 14 to the tail 23, progress through the queue, and are routed from the head 21 to the digital decoder 29. In the preferred embodiment, buffer 22 is implemented as one or more high speed hard disks, but any storage device that may be organized as a queue, which has a high storage capacity for audio and video signals, and which operates at acceptable speeds (e.g., solid state, magnetic, circuitry, optical) may be used. (col.3:36-48)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • In addition to routing packets of data, packet demultiplexer 26 also unscrambles encrypted data, provides buffering of the MPEG data, and maintains program clock reference handling to keep the local clock synchronized with the clock at the uplink center. (col.3:19-24) • A method and apparatus for delaying the display of a portion of audio and video broadcast signals received from a remote location. Received broadcast video and audio signals are placed in a first-in/first-out storage queue to enable the control of the playback of the signals. Signals may be placed in the tail of the queue while previously received signals are simultaneously routed from the head of the queue to a television monitor. Passing the signals through the queue creates the delay. The system may be controlled either by input to the receiver from the broadcast facility or by remote or manual control by the user. The control functions that are available to the user are pause, play, fast forward and replay. The control from the broadcast facility is through the ability to "mark" segments of the video and audio program to be immune to the fast forward function, thus guaranteeing that those segments are viewed by the user. (Abstract) • See FIG. 1 <p>Furthermore, NetShow also discloses this limitation expressly:</p> <p>For example, NetShow discloses that audio and video data associated with the selected program may be buffered and stored in memory.</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<div data-bbox="1024 261 1562 824" data-label="Image"> <p>The screenshot shows the 'Microsoft NetShow Player Properties' dialog box with the 'Advanced' tab selected. Under the 'Buffering' section, the 'Buffer 3 seconds of data' radio button is selected. Under the 'Protocols' section, 'Multicast', 'TCP', and 'HTTP' are checked. Under 'HTTP', the 'Use browser proxy settings' radio button is selected. The 'Use proxy' option is also visible with an empty text field and a port of 0.</p> </div> <p>Furthermore, RealPlayer 5.0 also discloses this limitation expressly:</p> <p>For example, RealPlayer 5.0 discloses that audio and video data associated with the selected program may be buffered and stored in memory.</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	 <p>One of skill in the art would combine Hoogenboom with Barton '389, The MPEG-2 Standard, Hatanaka, O'Connor, Sasaki, Schaefer, NetShow, and/or RealPlayer 5.0 with a reasonable expectation of success because, for example, all of the references relate to storing and playing back multiplexed packetized video data such as MPEG-2 streams.</p>
<p>a first clock recovery module having an input coupled to the first input node, and an output, wherein the first clock recovery module is to generate a clock at the output based upon received timing information transmitted in packets of the multiplexed packetized data stream before the select packets are stored in the storage device; and</p>	<p>Hoogenboom discloses a first clock recovery module having an input coupled to the first input node, and an output, wherein the first clock recovery module is to generate a clock at the output based upon received timing information transmitted in packets of the multiplexed packetized data stream before the select packets are stored in the storage device based on at least the following exemplary citations:</p> <ul style="list-style-type: none"> Timing information extracted from a PES header is stored together with picture information in a video memory to facilitate the decoding of the picture information. Various techniques are provided for masking and recovering from transmission errors. (col.12:8-12)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • Time stamp information obtained from the PES header is appended to the picture information for storage in a video memory. (Abstract) • The timing information carried by the transport stream also includes time stamps for the commencement of decoding and presentation of data for display. The presentation time stamp (PTS) is used for service component acquisition and also for evaluating whether timing and buffer control are operating properly at the decoder. The decoder time stamp (DTS) is used to indicate when the decoder should start to decode the first access unit (e.g., video frame) that starts somewhere in the payload of a packetized elementary stream (PES) packet whose header includes the DTS. A packetized elementary stream is a data stream composed of end-to-end PES packets which have variable length and are typically far longer than a fixed length transport packet. Thus, a PES packet is typically composed of data from a plurality of transport packets with a single PID. (col.3:7-21) • The DTS is required by a video decompression processor in order to properly time the commencement of video decoding. Since the DTS is packaged in a PES header, it has been difficult and complicated for a video decompression processor at the receiver to obtain the DTS at the same time it is receiving the associated video data to be parsed. Prior to parsing, the video data is retrieved from a video memory that temporarily stores the data after having been retrieved from the transport stream. The video data will not be ready for decoding by the video decompression processor until sometime after the PES header containing the necessary DTS has been discarded. (col.3:22-34) • In accordance with the present invention, a method is provided for acquiring video data for a desired service from a packetized data stream. The data stream includes transport packets carrying different components of the service, such as a video component, audio component and control component. The component carried by a particular transport packet is identified by a packet identifier (PID) for that component. One of the components includes a program clock reference (PCR) that provides timing information for the desired service. The method comprises the step of detecting the PCR for the desired service from the component carrying the PCR in the data stream. The recovered PCRs are used to acquire and track a decoder time clock that corresponds to the encoder timing. The PIDs of the transport packets are then monitored to recover those packets carrying a video component of the desired service. Header information from the recovered transport packets is processed to recover packetized elementary stream (PES) packets having a PES header and picture information. Time stamp information is obtained from the PES header of at least one of the PES packets. The time stamp information is buffered and then is appended to the related picture information for storage in a memory. In this manner, the picture information can be read from the memory and decoded using the time stamp information appended thereto without having to reaccess the PES header for the time stamp information. (col. 3:64-4:22)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • The video decompression processor 20 receives a clock signal via terminal 12. The clock provides timing information that is used, e.g., to enable a transport syntax parser 32 to recover timing information and video information from transport packets contained in a packetized data stream input via terminal 10. An acquisition and error management circuit 34 utilizes a program clock reference (PCR) and decode time stamp (DTS) detected by a video syntax parser 40 to synchronize the start of picture decoding. This circuit sets vertical synchronization and provides global synchronization for all video decode and display functions. (col.6:23-34) • One of the items contained in the PES header 72 (or inferred from a PTS in the PES header) is the decode time stamp (DTS) 104 which is required by the video syntax parser 40 in order to properly decode the picture data. Thus, in accordance with the present invention, the DTS is extracted from the PES header 72 and reinserted following the picture header 100 in the video information (picture data) 102 stored in the FIFO portion of DRAM 22. The insertion of the DTS in the video information stored in DRAM 22 enables the decompression processor to process the video information without having to retrieve the DTS from a source outside the DRAM. It should be noted that the PTS is also stored in DRAM 22 if it differs from the DTS. (col.9:38-51) • See FIGS. 1 and 3 <p>Even if AMD argues that Hoogenboom does not disclose this limitation expressly, U.S. Patent No. 6,233,389 to Barton et al. ("Barton '389") nonetheless expressly discloses this limitation:</p> <ul style="list-style-type: none"> • The invention parses the resulting MPEG stream and separates it into its video and audio components. It then stores the components into temporary buffers. Events are recorded that indicate the type of component that has been found, where it is located, and when it occurred. The program logic is notified that an event has occurred and the data is extracted from the buffers. (col.2:15-21) • Referring to FIG. 3, the incoming MPEG stream 301 has interleaved video 302, 305, 306 and audio 303, 304, 307 segments. These elements must be separated and recombined to create separate video 308 and audio 309 streams or buffers. This is necessary because separate decoders are used to convert MPEG elements back into audio or video analog components. Such separate delivery requires that time sequence information be generated so that the decoders may be properly synchronized for accurate playback of the signal. (col.4:24-33) • The Media Switch enables the program logic to associate proper time sequence information with each segment, possibly embedding it directly into the stream. The time sequence information for each segment is called a time stamp. These time stamps are monotonically increasing and start at zero each

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>time the system boots up. This allows the invention to find any particular spot in any particular video segment. For example, if the system needs to read five seconds into an incoming contiguous video stream that is being cached, the system simply has to start reading forward into the stream and look for the appropriate time stamp. (col.4:34-44)</p> <ul style="list-style-type: none"> • A binary search can be performed on a stored file to index into a stream. Each stream is stored as a sequence of fixed-size segments enabling fast binary searches because of the uniform time stamping. If the user wants to start in the middle of the program, the system performs a binary search of the stored segments until it finds the appropriate spot, obtaining the desired results with a minimal amount of information. If the signal were instead stored as an MPEG stream, it would be necessary to linearly parse the stream from the beginning to find the desired location. (col.4:45-54) • The input stream flows through a parser 401. The parser 401 parses the stream looking for MPEG distinguished events indicating the start of video, audio or private data segments. For example, when the parser 401 finds a video event, it directs the stream to the video DMA engine 402. The parser 401 buffers up data and DMAs it into the video buffer 410 through the video DMA engine 402. At the same time, the parser 401 directs an event to the event DMA engine 405 which generates an event into the event buffer 413. When the parser 401 sees an audio event, it redirects the byte stream to the audio DMA engine 403 and generates an event into the event buffer 413. Similarly, when the parser 401 sees a private data event, it directs the byte stream to the private data DMA engine 404 and directs an event to the event buffer 413. The Media Switch notifies the program logic via an interrupt mechanism when events are placed in the event buffer. (col.5:3-19) • Referring to FIGS. 4 and 5, the event buffer 413 is filled by the parser 401 with events. Each event 501 in the event buffer has an offset 502, event type 503, and time stamp field 504. The parser 401 provides the type and offset of each event as it is placed into the buffer. (col.5:20-25) • If the stream was produced by encoding an analog signal, it will not contain Program Time Stamp (PTS) values, which are used by the decoders to properly present the resulting output. Thus, the program logic uses the generated time stamp 504 to calculate a simulated PTS for each segment and places that into the logical segment time stamp 607. In the case of a digital TV stream, PTS values are already encoded in the stream. The program logic extracts this information and places it in the logical segment time stamp 607. • The program logic continues collecting logical segments 603 until it reaches the fixed buffer size. When this occurs, the program logic generates a new buffer, called a Packetized Elementary Stream (PES) 605 buffer containing these logical segments 603 in order, plus ancillary control information. Each logical

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>segment points 604 directly to the circular buffer, e.g., the video buffer 613, filled by the Media Switch 601. This new buffer is then passed to other logic components, which may further process the stream in the buffer in some way, such as presenting it for decoding or writing it to the storage media. (col.5:51-61)</p> <ul style="list-style-type: none"> • The parser 705 parses the input data stream from the MPEG encoder 703, audio encoder 704 and VBI decoder 702, or from the transport demultiplexor in the case of a digital TV stream. The parser 705 detects the beginning of all of the important events in a video or audio stream, the start of all of the frames, the start of sequence headers—all of the pieces of information that the program logic needs to know about in order to both properly play back and perform special effects on the stream, e.g. fast forward, reverse, play, pause, fast/slow play, indexing, and fast/slow reverse play. (col.6:36-46) • A hard disk or storage device 710 is connected to one of the ports of the Media Switch 701. The Media Switch 701 outputs streams to an MPEG video decoder 715 and a separate audio decoder 717. (col.6:62-65) • A system clock reference resides in the decoder. The system clock reference is sped up for fast play or slowed down for slow play. The sink simply asks for full buffers faster or slower, depending on the clock speed. (col.9:47-51) • Thus, the CC information is preserved in time synchronization with the audio and video, and can be correctly presented to the viewer when the stream is displayed. This also allows the stored stream to be processed for CC information at the leisure of the program logic, which spreads out load, reducing cost and improving efficiency. (col.10:45-51) • The derived class and resulting objects described here may be combined in an arbitrary way to create a number of different useful configurations for storing, retrieving, switching and viewing of TV streams. For example, if multiple input and output sections are available, one input is viewed while another is stored, and a picture-in-picture window generated by the second output is used to preview previously stored streams. Such configurations represent a unique and novel application of software transformations to achieve the functionality expected of expensive, sophisticated hardware solutions within a single cost-effective device. (col.11:27-38) • <i>See</i> FIGS. 4,-7, 9, 11 <p>Furthermore, The MPEG-2 Standard also discloses this limitation expressly:</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • Transport Streams are composed of Transport Stream packets with headers containing information which specifies the times at which each byte is intended to enter a Transport Stream Decoder from the channel. This schedule provides exactly the same function as that which is specified in the Program Stream. (p. xiii) • System Time Clock recovery in the decoder <p>Within the ITU-T Rec. H.222.0 I ISO/IEC 13818-1 Systems data stream there are, in addition to the PTS and DTS fields, clock reference timestamps. These references are samples of the system time clock, which are applicable both to a decoder and to an encoder. They have a resolution of one part in 27 000 000 per second, and occur at intervals up to 100 ms in Transport Streams, or up to 700 ms in Program Streams. As such, they can be utilized to implement clock reconstruction control loops in decoders with sufficient accuracy for all identified applications.</p> <p>In the Program Stream, the clock reference field is called the System Clock Reference or SCR. In the Transport Stream, the clock reference field is called the Program Clock Reference or PCR. In general the SCR and PCR definitions may be considered to be equivalent, although there are distinctions. The remainder of this subclause uses the term SCR for clarity; the same statements apply to the PCR except where otherwise noted. The PCR in Transport Streams provides the clock reference for one program, where a program is a set of elementary streams that have a common time base and are intended for synchronized decoding and presentation. There may be multiple programs in one Transport Stream, and each may have an independent time base and a separate set of PCRs.</p> <p>The SCR field indicates the correct value of the STC when the SCR is received at the decoder. Since the SCR occupies more than one byte of data, and System data streams are defined as streams of bytes, the SCR is defined to arrive at the decoder when the last byte of the system_clock_reference_base field is received at the decoder. Alternatively the SCR can be interpreted as the time that the SCR field should arrive at the decoder, assuming that the STC is already known to be correct. Which interpretation is used depends on the structure of the application system. In applications where the data source can be controlled by the decoder, such as a locally attached DSM, it is possible for the decoder to have an autonomous STC frequency, and so the STC need not be recovered. In many important applications, however, this assumption cannot be made correctly. For example, consider the case where a data stream is delivered simultaneously to multiple decoders. If each decoder has its own autonomous STC with its own independent clock frequency, the SCRs cannot be assured to arrive at the correct time at all decoders; one decoder will in general require the SCRs sooner than the source is delivering them, while another requires them later. This difference cannot be made up with a finite size data buffer over an unbounded length of time of data reception. Therefore the following addresses primarily the case where the STC must slave its timing to the received SCRs (or PCRs).</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>In a correctly constructed and delivered ITU-T Rec. H.222.0 I ISO/IEC 13818-1 data stream, each SCR arrives at the decoder at precisely the time indicated by the value of that SCR. In this context, "time" means correct value of the STC. In concept, this STC value is the same value that the encoder's STC had when the SCR was stored or transmitted. However, the encoding may have been performed not in real time or the data stream may have been modified since it was originally encoded, and in general the encoder or data source may be implemented in a variety of ways such that the encoder's STC may be a theoretical quantity.</p> <p>If the decoder's clock frequency matches exactly that of the encoder, then the decoding and presentation of video and audio will automatically have the same rate as those at the encoder, and the end-to-end delay will be constant. With matched encoder and decoder clock frequencies, any correct SCR value can be used to set the instantaneous value of the decoder's STC, and from that time on the decoder's STC will match that of the encoder without the need for further adjustment. This condition remains true until there is a discontinuity of timing, such as the end of a Program Stream or the presence of a discontinuity indicator in a Transport Stream.</p> <p>In practice a decoder's free-running system clock frequency will not match the encoder's system clock frequency which is sampled and indicated in the SCR values. The decoder's STC can be made to slave its timing to the encoder using the received SCRs. The prototypical method of slaving the decoder's clock to the received data stream is via a phase-locked loop (PLL). Variations of a basic PLL, or other methods, may be appropriate, depending on the specific application requirements.</p> <p>A straight-forward PLL which recovers the STC in a decoder is diagrammed and described here.</p> <p>Figure D.2 shows a classic PLL, except that the reference and feedback terms are numbers (STC and SCR or PCR values) instead of signal events such as edges.</p> <p>Upon initial acquisition of a new time base, i.e. a new program, the STC is set to the current value encoded in the SCRs. Typically the first SCR is loaded directly into the STC counter, and the PLL is subsequently operated as a closed loop. Variations on this method may be appropriate, i.e. if the values of the SCRs are suspect due to jitter or errors.</p> <p>The closed-loop action of the PLL is as follows. At the moment that each SCR (or PCR) arrives at the decoder, that value is compared with the current value of the STC. The difference is a number, which has one part in units of 90 kHz and one part in terms of 300 times this frequency, i.e. 27 MHz. The difference value is linearized to be in a single number space, typically units of 27 MHz, and is called "e", the error term in the loop. The sequence of e terms is input to the low-pass filter and gain stage, which</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>are designed according to the requirements of the application. The output of this stage is a control signal “f” which controls the instantaneous frequency of the Voltage Controlled Oscillator (VCO). The output of the VCO is an oscillator signal with a nominal frequency of 27 MHz; this signal is used as the system clock frequency within the decoder. The 27 MHz clock is input to a counter which produces the current STC values, which consist of both a 27 MHz extension, produced by dividing by 300, and a 90 kHz base value which is derived by counting the 90 kHz results in a 33-bit counter. The 33 bit, 90 kHz portion of the STC output is used as needed for comparison with PTS and DTS values. The complete STC is also the feedback input to the subtractor.</p> <p>The bounded maximum interval between successive SCRs (700 ms) or PCRs (100 ms) allows the design and construction of PLLs which are known to be stable. The bandwidth of the PLLs has an upper bound imposed by this interval. As shown below, in many applications the PLL required has a very low bandwidth, and so this bound typically does not impose a significant limitation on the decoder design and performance.</p> <p>If the free-running or initial frequency of the VCO is close enough to the correct, encoder's system clock frequency, the decoder may be able to operate satisfactorily as soon as the STC is initialized correctly, before the PLL has reached a defined locked state. For a given decoder STC frequency which differs by a bounded amount from the frequency encoded in the SCRs and which is within the absolute frequency bounds required by the decoder application, the effect of the mis-match between the encoder's and the decoder's STC frequencies if there were not PLL is the gradual and unavoidable increase or decrease of the fullness of the decoder's buffers, such that overflow or underflow would occur eventually with any finite size of decoder buffers. Therefore the amount of time allowable before the decoder's STC frequency is locked to that of the encoder is determined by the allowable amount of additional decoder buffer size and delay.</p> <p>If the SCRs are received by the decoder with values and timing that reflect instantaneously correct samples of a constant frequency STC in the encoder, then the error term e converges to an essentially constant value after the loop has reached the locked state. This condition of correct SCR values is synonymous with either constant-delay storage and transmission of the data from the encoder to the decoder, or if this delay is not constant, the effective equivalent of constant delay storage and transmission with the SCR values having been corrected to reflect the variations in delay. With the values of e converging to a constant, variations in the instantaneous VCO frequency become essentially zero after the loop is locked; the VCO is said to have very little jitter or frequency slew. While the loop is in the process of locking, the rate of change of the VCO frequency, the frequency slew rate, can be controlled strictly by the design of the low pass filter and gain stage. In general the VCO slew rate can be designed to meet application requirements, subject to constraints of decoder buffer size and delay.</p> <p>(pp.96-8)</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • See FIG. D.2 “STC recovery using PLL” (p.97) • The example presented in J.4.1 requires two stages of processing. The first stage is necessary to dejitter the network's output. The second stage, recovering the STC by processing PCRs or SCRs, is required for STD decoding. The example presented in this subclause is a decoder that integrates the dejittering and decoding functions in a single system. The STC clock is recovered directly using the jittered PCR or SCR values. For presenting this example, an MPEG-2 transport stream will be assumed. (p.115) • See FIG. J.3 “Integrated dejittering and MPEG-2 decoding” (p.115) • See FIG. Intro. 2 “Prototypical transport demultiplexing and decoding example” (p. x) <p>Furthermore, U.S. Patent No. 6,397,000 to Hatanaka et al. (“Hatanaka”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • FIG. 1 is a block diagram of a receiving/recording/playing back device for a digital broadcasting signal in a first embodiment of the present invention. In FIG. 1, reference numeral 1 denotes a digital broadcasting receiving device (Integrated Receiver & Decoder: IRD), 2 a recording/playback device, 3 an encoder, 4 a digital broadcasting signal input terminal, 5 a tuner, 6 a QPSK demodulator, 7 a forward error correction (FEC) unit for correcting an error involved in the transmission of a signal, 8 a playback changeover switch, 9 a demultiplexer, 10 a MPEG decoder, 11 an NTSC encoder, 12 an interface between the devices 1 and 2, 13 a clock recovery unit, 14 a D/A converter, 15 a video output terminal, 16 an audio output terminal, 17 a recorded signal changeover switch, 18 a packet control circuit, 19 a recording/playback data processing, 20 a record amplifier, 21 a playback amplifier, 22 a magnetic tape, 23 a rotary head, 24 a clock generator, 25 a clock changeover switch, 26 a video input terminal, 27 an audio input terminal, 28 a video A/D converter, 29 an audio A/D converter, 30 a video encoder, 31 an audio encoder, 32 a multiplexer, and 47 a digital signal processor. (col.2:30-50) • The multiplexed signal contains a packet called, for example, a PCR (Program Clock Reference) indicative of time information representing the time when compression took place in a broadcasting station concerned. Thus, the clock recovery unit 13 reproduces a data clock 45 using this PCR. The decoder clock 45 reproduced by the clock recovery unit 13 is controlled so as to have the same frequency as a clock used in a compressor (not shown) which compresses video and audio data information in accordance with the MPEG 2 in the broadcasting station. The MPEG decoder 10 expands the respective video and audio signals compressed in accordance with the MPEG 2, etc., by using the received separating signal and the data clock 45 reproduced by the clock reproducing unit 13, and provides decoded video/audio signals. (col.3:22-37)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> Also, in playback, the data clock 45 used in the MPEG decoder 10 is required to obtain the same frequency as it was compressed in the broadcasting station. To this end, at least the respective PCR time intervals inputted when recorded are required to be maintained, reproduced and outputted correctly. To this end, in recording, the time stamp 102 is added in the packet control circuit 18. In playback, the respective packets are outputted by the packet control circuit 18 in accordance with the time stamps 102 to maintain the time intervals at which the packets are outputted. To this end, clocks used for producing the time stamp 102 in the recording should be decoder clock 45 reproduced by the clock recovery unit 13. In recording, the clock changeover switch 25 is set at a contact e so that the decoder clock 45 is inputted to the packet control circuit 18. In reproduction, the clock recovery unit 13 of the digital broadcasting receiver 1 is operated by a timing signal outputted from the packet control circuit 18 to produce decoder clock 45. Thus, the packet control circuit 18 cannot use the decoder clock 45. In order to avoid-this, the clock generator 24 which generates a fixed clock 46 is provided so that when the clock changeover switch 25 is set at a contact f, the fixed clock 46 is inputted to the packet control circuit 18 and a packet is outputted at a timing generated by the fixed clock 46. Thus, the clock recovery unit 13 is able to generate a stabilized clock depending on the fixed clock 46. The clock generator 24 generally uses a crystal oscillator. In this case, the frequency of the crystal oscillator should be within the standards of MPEG 2, etc. (col.4:36-64) When the multiplexed stream 44 is recorded, the clock frequency used for producing the time stamp 102 in the packet control circuit 18 is required to have the same frequency as the clock used in the video and audio encoders 30 and 31, as described with respect to the recording of the digital broadcasting. Thus, as shown in FIG. 1, the video encoder 30, audio encoder 31, and multiplexer 32 are operated at the fixed clock 46 generated by the clock generator 24, the clock changeover switch 25 is set at a contact f so that the fixed clock 46 is inputted to the packet control circuit 18. Also, in playback, the clock changeover switch 25 is set at the contact f while the packet control circuit 18 uses the fixed clock 46. (col.6:3-16) This device is different in operation from the FIG. 1 device in that the broadcasting stream which is the output from the interface 12 is also inputted to the multiplexer 32, and that the video encoder 30, audio encoder 31 and multiplexer 32 are operated with the clock outputted from the clock changeover switch 25. (col.6:23-28) In this case, the packet control circuit 18 uses the data clock 45 produced by the clock recovery unit 13. Thus, the clock changeover switch is set at a contact e, and the video and audio encoders 30 and 31 also use the decoder clock 45. In playback, the clock changeover switch 25 is set at a contact f to use the fixed clock 46. (col.6:41-46)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • See also FIGS. 1-7, 9, 10 <p>Furthermore, U.S. Patent No. 7,024,100 to Furuyama (“Furuyama”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • The identification information indicative of the contents of the corresponding scene is recorded in the retrieval data stream along with PTS (Presentation Time Stamp) that is information to synchronously reproduce the corresponding video data streams and audio data streams, or time code. And each of the video data streams, the audio data streams and the retrieval data streams is constructed in packets and multiplexed as PES (Packetized Elementary Stream). Further, it may be possible to insert the retrieval data streams as a private descriptor in the PAT (Program Association Table), PMT (Program Map Table) or CAT (Conditional Access Table) to multiplex with the video data and audio data. (col.4:8-19) • In addition, the PTS to synchronously reproduce the video signal and audio signal is inserted to respective header areas of video stream (1) 102 to video stream (n) 105 and audio stream (1) 103 to audio stream (n) 106. The time stamps is inserted in a header area (203) of GOP1 (202-1) to GOPn (202-n) The operation of the apparatus of this embodiment with the configuration as described above is next explained. When control section 12 receives a reproduction instruction from a user interface, not shown in the figure, with a program address or program identification number designated, control section 12 provides the reproduction instruction to storage section 11 while specifying a header address of the MPEG stream of the instructed program. As a result of the instruction, the MPEG stream of the program instructed by control section 12 is provided from one of output ports of storage section 11 to first demultiplexing section 21. First demultiplexing section 21 demultiplexes the video streams and audio streams from the MPEG stream. The demultiplexed video streams are decoded in video decoding section 23, and the demultiplexed audio streams are decoded in audio decoding section 24. Then, the video signal and audio signal are synchronously output from video output section and audio output section 3. (col.4:59 to 5:15) • Further, second demultiplexing section 22 refers to the PTS or a value of the time code stored in the retrieval data stream, and calculates the GOP head address of the corresponding picture frames, and the number of the corresponding picture frames starting from the GOP head frame, to output to retrieval section 30. (col.5:36-41) • In addition, at the time the video is retrieved, the retrieval data streams stored in storage section 11 are input to retrieval section 30, and therein the same retrieval processing as in the first embodiment is executed. Comparison section 31 searches the retrieval data stream in which the identification information matches the retrieval scene, while referring to the PTS or a value of the time code stored in the retrieval data stream, and calculating the GOP head address of the corresponding picture frames, and

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>the number of the corresponding picture frames from the GOP head frame. The calculated values are used in reproducing the retrieved scene. (col.6:35-46)</p> <p>Furthermore, U.S. Patent No. 5,521,922 to Fujinami et al. ("Fujinami") also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • The data demultiplexer 5 has a data separation circuit 21 which demultiplexes the data supplied from the ring buffer 4 to thereby separate the same into video data and audio data, and further into timing data such as SCR (system clock reference) and DTS (decoding time stamp) inclusive of DTSV for the video data and DTSA for the audio data. (col. 1:22-27) • The data separation circuit 21 is controlled by the control circuit 28 and separates the output data of the ring buffer 4 into video data and audio data, which are then supplied to the video code buffer 6 and the audio code buffer 8, respectively. The circuit 21 further separates the timing data into SCR, DTSV and DTSA, which are supplied respectively to the STC register 26, the DTSV register 22 and the DTSA register 24 and then are stored therein. (col.2:28-35) • The STC register 26 having stored the timing data SCR therein counts the clock pulses outputted from the clock generator 27 and increments the storage value in response to the clock pulses. The storage value of the STC register 26 is supplied as a system time clock (STC) signal to the comparators 23 and 25. (col.2:36-41) • The DTSV register 22 holds the video timing data DTSV supplied first thereto after the start of reproduction by the drive 1. Consequently, the register 22 has a decoding start time relative to a top picture out of the entire data stored in the video code buffer 6. (col.2:42-46) • Similarly, the DTSA register 24 holds the audio timing data DTSA supplied first thereto after the start of reproduction, so that the register 24 has a decoding start time relative to a top decode unit out of the entire data stored in the audio code buffer 8. (col.2:47-52) • The reference timing data SCR corresponds to the time when demultiplexing is started after supply of the data from the ring buffer 4 to the data demultiplexer 5. More specifically, it corresponds to a time t1 in the timing chart of FIG. 7. Therefore the STC register 26 outputs the time data (current time) from the time t1 to one input terminal of each of the comparators 23 and 25. (col.2:53-59) • According to a first aspect of the present invention, there is provided a data demultiplexer for separating multiplex data which includes at least first coded data such as video data, first timing data indicative of a decoding start time of the first coded data, and second timing data indicative of a system clock reference

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>time. The demultiplexer comprises a separation means for separating the multiplex data into the first coded data, the first timing data and the second timing data; and a comparison means for comparing the time, which is indicated by the first timing data separated by the separation means, with the time indicated by the second timing data; wherein, when the time indicated by the second timing data is temporally anterior to the time indicated by the first timing data, the multiplex data is supplied at the maximum transfer rate to the separation means.</p> <p>The data demultiplexer further comprises a system time clock generation means for generating a system time clock signal by setting an initial value thereof on the basis of the first timing data and then incrementing predetermined clock pulses; and a means for generating a first decoding start signal by comparing the first timing data with the system time clock signal.</p> <p>The multiplex data further includes second coded data such as audio data, and third timing data indicative of a decoding start time of the second coded data. The demultiplexer further comprises a means for generating a second decoding start signal by comparing the third timing data with the system time clock signal. □(col.4:56-5:16)</p> <ul style="list-style-type: none"> • See FIGS 1A, 1B, 5A, and 5B <p>Furthermore, NetShow also discloses this limitation expressly:</p> <p>For example, NetShow discloses that streaming multimedia files may contain timing information, which is recovered from received packets in order to synchronize the audio and video elements during playback.</p> <p>Furthermore, RealPlayer 5.0 also discloses this limitation expressly:</p> <p>For example, RealPlayer 5.0 discloses that streaming multimedia files may contain timing information, which is recovered from received packets in order to synchronize the audio and video elements during playback.</p> <p>One of skill in the art would combine Hoogenboom with Barton '389, The MPEG-2 Standard, Hatanaka, Furuyama, Fujinami, NetShow, and/or RealPlayer 5.0 with a reasonable expectation of success because, for example, all of the references relate to storing and playing back multiplexed packetized video data such as MPEG-2 streams.</p>
a decoder having a first input coupled to the output of the first clock recovery module to receive the clock, a second input coupled to the data port of the storage device to receive	Hoogenboom discloses a decoder having a first input coupled to the output of the first clock recovery module to receive the clock, a second input coupled to the data port of the storage device to receive the select packets, and an output to provide decoded real-time data based on at least the following exemplary citations:

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
<p>the select packets, and an output to provide decoded real-time data.</p>	<ul style="list-style-type: none"> Picture information can subsequently be read from the memory and decoded using the appended time stamp information without having to reaccess the PES header. Various schemes for detecting, masking and recovering from transmission errors are disclosed. (Abstract) In accordance with the present invention, a method is provided for acquiring video data for a desired service from a packetized data stream. The data stream includes transport packets carrying different components of the service, such as a video component, audio component and control component. The component carried by a particular transport packet is identified by a packet identifier (PID) for that component. One of the components includes a program clock reference (PCR) that provides timing information for the desired service. The method comprises the step of detecting the PCR for the desired service from the component carrying the PCR in the data stream. The recovered PCRs are used to acquire and track a decoder time clock that corresponds to the encoder timing. The PIDs of the transport packets are then monitored to recover those packets carrying a video component of the desired service. Header information from the recovered transport packets is processed to recover packetized elementary stream (PES) packets having a PES header and picture information. Time stamp information is obtained from the PES header of at least one of the PES packets. The time stamp information is buffered and then is appended to the related picture information for storage in a memory. In this manner, the picture information can be read from the memory and decoded using the time stamp information appended thereto without having to reaccess the PES header for the time stamp information. (col. 3:64-4:22) Memory manager 30 schedules all activity on the external DRAM address and data buses 24, 26 and efficiently addresses DRAM 22. The memory manager insures that the data transfer requirements of the input FIFO portion of DRAM 22, the video syntax parser 40 and the video reconstruction circuit 36 (as well as prediction calculator 46 and differential decoder 48) are all met. The video reconstruction circuit 36 builds a current picture and inserts closed captions, a vertical interval test signal (VITS) and/or test pattern data for output on video output line 38. The decode process for a compressed frame of video data is synchronized by comparing the time specified by the decoder time clock to a decode time stamp (DTS), which indicates when the video frame is to be decoded. The display process for the decompressed frame is synchronized by comparing the time specified by the decoder time clock to a presentation time stamp (PTS), which indicates when the video frame is to be presented for display. (col.6:64-7:14) See FIG. 1 <p>Even if AMD argues that Hoogenboom does not disclose this limitation expressly, U.S. Patent No. 6,233,389 to Barton et al. ("Barton '389") nonetheless expressly discloses this limitation:</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • The MPEG stream is sent to a decoder. The decoder converts the MPEG stream into TV output signals and delivers the TV output signals to a TV receiver. (col.2:29-33) • The Output Section 103 takes MPEG streams as input and produces an analog TV signal according to the NTSC, PAL, or other required TV standards. The Output Section 103 contains an MPEG decoder, On-Screen Display (OSD) generator, analog TV encoder and audio logic. (col.4:3-6) • With respect to FIG. 2, the invention easily expands to accommodate multiple Input Sections (tuners) 201, 202, 203, 204, each can be tuned to different types of input. Multiple Output Modules (decoders) 206, 207, 208, 209 are added as well. Special effects such as picture in a picture can be implemented with multiple decoders. The Media Switch 205 records one program while the user is watching another. This means that a stream can be extracted off the disk while another stream is being stored onto the disk. (col.4:14-23) • Referring to FIG. 3, the incoming MPEG stream 301 has interleaved video 302, 305, 306 and audio 303, 304, 307 segments. These elements must be separated and recombined to create separate video 308 and audio 309 streams or buffers. This is necessary because separate decoders are used to convert MPEG elements back into audio or video analog components. Such separate delivery requires that time sequence information be generated so that the decoders may be properly synchronized for accurate playback of the signal. (col.4:24-33) • The program logic continues collecting logical segments 603 until it reaches the fixed buffer size. When this occurs, the program logic generates a new buffer, called a Packetized Elementary Stream (PES) 605 buffer containing these logical segments 603 in order, plus ancillary control information. Each logical segment points 604 directly to the circular buffer, e.g., the video buffer 613, filled by the Media Switch 601. This new buffer is then passed to other logic components, which may further process the stream in the buffer in some way, such as presenting it for decoding or writing it to the storage media. (col.5:51-61) • A hard disk or storage device 710 is connected to one of the ports of the Media Switch 701. The Media Switch 701 outputs streams to an MPEG video decoder 715 and a separate audio decoder 717. (col.6:62-65) • The Media Switch 701 takes in 8-bit data and sends it to the disk, while at the same time extracts another stream of data off of the disk and sends it to the MPEG decoder 715. All of the DMA engines described above can be working at the same time. (col.7:5-9)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • The buffer that is pointed to by the current pointer is handed to the Vela decoder class 916. The Vela decoder class 916 talks to the decoder 921 in the hardware. The decoder 921 produces a decoded TV signal that is subsequently encoded into an analog TV signal in NTSC, PAL or other analog format. When the Vela decoder class 916 is finished with the buffer it calls releaseEmptyBuf. (col.9:12-15) • The derived class and resulting objects described here may be combined in an arbitrary way to create a number of different useful configurations for storing, retrieving, switching and viewing of TV streams. For example, if multiple input and output sections are available, one input is viewed while another is stored, and a picture-in-picture window generated by the second output is used to preview previously stored streams. Such configurations represent a unique and novel application of software transformations to achieve the functionality expected of expensive, sophisticated hardware solutions within a single cost-effective device. (col.11:27-38) • See FIGS. 1, 7-9, 13 <p>Furthermore, The MPEG-2 Standard also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • A prototypical decoder for Transport Streams, including audio and video, is also depicted in Figure Intro. 2 to illustrate the function of a decoder. The architecture is not unique - some system decoder functions, such as decoder timing control, might equally well be distributed among elementary stream decoders and the channel specific decoder - but this figure is useful for discussion. Likewise, indication of errors detected by the channel specific decoder to the individual audio and video decoders may be performed in various ways and such communication paths are not shown in the diagram. The prototypical decoder design does not imply any normative requirement for the design of a Transport Stream decoder. Indeed non-audio/video data is also allowed, but not shown. (p. x) • See FIG. Intro. 2 “Prototypical transport demultiplexing and decoding example” (p. x) • The prototypical decoder for Program Streams shown in Figure Intro. 5 is composed of System, Video, and Audio decoders conforming to Parts 1, 2, and 3, respectively, of ISO/IEC 13818. In this decoder, the multiplexed coded representation of one or more audio and/or video streams is assumed to be stored or communicated on some channel in some channel-specific format. The channel-specific format is not governed by this Recommendation I International Standard, nor is the channel-specific decoding part of the prototypical decoder. <p>The prototypical decoder accepts as input a Program Stream and relies on a Program Stream Decoder to extract timing information from the stream. The Program Stream Decoder demultiplexes the stream, and</p>

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>the elementary streams so produced serve as inputs to Video and Audio decoders, whose outputs are decoded video and audio signals. Included in the design, but not shown in the figure, is the flow of timing information among the Program Stream decoder, the Video and Audio decoders, and the channel-specific decoder. The Video and Audio decoders are synchronized with each other and with the channel using this timing information. (p. xii)</p> <ul style="list-style-type: none"> • See FIG. Intro. 5 - Prototypical decoder for Program Streams (p. xi) • See FIG. D.1 "Constant delay model" (p.93) • See FIG. J.3 "Integrated dejittering and MPEG-2 decoding" (p.115) <p>Furthermore, U.S. Patent No. 6,397,000 to Hatanaka et al. ("Hatanaka") also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • FIG. 1 is a block diagram of a receiving/recording/playing back device for a digital broadcasting signal in a first embodiment of the present invention. In FIG. 1, reference numeral 1 denotes a digital broadcasting receiving device (Integrated Receiver & Decoder: IRD), 2 a recording/playback device, 3 an encoder, 4 a digital broadcasting signal input terminal, 5 a tuner, 6 a QPSK demodulator, 7 a forward error correction (FEC) unit for correcting an error involved in the transmission of a signal, 8 a playback changeover switch, 9 a demultiplexer, 10 a MPEG decoder, 11 an NTSC encoder, 12 an interface between the devices 1 and 2, 13 a clock recovery unit, 14 a D/A converter, 15 a video output terminal, 16 an audio output terminal, 17 a recorded signal changeover switch, 18 a packet control circuit, 19 a recording/playback data processing, 20 a record amplifier, 21 a playback amplifier, 22 a magnetic tape, 23 a rotary head, 24 a clock generator, 25 a clock changeover switch, 26 a video input terminal, 27 an audio input terminal, 28 a video A/D converter, 29 an audio A/D converter, 30 a video encoder, 31 an audio encoder, 32 a multiplexer, and 47 a digital signal processor. (col.2:30-50) • When the broadcasting signal is outputted from the present device, the playback changeover switch 8 is set at a contact to input the output from the FEC 7 to demultiplexer 9, which determines a type of a respective packet, using the PID 57, etc., of the header 50, separates only packets of a video, audio, etc., relating to a specified program, and then outputs these packets to the MPEG decoder 10. The multiplexed signal contains a packet called, for example, a PCR (Program Clock Reference) indicative of time information representing the time when compression took place in a broadcasting station concerned. Thus, the clock recovery unit 13 reproduces a data clock 45 using this PCR. The decoder clock 45 reproduced by the clock recovery unit 13 is controlled so as to have the same frequency as a clock used in a compressor (not shown) which compresses video and audio data information in accordance with the MPEG 2 in the broadcasting station. The MPEG decoder 10 expands the respective

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>video and audio signals compressed in accordance with the MPEG 2, etc., by using the received separating signal and the data clock 45 reproduced by the clock reproducing unit 13, and provides decoded video/audio signals. The video signal is converted by the NTSC encoder 11 to a television analog video signal, which is then output from the video output terminal 15. The audio signal is converted by the D/A converter 14 to an analog audio signal, which is then outputted from the audio output terminal 16. (col.3:16-41)</p> <ul style="list-style-type: none"> • The demultiplexer 9 automatically selects a broadcasting station on the basis of the packet of program information which was selected and converted by the interface 12 when the data was recorded, and outputs only a packet required for the MPEG decoder 10. Video/audio signals are obtained in a manner similar to that in which an output is obtained from a broadcasting signal. (col.4:30-36) • Also, in playback, the data clock 45 used in the MPEG decoder 10 is required to obtain the same frequency as it was compressed in the broadcasting station. To this end, at least the respective PCR time intervals inputted when recorded are required to be maintained, reproduced and outputted correctly. To this end, in recording, the time stamp 102 is added in the packet control circuit 18. In playback, the respective packets are outputted by the packet control circuit 18 in accordance with the time stamps 102 to maintain the time intervals at which the packets are outputted. To this end, clocks used for producing the time stamp 102 in the recording should be decoder clock 45 reproduced by the clock recovery unit 13. In recording, the clock changeover switch 25 is set at a contact e so that the decoder clock 45 is inputted to the packet control circuit 18. (col.4:36-50) • In playback, the user selects one of the digital and analog broadcasts, the demultiplexer 9 selects only one of the digital and analog broadcasts on the basis of the PAT converted in the recording, and inputs the selected program packet to the MPEG decoder 10 to obtain the video and audio of the desired program. (col.6:47-52) • The video A/D converter 28, audio A/D converter 29, video encoder 30, audio encoder 31 and multiplexer 32 may be built either in the recording/playback device 2 or in the digital broadcasting receiver 1. Although not shown, the demultiplexer 9, MPEG decoder 10, NTSC encoder 11, and D/A converter 14 may also be provided in the recording/playback device 2 as well. Thus, even the recording/playback device is capable of providing a reproduced video signal by itself. Of course, the digital broadcasting receiver 1, recording/playback device 2 and encoder 3 may be all integrated in one unit. (col.7:21-32) • <i>See also</i> FIGS. 1-7, 9, 10

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>Furthermore, U.S. Patent No. 6,226,447 to Sasaki et al. ("Sasaki") also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • In still another embodiment, the display means simultaneously displays a received video signal and an output of the decoding means which was previously recorded, reproduced and decoded. (col.2:39-44) • The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal, thereby reading out predetermined video and audio signals at a predetermined time. (col.2:52-67) • The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; display means for displaying the restored video signal; and sound recognition means for recognizing an audio signal. In the video signal recording and reproducing apparatus, predetermined video and audio signals are read out at a point of time when the sound recognition means recognizes a predetermined sound. (col.3:1-18) • The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal. In the video signal recording and reproducing apparatus, a video signal at an arbitrary point of time is retrieved for an arbitrary time period by an operation of a viewer from video signals which are being received or video signals which were previously recorded, and information for prohibiting overwriting data of the retrieved video signal is added to the retrieved video signal so as to be stored into the hard disk apparatus. (col.3:21-39)

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<ul style="list-style-type: none"> • In one embodiment, when a video signal retrieved by an operation of a viewer is saved, search information required for the viewer to search for a desired video signal later is added to the video signal to be saved, and after the video signal which was previously retrieved and saved has been searched for and read out based on the search information, the read compressed video signal is decoded to be displayed on the display means. (col.3:39-47) • In the video signal recording and reproducing apparatus, while compressing a video signal which is being received and writing the compressed video signal onto the hard disk apparatus, a video signal which was previously recorded is read out and decoded into an original video signal, and after an amount of data of the decoded video signal has been reduced, the video signal is subjected to an image compression again and written onto the hard disk apparatus. (col.4:2-9) • FIG. 1 is a block diagram illustrating a configuration for a video signal recording and reproducing apparatus in a first example of the present invention. In FIG. 1, the reference numeral 1 denotes an antenna; 2 denotes a tuner; 3 denotes a demodulator; 4 denotes an MPEG1 encoder; 5 and 6 denote recording buffer memories; 7 denotes a first switch; 8 denotes a hard disk apparatus; 9 and 10 denote reproducing buffer memories; 11 denotes a second switch; 12 denotes an MPEG1 decoder; 13 denotes a TV monitor; 14 denotes a hard disk controller; 15 denotes a table RAM; 16 denotes a system controller; 17 denotes a timer; and 18 denotes an operator panel. (col.6:2-13) • The hard disk controller 14 controls the hard disk apparatus 8 in accordance with the information supplied from the table RAM 15, so that the compressed video signals recorded on the hard disk apparatus 8 are reproduced via the reproducing buffer memories 9 and 10 and the second switch 11. This operation will be described in detail later with reference to FIG. 3. The reproduced compressed video signals are decoded by the MPEG1 decoder 12 so as to be video signals which are displayed on the TV monitor 13. (col.7:3-12) • A time difference between the time when the video which is now being reproduced was recorded (hereinafter, such a time will be referred to as a “video recording time”) and the current time, can be calculated by subtracting the video recording time, obtained by using the time information supplied from the table RAM 15, from the current time. If the time difference is displayed on the TV monitor 13, the time difference can be monitored. Before this time difference becomes zero, any arbitrary part of the video which has already been recorded can be reproduced. In addition, it is also possible to simultaneously display on the TV monitor 13 both the time corresponding to the output of the demodulator 3 and the time corresponding to the output of the MPEG1 decoder 12 by dividing the screen into two parts. Then, a video which is now being broadcast (and corresponds to the output of the demodulator 3) and a video which is now being reproduced (and corresponds to the output of the

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>MPEG1 decoder 12) can be simultaneously watched on the same screen. (col.7:63 to col.8:14)</p> <ul style="list-style-type: none"> • Portion (j) of FIG. 4 represents an input to the MPEG1 decoder 12. As shown in FIG. 4, the input has been extended so as to have the same period as that of the output in portion (a) and is continuously reproduced. (col.9:21-24) • In this example, when the video data is updated, the previously recorded video data is once read out; passed through the buffer memories 23 and 24; and then decoded by the decoder 26 into the original video signals. (col.13:46-49) • It is naturally possible to directly display the composite video signal output from the decoder 12 without performing a screen separation. (col.15:45-48) • <i>See also</i> FIGS. 1, 5, 6 <p>Furthermore, U.S. Patent No. 7,024,100 to Furuyama (“Furuyama”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • In FIG. 1, recorded in storage section 10 is video data comprised of bitstreams conforming to MPEG (International Standard for Moving Picture Coding). Identification information indicative of the contents of the scene corresponding to the user area is inserted in the user data area in the bitstreams. MPEG decoder 20 has a user area code extraction section 28 that extracts the identification information inserted in the user data area. Retrieval section 30 is comprised of retrieval information input section 32 to which the contents of the scene a user desires are input, comparison section 31 which compares the contents input from retrieval information input section 32 to the extracted contents by the user area code extraction section 28. (col.1:19-31) • Then, when the retrieval scene and identification information match, retrieval section 30 provides an instruction indicative of ON to MPEG decoder 20, and then the decoding and indication of the corresponding video signals (scene) are initiated. (col.1:36-40) • In various data streams including an MPEG stream, compressed coded video streams, audio streams, and private streams to store user data are multiplexed (hereinafter, the private stream is called retrieval data stream since identification information for retrieval is used as the user data in the present invention). Execution of the reproduction and retrieval from the above-mentioned data streams requires a demultiplexing function for demultiplexing the multiplexed data streams to the private streams, video streams and audio streams, a video decoding and audio decoding function for extending the compressed coded video and audio data to decode, and a retrieval function for executing the retrieval. Accordingly,

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>to execute the reproduction and retrieval in parallel, it is necessary to concurrently process streams being reproduced and streams for retrieval, however the function requiring concurrent processing is only the demultiplexing function. (col.2:4-20)</p> <ul style="list-style-type: none"> • First demultiplexing section 21 is connected to video decoding section 23 and audio decoding section 24 in parallel. Video decoding section 23 extends the compressed video streams to decode, and outputs the decoded signal to video output section 2. Audio decoding section 24 extends the compressed audio streams to decode, and outputs the decoded signal to audio output section 3. Video decoding section 23 and audio decoding section 24 operate synchronously. (col.3:46-54) • The processing is executed on a GOP-by-GOP basis in decoding the video signal. Video decoding section 23 executes decoding of pictures input in the order of I1, B-1, B0, P4, B2, B3, The decoded video signal is output to a display device through video output section 2, and displayed in the order of frames (B-1), (B0), I1, B2, B3, P4 (col.4:53-58) • The demultiplexed video streams are decoded in video decoding section 23, and the demultiplexed audio streams are decoded in audio decoding section 24. Then, the video signal and audio signal are synchronously output from video output section and audio output section 3. (col.5:11-15) • The output ports of storage section 11 are respectively connected to video decoding section 23, audio decoding section 24 and comparison section 31 of retrieval section 30. The operation of the video storage and retrieval apparatus according to the second embodiment is explained below. The multiplexed MPEG stream is input to MPEG stream input section 1, and demultiplexed in third demultiplexing section 25 to video streams, audio streams and retrieval data streams, which are stored in storage section 11. At the time the video is reproduced, the video streams are input to video decoding section 23, while the audio streams are input to audio decoding section 24, both from storage section 11, and the video and audio are synchronously output from respective sections. (col.6:21-34) • The video streams and audio streams are converted into video signals and audio signals in video decoding section 23 and audio decoding section 24, and output therefrom, respectively. (col.7:22-25) • Then, temporary storage section 40 transfers the video streams and audio streams respectively to video decoding section 23 and audio decoding section 24 at the same data transfer rate as in the ordinary reproducing processing. Video decoding section 23 and audio decoding section 24 respectively output the decoded video signals and audio signals. (col.9:15-21) • Then, the decoding section comprised of video decoding section 23 and audio decoding section 24

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>decodes the streams of video data and audio data, while retrieval section 30 executes the retrieval processing using the identification data read from temporary storage section 40. (col.10:2-7)</p> <ul style="list-style-type: none"> • First demultiplexing section 21 demultiplexes video streams and audio streams from the MPEG stream, and outputs video streams and audio streams respectively to video decoding section 23 and audio decoding section 24. Thereby, the decoded video signals and audio signals are output. (col.10:31-36) • The received video and audio streams are demultiplexed in fifth demultiplexing section 27, and the demultiplexed video streams and audio streams are respectively expanded in video decoding section 23 and audio decoding section 24, thus outputting the videos and audios. Further, since the retrieval data streams are demultiplexed and stored in storage section 11, it is possible to concurrently execute the processing fast for the retrieval requests from a plurality of terminals. In addition, when at least the storage section and retrieval section, and at least the video decoding section and audio decoding section in the video storage and retrieval apparatus described in one of the first to eighth embodiments and various modifications thereof are respectively provided at the video retrieval server side, and at the video reproducing terminal, it may be possible to provide the other components at either side, enabling the appropriate design and/or modification. (col.13:63 to col.14:13) • <i>See also</i> FIGs. 1-3A, 4-6B, 7-12. <p>Furthermore, U.S. Patent No. 5,881,245 to Thompson (“Thompson”) also discloses this limitation expressly:</p> <ul style="list-style-type: none"> • The document ISO/IEC 13818-2 (video) specifies the coded representation of video data and the decoding process required to reconstruct pictures. The document ISO/IEC 13818-3 (audio) specifies the coded representation of audio data and the decoding process required to reconstruct the audio data. (col.1:29-34) • FIG. 4 is a high level block schematic showing a system 400 for communicating and decoding video and audio data in accordance with the MPEG-2 standard. This system 400 basically includes a MPEG stream server 402 which provides data to an MPEG decoder 404 via a communications link 406. (col.2:57-63) • At a remote end of the communications link 406, the MPEG decoder 404 includes a transport stream demultiplexer 416, a video decoder 418, an audio decoder 420, and clock control unit 422. The transport stream demultiplexer 416 receives the output of the stream server 402 in the form of a transport stream 112. Based on the packet identification (or PID) number 220 of a particular transport stream packet 200, the transport stream demultiplexer 416 separates the encoded audio and video packets and provides the video packets to the video decoder 418 and the audio packets to an audio decoder 420. The transport

Asserted Claims of U.S. Patent No. 7,095,945	Exemplary citations to Hoogenboom
	<p>stream demultiplexer 416 also provides timing information to a clock control unit 422. The clock control unit 422 provides timing signals to both the video decoder 418 and the audio decoder 420 based on the timing information provided by the transport stream demultiplexer 416. The video decoder 418 provides decoded video data which corresponds to the video data originally encoded. Similarly, the audio decoder 420 provides decoded audio data which corresponds to the audio data originally encoded. (col.3:16-36)</p> <ul style="list-style-type: none"> • The clock control unit 422 provides timing signals to both the video decoder 418 and the audio decoder 420 based on the timing information provided by the transport stream demultiplexer 416. The video decoder 418 provides decoded video data which corresponds to the video data originally encoded. Similarly, the audio decoder 420 provides decoded audio data which corresponds to the audio data originally encoded. (col.3:28-35) • The encoded audio data are provided to the audio decoder 608 and the encoded video data are provided to the video decoder 610. The memory 612 of the video decoder 610 may be used as a frame buffer. The audio decoder 608 outputs decoded audio data and the video decoder 610 outputs decoded video data. The decoded audio and video data may be further processed in the playback card 504. (col.16:41-48) • See FIGS 4 and 6 <p>Furthermore, NetShow also discloses this limitation expressly:</p> <p>For example, NetShow discloses an MPEG-4 video decoder.</p> <p>Furthermore, RealPlayer 5.0 also discloses this limitation expressly:</p> <p>For example, RealPlayer 5.0 discloses a decoder that can be used with the RealVideo compression format, which is based on the H.263 video compression format.</p> <p>One of skill in the art would combine Hoogenboom with Barton '389, The MPEG-2 Standard, Hatanaka, Sasaki, Furuyama, Thompson, NetShow, and/or RealPlayer 5.0 with a reasonable expectation of success because, for example, all of the references relate to storing and playing back multiplexed packetized video data such as MPEG-2 streams.</p>