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Patent Application

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Branko Kovacevic

Entitled: SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Box PATENT APPLICATION
Assistant Commissioner of Patents
Washington, D.C. 20231

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Dear Sir:

REQUEST FOR FILING A NATIONAL PATENT APPLICATION

Transmitted herewith for filing, please find the following:

_X_ 1. Specification, claims and abstract of the above-referenced patent application having _23_ pages.

_X_ 2. _6_ sheet(s) of drawing(s) (_X_ formal / _ informal) comprising Figures _1_ through _6_.

_X_ 3. Declaration and executed Power of Attorney's (_X_ signed ___ unsigned).

_____ 3A. No filing fee, Oath, or Declaration is enclosed pursuant to 37 C.F.R 1.53(d).

____ 4. Information Disclosure Statement along with Form PTO-1449 and references.

____ 5. This is a: ____ Continuation-In-Part; ____ Divisional; ____ Continuation; ____substitute Application (MPEP 201.09) of Application Serial No. ____ filed ____; ____ reissue of U.S. Patent No. ____ filed on ____.
An extension to extend the life of the above prior Application to at least the date of filing hereof
(One box must be marked)
(a)____ is concurrently being filed in that prior Application,
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SKL 6/25

__X__ 6. Attached is an assignment to **ATI Technologies ~~Inc.~~** Please return the recorded assignment to the undersigned.

____ 7. Priority is claimed under 35 U.S.C. § 119 based on filing in _____.

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(1)		
(2)		
(3)		

____ (No.) Certified copy (copies) ____ are attached; or ____ were previously filed on ____.

____ 8. Attached: ___ (No.) verified statement(s) establishing "small entity" status under 37 CFR § 1.9 and 1.27.

__X__ 9. Attached:

__X__ Return Postcard
____ (Other)

____ 10. Preliminary Amendment:

Prior to a first Office Action, kindly amend the Application as follows:

11. The following Filing Fee calculation is based on the claims filed less any claims canceled by the Preliminary Amendment of Item 10.

					SMALL ENTITY RATE		LARGE ENTITY RATE		
BASIC FEE					$355	OR	$710	=	$710 00
	NUMBER FILED			NUMBER EXTRA					
TOTAL CLAIMS	27	-20	=	7 (at least 0)	x 9	OR	x 18	=	$126 00
INDEP CLAIMS	3	-3	=	0 (at least 0)	x 40	OR	x 80	=	$ 00 00
If any proper multiple dependent claim (ignore improper) is present (Enter $0 00 if this is a reissue application)					+$135	OR	+$270	=	+$
If assignment is x'd (item 6), add recording fee $40 00									+$ 40 00
Attached is a Rule 47 Petition (inventor refuses to sign or cannot be reached) $130									+$
TOTAL FILING FEE									**=$876.00**

____ 12. A check in the amount of ___ to cover the Filing Fee calculated in Item 11 is attached. Please charge any deficiency or credit any overpayment to ATI Technologies, Inc., PLC Deposit Account No. 50-0441.

__X__ 13. Please charge **ATI TECHNOLOGIES, INC.**, Deposit Account No. **50-0441** in the amount of **$ 876.00** the Filing Fee calculated in Item 11. This sheet is attached in duplicate.

__X__ 14. The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and may be required under 37 CFR 1.16-1.18 (missing or insufficiencies only) now or hereafter relative to this application and for the resulting Official Document under 37 CFR 1.20, and to have and cause any necessary petition for extension of time to be filed and any fees necessary to be paid for said extension of time OR credit any overpayment to ATI TECHNOLOGIES, INC., Deposit Account No. 50-0441 , for which purpose a duplicate copy of this sheet is attached.

Respectfully submitted,
Branko Kovacevic

11-6-2000
Date

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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

FILING OF A UNITED STATES PATENT APPLICATION

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

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SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Field Of The Invention

The present invention relates generally to time shifting of video data, and more specifically to time shifting of digital video data.

Background Of The Invention

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 addition 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. A digital signal stored directly can require a large amount of storage space, even when only a few minutes of video are captured. The digital signal can be compressed to reduce the amount of storage space required. However, compressing a video signal requires additional processing power, resulting in additional costs.

As the use of digital video data becomes increasingly common, a method and apparatus for time shifting a digital program that is more efficient than those known in art would be advantageous. 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) 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.

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.

A transport stream consists of fixed length packets based on 4 bytes of header followed by 184 bytes of data payload, where data payload is obtained by partitioning larger data blocks. For example, an elementary stream (ES) is a set of data generally consisting of compressed data from a single source, such as a video or audio source, with some additional ancillary data for identification, characterization and synchronization. ES streams are first packetized into either constant length or variable length Packetized Elementary Stream packets (PES packets) consisting of a header and payload. Each PES packet header starts with start code (ox000001) followed with the stream_id byte identifying type of ES underneath.

PES packets from various elementary streams are merged together to form a program (service) with its own system time clock (STC). All ES component streams within one program are synchronized have periodic PTS stamps corresponding to the STC counter to indicate the proper timing for each ES.

The relatively long and most often variable length PES packets are further packetized into shorter TS packets having a constant size of 188 bytes. A small and constant TS packet size makes error recovery easier and faster. Usually, the transport

stream carries several programs, each with its own STC. 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.

Each TS PSI table is sent in sections, usually occupying one or more TS packets. Four types of PSI tables exist: 1) Program Association Table (PAT) listing unique program_number (as an identifier of each program in one multiplex) and PID of the PMT table; 2) Program Map Table (PMT) listing PIDs of all component streams making a given program. PMT may be constructed for each program separately or be common for a group of programs; 3) Conditional Access Table (CAT) identifying PID of Entitlement Management Messages and ID of used conditional access system if any scrambling of TS or PES packets is done; 4) Private Table carrying Network Information Table (NIT) or private data.

The Hierarchical structure which exists between ES streams, PES and TP packets is illustrated in prior art Figure 1-4.

A method and apparatus for efficient time shifting of multiplexed packetized data streams, such as a packet stream, would be advantageous.

Brief Description Of The Drawings

Figures 1-4 illustrate various information associated with an MPEG transport stream of the prior art.

Figure 5 illustrates in graphical form a time line indicating various modes of operation in accordance with the present invention;

Figure 6 illustrates in block diagram form a specific embodiment of a system having to digital transport stream receivers in accordance with the present invention.

Detailed Description Of The Drawings

A specific method and apparatus is disclosed describing a time shifting technique. In one embodiment, the disclosed time shifting technique can be based upon a hardware transport stream demultiplexer that interfaces to a transport stream. The hardware demultiplexer application assists in the extraction and parsing of a multiplexed packetized data stream, such as a MPEG-2 Transport Stream (TS) multiplex. One such hardware demultiplexer is disclosed in pending patent application (990135), which is hereby incorporated herein by reference. The disclosed hardware transport core is used to filter component streams into 15 memory ring buffers, one allocated in the frame memory for the dedicated MPEG-2 video decoder and others in the system memory for the dedicated software parser. It can demultiplex the most frequent transport packets of video stream into an Elementary Stream (ES) by monitoring the first packet identifier (PID) of each TS packet. This flexible filter can be set to extract private data from the adaptation field (AF) or from the PES packet header. Thirty-one other PIDs can be simply filtered and routed to a common (joint) or individual memory buffers for subsequent software processing on the host processor. The basic idea of a time shifting is shown in Figure 5.

Figure 5 illustrates three functions performed by a time shifting system. A first function is to receive a live broadcast stream 510. According to the graph of Figure 5, the live broadcast stream is continuously received during the time represented in Figure 5.

A second function of a time shifting system is to record a specific program after a user activates the time shifting feature. Vector 520 of Figure 5 indicates when a specific program is being recorded by the time shifting system.

A third function of the time shifting system is to display the specific program. Vector 530 of Figure 5 indicates when a specific program is being played back. Specifically, vector portion 531 represents the time where the program is being displayed directly from the live broadcast stream. Vector portion 532 represents the time that the user is unable to view the program, i.e. the user is away from the television. Therefore, in

one embodiment, during this time no program is displayed. In an alternate embodiment, the live feed can continue to be displayed, even though the program is being recorded.

Vector 533 represents the time during which the time-shifted program, which has been stored, is being replayed at a normal playback rate. Note that during this time, the live program feed continues to be recorded for future time shifted play back.

Vector 534 represents a time during which the time shifted program is being replayed at a faster than normal replay rate. By being able to playback at a faster than normal rate, it is possible to catch-up to the live broadcast stream.

The receive-only mode of vector 31 represents where the digital transport stream receiver (DTSR) is receiving a live broadcast and demultiplexing one program of a plurality of programs available in the live broadcast stream. This will be referred to as **Transparent Mode** indicating the transport stream is accessed immediately and not saved. Therefore, from the point of view of digital storage media (DSM), the received data is transparent.

Note that the PAT table is constantly acquired, in transparent mode, and other modes, so that version number change or PMT table PID change for a currently viewed program can be detected. If such a change occurs during the live broadcast of a program, PIDs will be reprogrammed for video and splicing with be handled.

A Continuous Time Shifting Mode occurs during vectors 532-534. Continuous time shifting mode occurs when time shifting is selected by the viewer to store part or all of a program for later viewing after a short or long intermission. During continuous time shifting mode, a selected program from a given multiplex is received and stored on a hard disk, or other storage media, in the form of full transport stream packets or PES packets.

A Part-Time Time-Shifting Mode, when selected by the viewer, allows for replay of a time shifted program or fast forward (FF) replay of a time shifted program at user defined FF speed. In Figure 5 this is represented as vectors 533 and 534. In a

specific embodiment discussed herein, this time-shifting mode is the most demanding mode of the 3 described modes because: the host CPU system is receiving and storing a real time event; at the same time, the host CPU is retrieving saved stream data from the disk; simultaneously with first two operations, the host CPU is performing transport stream de-multiplexing of video, audio, private and PSI/SI data on a host CPU; and at the same time the host CPU is restoring PCR/PTS time-base information as described later.

For some digital television applications, time-shifting may be considered a peak event that occurs sometimes or occasionally. However, some users may depend on it all the time, up to the end of the current program once it was started. For those users, typical operating state of the system is time shifting, de-coupled from the live stream. Time shifting of the digital transport stream should offer the same quality as from the live broadcast (source stream).

Systems suitable for time-shifting need to simultaneously receive and decode a transport stream and handle incoming source stream (to process all PSI and SI data) and record incoming source stream as a full entity or just its one program. Time shifting allows the viewer to step away from the TV monitor without missing any of the program parts. One embodiment of time shifting includes storing all transport packets received on the transport stream. Another embodiment of time shifting that is more efficient includes: 1) selecting just the transport packets of interest (PSI, SI, video, audio and data packets) that constitute one program event to minimize the bit-rate of the recorded stream, to minimize the bandwidth through the host bus interface unit, and to minimize hard disk head movement (if any); 2) increasing the amount of storage and useful life of the hard disk; and 3) assuring that the amount of data that needs to be processed by the host processor is received and stored as: transport stream packets; PES packets of video, audio, data, PSI and SI content, de-multiplexed transport; or PES packets of video and audio and bus master compressed video into the video bit-stream buffer of the MPEG video decoding device.

Selection of just one time shifted program reduces the potentially high bit-rate of a transport stream multiplex to a manageable size, suitable for storage on current 10GB hard disk units (two hours of 10Mbps stream). Obviously, a large disk drive is needed to allow any reasonable length of time shifting. In time shifting mode where time shifted material is simultaneously received and stored, the bit-rate of the host bus-interface unit (HBIU) needs to be double a system where the HBIU is only responsible for playing a single program stream. Generally the bandwidth needed is calculated to be approximately 20Mbps instead 10Mbps.

Because closed or proprietary systems, such as set-top boxes, usually do not share the hard disk drive with other systems, very specialized disk drives for audio-video applications with specialized interfaces can be used. Hard drive features that would be advantageous include: 1) Increasing access speeds and sustained sequence transfers in two directions; 2) Having deferred re-calibration of drive heads to prevent glitches or latencies during playback; 3) Having head offsets to prevent losing a revolution when going from side to side on a platter; 4) Supporting on the fly error correction; and 5) Having embedded multi-disk drive units that decrease access latencies.

The operating system can play a significant role in the efficient use of the drive by accessing most frequent video data in large blocks and decreasing seek time. Generally, larger read/write blocks increase efficiency of data storage and retrieval. Sometimes they can cause unwanted glitches by increasing latency during access.

The first time shifting mode of operation is a receive-only mode. During receive-only mode of operation a master digital time shifting receiver (DTSR) 610, of Figure 6, is programmed to receive and parse transport stream packets matching video and PCR PIDs. A host CPU 632 is assisting MPEG-2 clock recovery, and the same recovered clock data is supplying Master DTSR 610 and the Secondary DTSR 620. In one embodiment, the recovered clock is provided to the secondary DTSR 620 registers through the use of the system memory controller 630. Also, the Master DTSR 610 is programmed to perform PID filtering of audio, private, and PSI/SI PIDs programmed in the auxiliary PID registers. Secondary DTSR 620 is programmed for PID filtering

operations on Video PID programmed on a first auxiliary PID register. However, since the receiver is in receive-only mode, the video transport packets in the ring buffer 624 are disregarded. The clock recovery algorithm is suppressed on the secondary DTSR 620. Only STC of the slave DTSR is set upon the channel change. Host CPU 632 performs PES parsing of audio transport stream packets, decode and presentation of audio frames (on AC-97 codec or wave device), and continuous parsing and data processing of PSI sections monitoring real-time events like PID change, PCR discontinuity or splicing of audio stream. This activity by the host CPU 632 is part of the normal receive only mode of operation where a specified channel is being decoded and displayed. Specific systems and methods for supporting these processes are described in the patent application already incorporated by reference.

When in continuous time-shifting mode of operation, the host CPU 632 performs additional processing including: retrieval; multiplexing; time base corrections; storage of video audio, private and PSI/SI transport stream packets from multiple buffers 614 allocated in the memory space of the host CPU. In one embodiment, however, the master DTSR 620 is used to decode and display video stream as describe previously with reference to receive only mode. Transport packets from a common program are retrieved from the buffer 614 and provided to a digital storage media circular file system in a multiplexed manner. Multiplexing is performed by inserting audio, video, private, and PSI/SI transport stream packets to satisfy a group of relevant criteria.

Fundamental functions performed during continuous digital time shifting include: 1) Preserving of original ES_rate of each component stream; 2) Limiting PCR jitter of newly created single program multiplex; 3) Preserving VBV_delay value (the number of periods of a 90KHz clock derived from the 27MHz system clock that the VBV shall wait after receiving the final byte of the picture start code before decoding the picture) to insure non-interrupted MPEG video decode after initial VBV_delay time in constant bit-rate (CBR) stream environments; 4) Preventing underflow or overflow of elementary stream decoder buffers in accordance with the T_STD model defined in ISO/IEC 13818-1 standard; 5) providing PID values in the video or audio TS packets that were originally defined in the PMT section to be a video or audio PIDs. Alternatively, a new artificial

PCR stream can be separately created and injected as TS PCR packets at the rate of at least 10 times per second to create a new time base for decimated, time-shifted stream stored on the DSM. Whereby, the original PAT transport packet is modified or a new PAT packet is inserted into the stream instead of the original PAT section to indicate a single program only whose PMT section indicates video, audio, PCR and other PID that carry subtitles, program descriptions, etc. As a stable clock source, STC of the Master DTSR is used to measure elapsed time between two PCR samples; 6) Providing PTS values in the video, audio or private data streams by using STC of the Master DTSR as elapsed time counter; and 7) Initializing STC of the playback DTSR device to a first available PCR value encoded in the stream saved on DSM media, immediately after channel change.

While in part-time digital time-shifting mode, the host CPU 632 performs some additional processing like retrieval and de-multiplexing of the single program transport stream created in continuous time digital time-shifting mode during a storage process. Generally, the playback of the stored program is combined with continued transport stream de-multiplexing and recording of the real-time transport stream. Such a mode of operation is the most intensive mode of operation because the host CPU 632 must create/store a multiplexed single program transport stream from a continued reception of a live broadcast; and retrieve and de-multiplex saved content from a digital storage media while performing transport stream de-multiplexing, audio decode, and bus mastering elementary stream video to the MPEG video decoder.

In one implementation, an MPEG decoder associated with the Master DTSR 610 is used to decode and display a video stream from a DSM media and receive private data, and PSI/SI sections from a live broadcast. In such a case, a video PID of the Master DTSR 610 is disabled, while video data with its PTS information is fed directly to the MPEG decoder using the system memory controller 630. However, PCR PID is programmed on a Master DTSR so that MPEG clock recovery continues from a live transport stream feed and is supplied to the STC counters of both the master DTSR 610 and the second DTSR 620. In one implementation, only the video PID is programmed into the Slave DTSR for retrieving live video stream and sending it to circular buffer on

the host system in the form of a full MPEG-2 transport stream packets, while the Master DTSR is used to buffer the non-video components of a specific program.

In another embodiment, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of a digital time shifting. In the second embodiment, a first DTSR is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID of the first DTSR is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR can be used in all 3 modes to receive video, audio, private data and PSI/SI sections, all utilizing auxiliary PID filters and received as full MPEG-2 transport packets arriving in the single memory queue. This way, the temporal order of a stream and validity of the T-STD decoder model is inherently preserved. Also, the amount of the host DRAM memory required for queue allocation is less than in the first case. In both embodiments, a quality digital stream time shifting at the transport packet level is achieved.

In yet another operating mode, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of digital time shifting by storing PES layers as a basic format of the audio/video data saved on a DSM. In PES operating mode, two hardware embodiments are possible, the same as in TP operating mode.

In a first hardware embodiment, the first DTSM is used as a combo device, to achieve playback of live or stored MPEG video and reception of audio, private & PSI/SI content. The second device is used only to receive and de-multiplex MPEG-2 video transport stream and retrieve MPEG-2 elementary stream from a live broadcast. Upon retrieval of ES video, PES packets are formed and stored on the DSM media.

In the second hardware embodiment, the first DTSM is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR is used in all 3 time-shifting modes to receive audio, private data, PSI/SI sections, by utilizing auxiliary PID filters to store

the transport packets to a single memory queue. That way, a temporal order of a stream and validity of T-STD decoder model is already preserved.

In yet another time shifting embodiment, the video is de-multiplexed to the level of elementary stream and stored at the bit-stream buffer of the MPEG video decoder physically allocated in the frame memory. The MPEG video stream is then retrieved from this buffer by a software processing thread running on a host CPU. Every time a picture start code is found in the video bit-stream buffer, a full compressed MPEG picture, in the form of elementary stream, is sent to the system memory buffer by DMA. One such method is disclosed in patent application (990135) which is hereby incorporated herein by reference.

Before storing the full compressed MPEG picture in the DSM, a PES packet header is added. The audio stream is de-multiplexed and decoded by the host CPU. In a similar fashion as the video, prior to audio decoding, the audio frames are packetized into PES packets. Essential information from the PSI/SI/private data tables is decoded and stored in a pure source form on a DSM. This way, further reduction of the host DRAM memory requirements for queue allocation and memory on the DSM media is reduced. An advantage of this mode is reduction of CPU cycles needed for A/V playback of stored data due to the PES format of audio/video data. PES de-multiplexing is done in place, passing pointers to the payload of PES packets that contain video or audio frames, other implementations required they be sent by DMA to the video decoder before they were decoded on host CPU (MPEG or AC-3 audio). As a result, the host CPU doesn't move any raw audio or video data, and host CPU utilization is reduced in order of magnitude compared to TS playback operating mode.

In the foregoing specification, the invention has been described with reference to specific embodiments. However, one of ordinary skill in the art appreciates that various modifications and changes can be made without departing from the scope of the present invention as set forth in the claims below. For example, the specific time-shifting implementation has been described as with reference to a specific transport stream demultiplexer, and described in a previous applications which have been incorporated by

reference. Different transport stream demultiplexers and method of implementing specific aspects of the present invention can be used as well. Likewise, specific partitions between hardware and software implementions have been described, which can vary depending upon the implemented demultiplexer. For example, the video stream parser can be designed to support routing the parsed video data to a circular buffer that is accessible by the system memory controller. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of present invention. In the claims, means-plus-function clause(s), if any, cover the structures described herein that perform the recited function(s). The mean-plus-function clause(s) also cover structural equivalents and equivalent structures that perform the recited function(s). Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any element(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature or element of any or all the claims.

WHAT IS CLAIMED IS:

1. A method comprising the steps of:

receiving a multiplexed packetized data stream that carries real-time multimedia programs;

during a first time:

storing a first portion of the packetized data stream representing video data and timing data of a program;

setting a system time indicator to a stored system time value, wherein the stored system time value is based on a portion of the timing data of the first portion of the packetized data stream;

during a second time:

incrementing the system time indicator;

retrieving the video data of the first portion of the packetized data stream for video decoding; and

storing a second portion of the packetized data stream representing video data and timing data of the program.

2. The method of claim 1, wherein

the step of storing the first portion of the packetized data stream includes the first portion of the packetized data stream representing audio data of the program;

the step of storing the second portion of the packetized data stream includes the second portion of the packetized data stream representing audio data of the program;

the method further including the step of

during the second time

the step of accessing the audio data of the first portion of the packetized data stream for audio playback.

3. The method of claim 1, wherein the multiplexed packetized data stream is a

multiplexed packetized data stream that substantially meets an MPEG2 specification.

4. The method of claim 3, wherein the step of storing the first portion includes storing transport stream packets.

5. The method of claim 4, wherein the step of storing the first portion includes the sub-steps of

   determining transport stream packets containing data associated with the program; and

   storing the transport stream packets containing data associated with the program after the step of determining.

6. The method of claim 3, wherein the step of storing the first portion includes storing packetized elementary stream (PES) packets.

7. The method of claim 6, wherein the step of storing the first portion includes the sub-steps of

determining transport stream packets containing data associated with the program; and

storing PES packets based upon the transport stream packets containing data associated with the program after the step of determining.

8. The method of claim 1, wherein the step of storing the first portion of the transport stream includes the timing data including synchronization information used for playing the program back at a real time program bit-rate.

9. The method of claim 1 wherein the step of incrementing the system time indicator includes incrementing the system time indicator based upon a signal generated from multiplexed packetized data stream data received after the first time.

10. The method of claim 1 further comprising the step of:
decoding the video data of the first portion to provide a decoded video stream.

11. The method of claim 10, wherein the steps of receiving a multiplexed packetized data stream and decoding the video data are performed by an integrated semiconductor device.

12. The method of claim 10 further comprising the step of:
providing the decoded video stream for display at a play back rate.

13. The method of claim 12 wherein the play back rate is a real time rate.

14. The method of claim 12 wherein the step of providing the decoded video stream for display includes determining the play back rate based upon clock recovery data of the first portion of the transport stream, wherein the play back rate will vary

depending upon a rate at which the first portion of the transport stream data is provided to a decoder during the step of decoding.

15. The method of claim 12 wherein the step of providing the decoded video stream for display includes determining the play back rate based upon timing data received from the multiplexed packetized data stream after the first time.

16. The method of claim 15, wherein the timing data received from the multiplexed packetized data stream after the first time is associated with a current real-time data stream.

17. The method of claim 12, wherein the play back rate is faster than a real time rate.

18. A method comprising the steps of:

determining a mode of operation;

during a first mode of operation:

receiving a multiplexed packetized data stream at a first demultiplexer;

selecting a first program from the multiplexed packetized data stream;

decoding a video portion of the first program for display;

during a second mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing the first program;

during a third mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing a first program portion of the first program;

providing the first program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the first program portion;

decoding the video portion of the first program portion for display; and

storing a second program portion of the first program simultaneous to the step of decoding.

19. The method of claim 18, further comprising during the third mode of operation the steps of:

providing the second program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the second program portion; and

decoding the video portion of the second program portion for display.

20. The method of claim 18 further comprising, during the third mode of operation, the steps of:

incrementing a counter associated with the second demultiplexer based upon a signal generated using a live feed of the multiplexed packetized data stream as it is received at the first demultiplexer.

21. A system comprising:

a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs;

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;

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;

a first clock recovery module having an input coupled to the first input node, and an output, wherein the 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 it is stored in the storage device;

a decoder having a first input coupled to the output of the first clock recovery system to receive the clock, a second input coupled the data port of the storage device to receive the select packets, and an output to provide decoded real-time data

22. The system of claim 21, wherein the first clock recovery module further generates the clock based upon data transmitted in packets of a currently received multiplexed packetized data stream.

23. The system of claim 21, wherein the first clock recovery module further generates the clock based upon multiplexed packetized data stream data stored in the storage device.

24. The system of claim 21, wherein the decoder includes a video decoder.

25. The system of claim 24, wherein the decoder includes an audio decoder.

26. The system of claim 21 further comprising:

a second transport stream demultiplexer having an input coupled to the data port of the storage device;

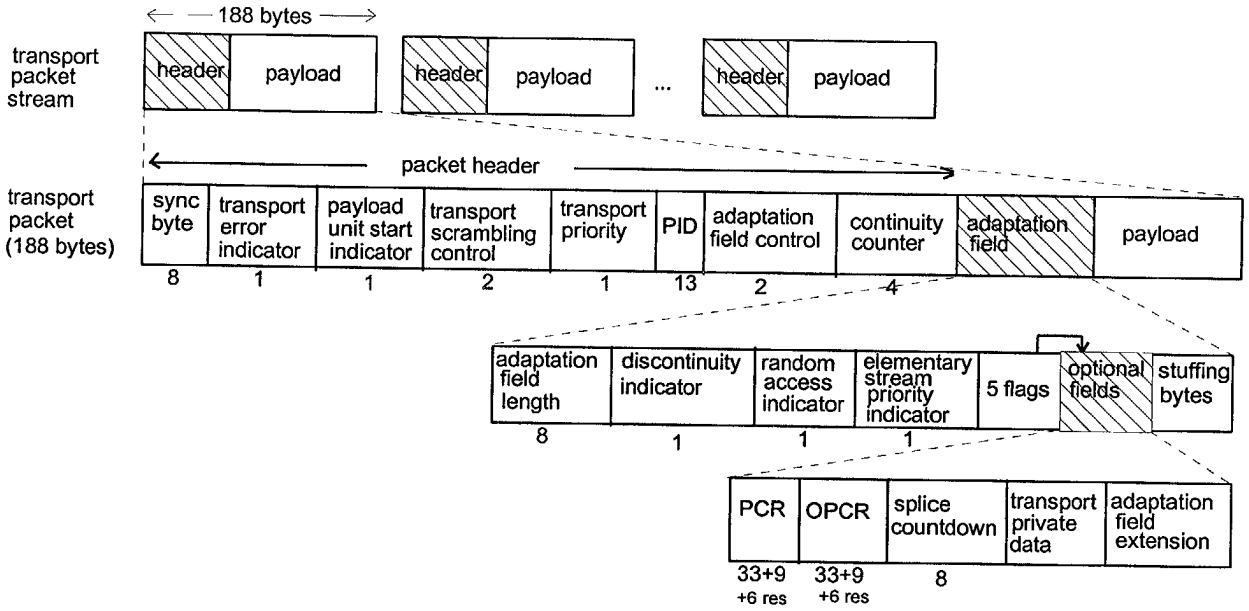
27. The system of claim 26 further comprising:

a second clock recovery module having an input coupled to the data port of the storage device to allow STC setting based on a stored system time.

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

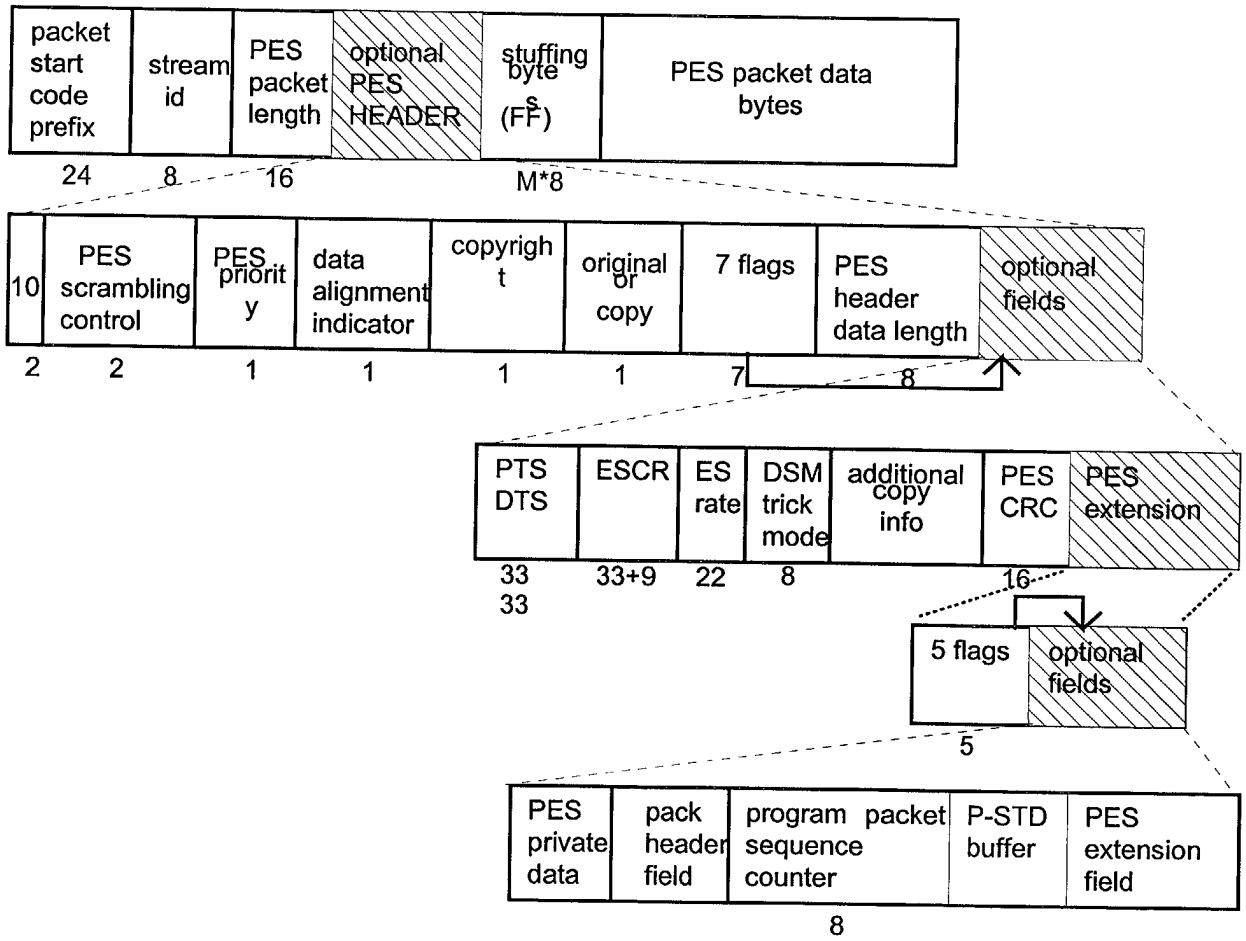
Abstract Of The Disclosure

A multiplexed packetized data stream carrying real-time multimedia programs is received at a first hardware demultiplexer. Based on a user input, a video and timing portion of a program associated with the multiplexed packetized data stream can be stored for subsequent display. One type of subsequent display is time shifted display, where the stored portion of the program is played back while new portions of the program are being stored. During time shifted play back, a second hardware demultiplexer can be used, so that one demultiplexer stores new data and maintains a current clock value while the other decodes and displays the stored data.



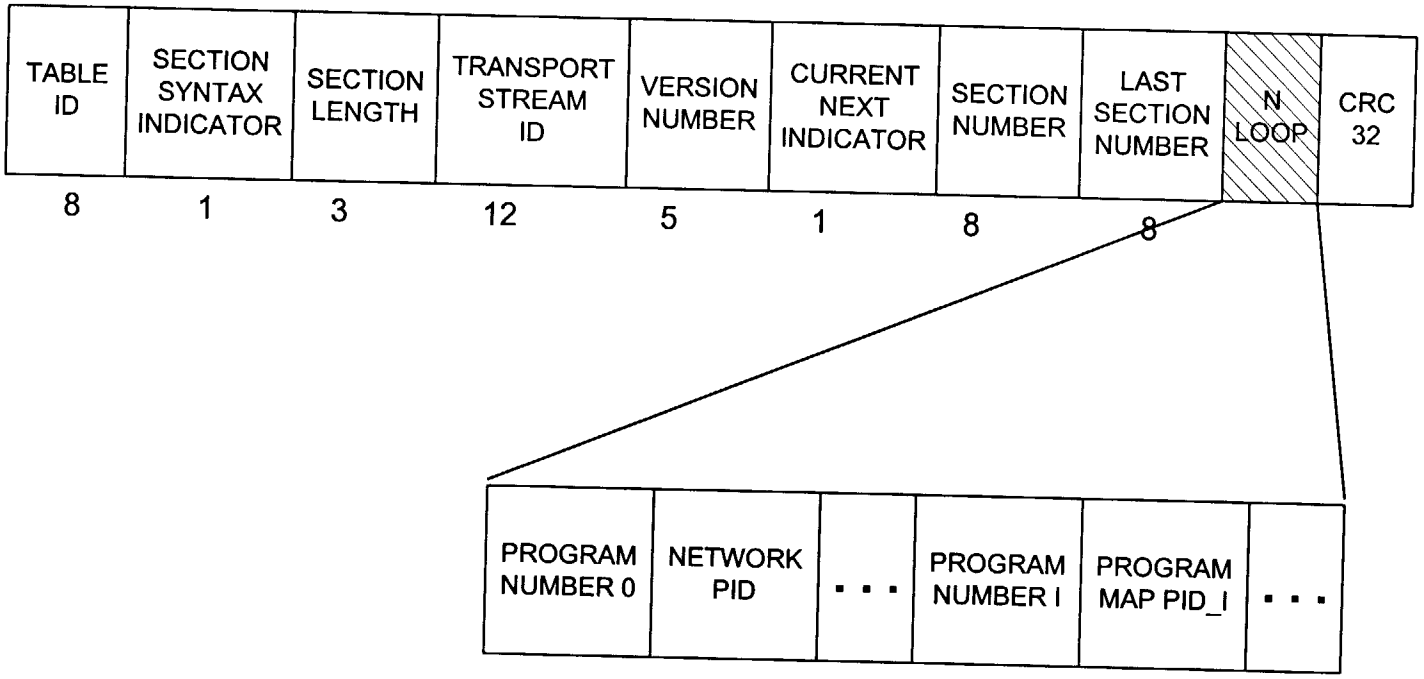
--PRIOR ART--

FIGURE 1



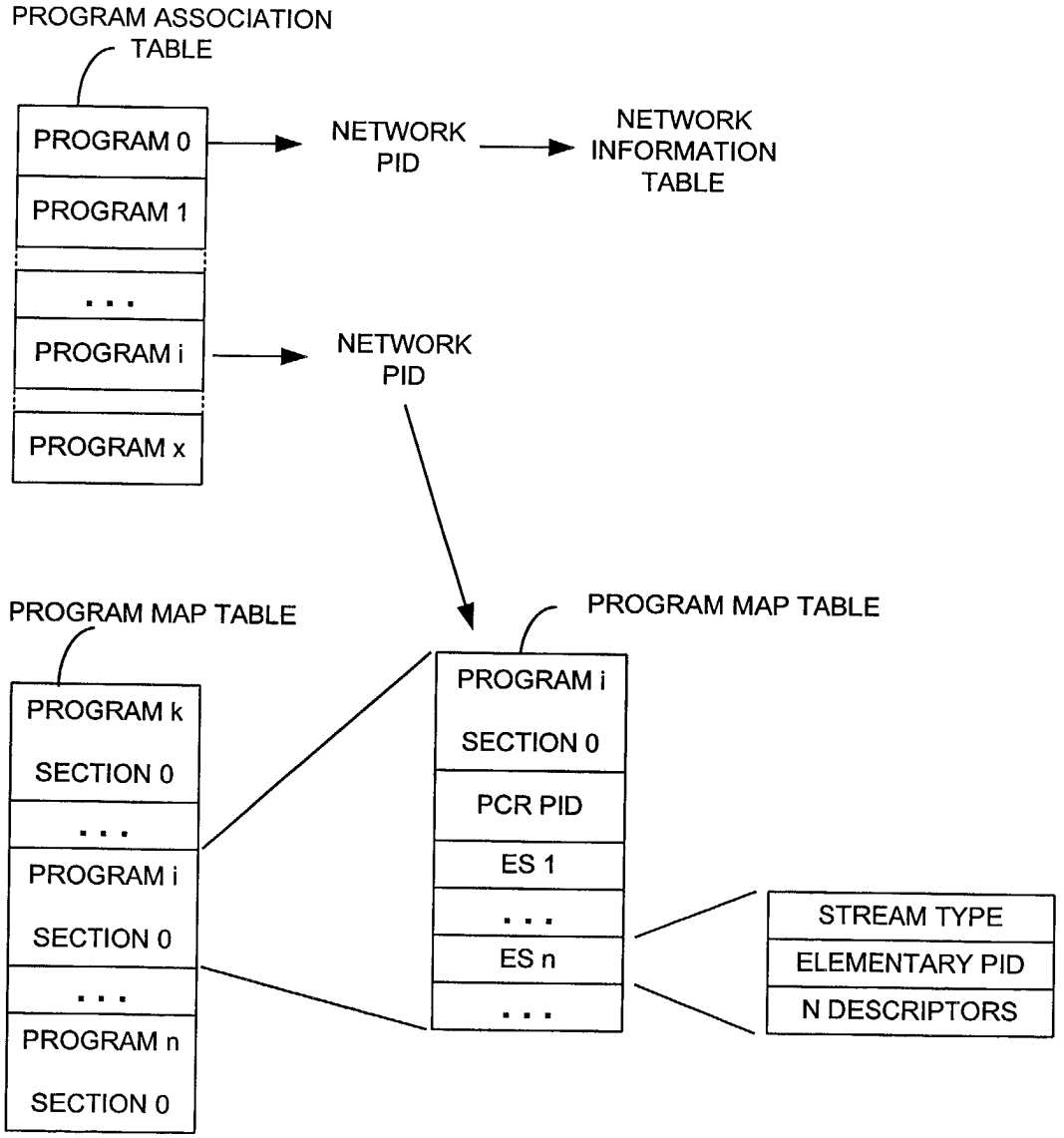
--PRIOR ART--

FIGURE 2



--PRIOR ART--

FIGURE 3



--PRIOR ART--

FIGURE 4

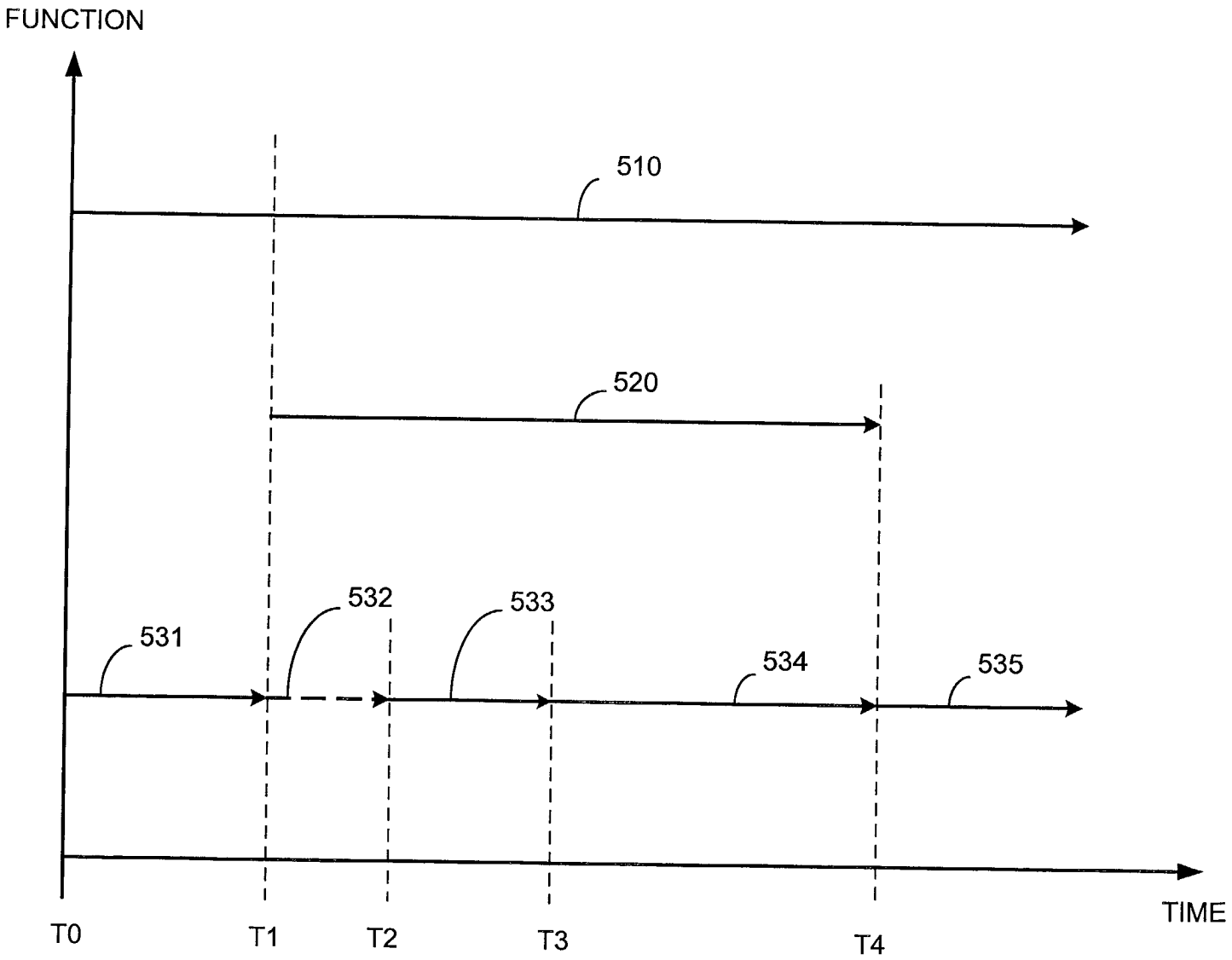


FIGURE 5

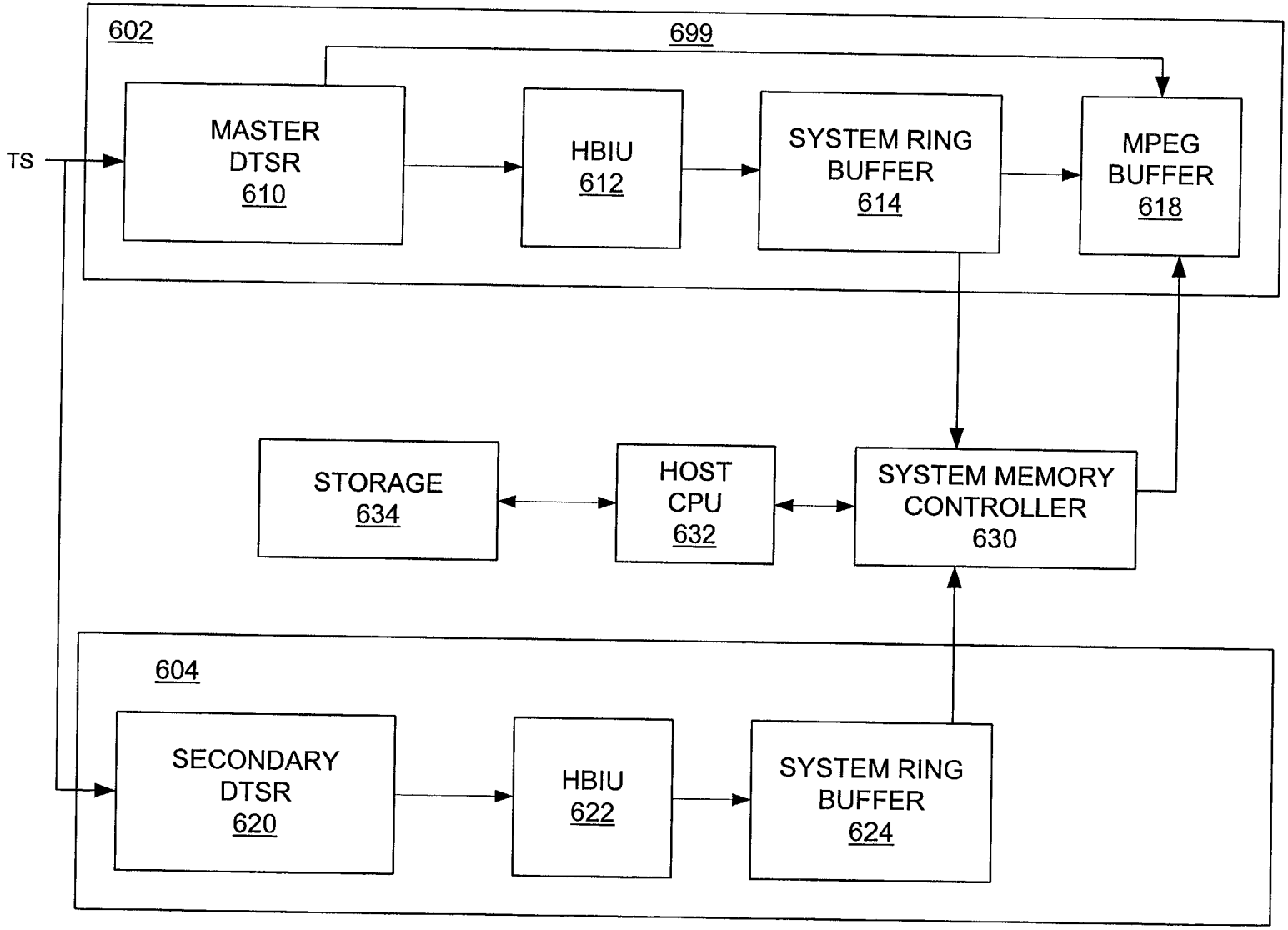


Figure 6

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing, OR
☐ **Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)**

Attorney Docket Number ATI0000690
First Named Inventor Branko Kovacevic
COMPLETE IF KNOWN
Application Number
Filing Date
Group Art Unit
Examiner Name

As a below named inventor, I hereby declare that:
My residence, post office address, and citizenship are as stated below next to my name.
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

the specification of which:
☒ is attached hereto.
☐ was file on (MM/DD/YYYY) as United States Application Number or PCT International Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Data (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Name	Registration Number	Name	Registration Number
J. Gustav Larson	39,263	Sally Daub	41,478

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: **Simon Fakhoury Tangalos Frantz & Galasso**
P.O. Box 26503
Austin, Texas 78755-0503
Telephone: 512-336-8957
Facsimile: 512-336-9155

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])			Family Name or Surname	
Branko			Kovacevic	
Inventor's Signature	Branko Kovacevic		Date	OCTOBER 26, 2000.
Residence	City: Willowdale	State: Ontario	Country: Canada	Citizenship: Canadian
Post Office Address	60 Clipper Road, Suite 1402			
City: Willowdale	State: Ontario	ZIP:	Country: Canada	

☒ Additional inventors are being named on the _____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

11-07-00

A

ATI000069
Patent Application

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Branko Kovacevic

Entitled: SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Box PATENT APPLICATION
Assistant Commissioner of Patents
Washington, D.C. 20231

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Date of Deposit 11/06/00
I hereby certify that this paper or fee is being deposited with the U S Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1 10 on the date indicated above and is addressed to Box PATENT APPLICATION
Assistant Commissioner of Patents, Washington, D C 20231

Type or Print Name Martha Rocha

Martha Rocha
Signature

Dear Sir:

REQUEST FOR FILING A NATIONAL PATENT APPLICATION

Transmitted herewith for filing, please find the following:

_X_ 1. Specification, claims and abstract of the above-referenced patent application having _23_ pages.

_X_ 2. _6_ sheet(s) of drawing(s) (_X_ formal / _ informal) comprising Figures _1_ through _6_.

_X_ 3. Declaration and executed Power of Attorney's (_X_ signed ___ unsigned).

_____ 3A. No filing fee, Oath, or Declaration is enclosed pursuant to 37 C.F.R 1.53(d).

____ 4. Information Disclosure Statement along with Form PTO-1449 and references.

____ 5. This is a: ____ Continuation-In-Part; ____ Divisional; ____ Continuation; ____substitute Application (MPEP 201.09) of Application Serial No. ____ filed ____; ____ reissue of U.S. Patent No. ____ filed on ____.
An extension to extend the life of the above prior Application to at least the date of filing hereof
(One box must be marked)
(a)____ is concurrently being filed in that prior Application,
(b)____ was previously filed in that prior Application,

(c)____ is not necessary for copendency.

SRL 5/25

__X__ 6. Attached is an assignment to **ATI Technologies ~~Inc.~~** Please return the recorded assignment to the undersigned.

____ 7. Priority is claimed under 35 U.S.C. § 119 based on filing in _____.

	Application No.	Filing Date
(1)		
(2)		
(3)		

____ (No.) Certified copy (copies) ____ are attached; or ____ were previously filed on ____.

____ 8. Attached: ___ (No.) verified statement(s) establishing "small entity" status under 37 CFR § 1.9 and 1.27.

__X__ 9. Attached:

__X__ Return Postcard
____ (Other)

____ 10. Preliminary Amendment:

Prior to a first Office Action, kindly amend the Application as follows:

11. The following Filing Fee calculation is based on the claims filed less any claims canceled by the Preliminary Amendment of Item 10.

					SMALL ENTITY RATE		LARGE ENTITY RATE		
BASIC FEE					$355	OR	$710	=	$710 00
	NUMBER FILED			NUMBER EXTRA					
TOTAL CLAIMS	27	-20	=	7 (at least 0)	x 9	OR	x 18	=	$126 00
INDEP CLAIMS	3	-3	=	0 (at least 0)	x 40	OR	x 80	=	$ 00 00
If any proper multiple dependent claim (ignore improper) is present (Enter $0 00 if this is a reissue application)					+$135	OR	+$270	=	+$
If assignment is x'd (item 6), add recording fee $40 00									+$ 40 00
Attached is a Rule 47 Petition (inventor refuses to sign or cannot be reached) $130									+$
TOTAL FILING FEE									**=$876.00**

____ 12. A check in the amount of ___ to cover the Filing Fee calculated in Item 11 is attached. Please charge any deficiency or credit any overpayment to ATI Technologies, Inc., PLC Deposit Account No. 50-0441.

__X__ 13. Please charge **ATI TECHNOLOGIES, INC.**, Deposit Account No. **50-0441** in the amount of **$ 876.00** the Filing Fee calculated in Item 11. This sheet is attached in duplicate.

__X__ 14. The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and may be required under 37 CFR 1.16-1.18 (missing or insufficiencies only) now or hereafter relative to this application and for the resulting Official Document under 37 CFR 1.20, and to have and cause any necessary petition for extension of time to be filed and any fees necessary to be paid for said extension of time OR credit any overpayment to ATI TECHNOLOGIES, INC., Deposit Account No. 50-0441 , for which purpose a duplicate copy of this sheet is attached.

Respectfully submitted,
Branko Kovacevic

11-6-2000
Date

J. Gustav Larson
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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

FILING OF A UNITED STATES PATENT APPLICATION

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

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SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Field Of The Invention

The present invention relates generally to time shifting of video data, and more specifically to time shifting of digital video data.

Background Of The Invention

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 addition 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. A digital signal stored directly can require a large amount of storage space, even when only a few minutes of video are captured. The digital signal can be compressed to reduce the amount of storage space required. However, compressing a video signal requires additional processing power, resulting in additional costs.

As the use of digital video data becomes increasingly common, a method and apparatus for time shifting a digital program that is more efficient than those known in art would be advantageous. 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) 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.

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.

A transport stream consists of fixed length packets based on 4 bytes of header followed by 184 bytes of data payload, where data payload is obtained by partitioning larger data blocks. For example, an elementary stream (ES) is a set of data generally consisting of compressed data from a single source, such as a video or audio source, with some additional ancillary data for identification, characterization and synchronization. ES streams are first packetized into either constant length or variable length Packetized Elementary Stream packets (PES packets) consisting of a header and payload. Each PES packet header starts with start code (ox000001) followed with the stream_id byte identifying type of ES underneath.

PES packets from various elementary streams are merged together to form a program (service) with its own system time clock (STC). All ES component streams within one program are synchronized have periodic PTS stamps corresponding to the STC counter to indicate the proper timing for each ES.

The relatively long and most often variable length PES packets are further packetized into shorter TS packets having a constant size of 188 bytes. A small and constant TS packet size makes error recovery easier and faster. Usually, the transport

stream carries several programs, each with its own STC. 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.

Each TS PSI table is sent in sections, usually occupying one or more TS packets. Four types of PSI tables exist: 1) Program Association Table (PAT) listing unique program_number (as an identifier of each program in one multiplex) and PID of the PMT table; 2) Program Map Table (PMT) listing PIDs of all component streams making a given program. PMT may be constructed for each program separately or be common for a group of programs; 3) Conditional Access Table (CAT) identifying PID of Entitlement Management Messages and ID of used conditional access system if any scrambling of TS or PES packets is done; 4) Private Table carrying Network Information Table (NIT) or private data.

The Hierarchical structure which exists between ES streams, PES and TP packets is illustrated in prior art Figure 1-4.

A method and apparatus for efficient time shifting of multiplexed packetized data streams, such as a packet stream, would be advantageous.

Brief Description Of The Drawings

Figures 1-4 illustrate various information associated with an MPEG transport stream of the prior art.

Figure 5 illustrates in graphical form a time line indicating various modes of operation in accordance with the present invention;

Figure 6 illustrates in block diagram form a specific embodiment of a system having to digital transport stream receivers in accordance with the present invention.

Detailed Description Of The Drawings

A specific method and apparatus is disclosed describing a time shifting technique. In one embodiment, the disclosed time shifting technique can be based upon a hardware transport stream demultiplexer that interfaces to a transport stream. The hardware demultiplexer application assists in the extraction and parsing of a multiplexed packetized data stream, such as a MPEG-2 Transport Stream (TS) multiplex. One such hardware demultiplexer is disclosed in pending patent application (990135), which is hereby incorporated herein by reference. The disclosed hardware transport core is used to filter component streams into 15 memory ring buffers, one allocated in the frame memory for the dedicated MPEG-2 video decoder and others in the system memory for the dedicated software parser. It can demultiplex the most frequent transport packets of video stream into an Elementary Stream (ES) by monitoring the first packet identifier (PID) of each TS packet. This flexible filter can be set to extract private data from the adaptation field (AF) or from the PES packet header. Thirty-one other PIDs can be simply filtered and routed to a common (joint) or individual memory buffers for subsequent software processing on the host processor. The basic idea of a time shifting is shown in Figure 5.

Figure 5 illustrates three functions performed by a time shifting system. A first function is to receive a live broadcast stream 510. According to the graph of Figure 5, the live broadcast stream is continuously received during the time represented in Figure 5.

A second function of a time shifting system is to record a specific program after a user activates the time shifting feature. Vector 520 of Figure 5 indicates when a specific program is being recorded by the time shifting system.

A third function of the time shifting system is to display the specific program. Vector 530 of Figure 5 indicates when a specific program is being played back. Specifically, vector portion 531 represents the time where the program is being displayed directly from the live broadcast stream. Vector portion 532 represents the time that the user is unable to view the program, i.e. the user is away from the television. Therefore, in

one embodiment, during this time no program is displayed. In an alternate embodiment, the live feed can continue to be displayed, even though the program is being recorded.

Vector 533 represents the time during which the time-shifted program, which has been stored, is being replayed at a normal playback rate. Note that during this time, the live program feed continues to be recorded for future time shifted play back.

Vector 534 represents a time during which the time shifted program is being replayed at a faster than normal replay rate. By being able to playback at a faster than normal rate, it is possible to catch-up to the live broadcast stream.

The receive-only mode of vector 31 represents where the digital transport stream receiver (DTSR) is receiving a live broadcast and demultiplexing one program of a plurality of programs available in the live broadcast stream. This will be referred to as **Transparent Mode** indicating the transport stream is accessed immediately and not saved. Therefore, from the point of view of digital storage media (DSM), the received data is transparent.

Note that the PAT table is constantly acquired, in transparent mode, and other modes, so that version number change or PMT table PID change for a currently viewed program can be detected. If such a change occurs during the live broadcast of a program, PIDs will be reprogrammed for video and splicing with be handled.

A Continuous Time Shifting Mode occurs during vectors 532-534. Continuous time shifting mode occurs when time shifting is selected by the viewer to store part or all of a program for later viewing after a short or long intermission. During continuous time shifting mode, a selected program from a given multiplex is received and stored on a hard disk, or other storage media, in the form of full transport stream packets or PES packets.

A Part-Time Time-Shifting Mode, when selected by the viewer, allows for replay of a time shifted program or fast forward (FF) replay of a time shifted program at user defined FF speed. In Figure 5 this is represented as vectors 533 and 534. In a

specific embodiment discussed herein, this time-shifting mode is the most demanding mode of the 3 described modes because: the host CPU system is receiving and storing a real time event; at the same time, the host CPU is retrieving saved stream data from the disk; simultaneously with first two operations, the host CPU is performing transport stream de-multiplexing of video, audio, private and PSI/SI data on a host CPU; and at the same time the host CPU is restoring PCR/PTS time-base information as described later.

For some digital television applications, time-shifting may be considered a peak event that occurs sometimes or occasionally. However, some users may depend on it all the time, up to the end of the current program once it was started. For those users, typical operating state of the system is time shifting, de-coupled from the live stream. Time shifting of the digital transport stream should offer the same quality as from the live broadcast (source stream).

Systems suitable for time-shifting need to simultaneously receive and decode a transport stream and handle incoming source stream (to process all PSI and SI data) and record incoming source stream as a full entity or just its one program. Time shifting allows the viewer to step away from the TV monitor without missing any of the program parts. One embodiment of time shifting includes storing all transport packets received on the transport stream. Another embodiment of time shifting that is more efficient includes: 1) selecting just the transport packets of interest (PSI, SI, video, audio and data packets) that constitute one program event to minimize the bit-rate of the recorded stream, to minimize the bandwidth through the host bus interface unit, and to minimize hard disk head movement (if any); 2) increasing the amount of storage and useful life of the hard disk; and 3) assuring that the amount of data that needs to be processed by the host processor is received and stored as: transport stream packets; PES packets of video, audio, data, PSI and SI content, de-multiplexed transport; or PES packets of video and audio and bus master compressed video into the video bit-stream buffer of the MPEG video decoding device.

Selection of just one time shifted program reduces the potentially high bit-rate of a transport stream multiplex to a manageable size, suitable for storage on current 10GB hard disk units (two hours of 10Mbps stream). Obviously, a large disk drive is needed to allow any reasonable length of time shifting. In time shifting mode where time shifted material is simultaneously received and stored, the bit-rate of the host bus-interface unit (HBIU) needs to be double a system where the HBIU is only responsible for playing a single program stream. Generally the bandwidth needed is calculated to be approximately 20Mbps instead 10Mbps.

Because closed or proprietary systems, such as set-top boxes, usually do not share the hard disk drive with other systems, very specialized disk drives for audio-video applications with specialized interfaces can be used. Hard drive features that would be advantageous include: 1) Increasing access speeds and sustained sequence transfers in two directions; 2) Having deferred re-calibration of drive heads to prevent glitches or latencies during playback; 3) Having head offsets to prevent losing a revolution when going from side to side on a platter; 4) Supporting on the fly error correction; and 5) Having embedded multi-disk drive units that decrease access latencies.

The operating system can play a significant role in the efficient use of the drive by accessing most frequent video data in large blocks and decreasing seek time. Generally, larger read/write blocks increase efficiency of data storage and retrieval. Sometimes they can cause unwanted glitches by increasing latency during access.

The first time shifting mode of operation is a receive-only mode. During receive-only mode of operation a master digital time shifting receiver (DTSR) 610, of Figure 6, is programmed to receive and parse transport stream packets matching video and PCR PIDs. A host CPU 632 is assisting MPEG-2 clock recovery, and the same recovered clock data is supplying Master DTSR 610 and the Secondary DTSR 620. In one embodiment, the recovered clock is provided to the secondary DTSR 620 registers through the use of the system memory controller 630. Also, the Master DTSR 610 is programmed to perform PID filtering of audio, private, and PSI/SI PIDs programmed in the auxiliary PID registers. Secondary DTSR 620 is programmed for PID filtering

operations on Video PID programmed on a first auxiliary PID register. However, since the receiver is in receive-only mode, the video transport packets in the ring buffer 624 are disregarded. The clock recovery algorithm is suppressed on the secondary DTSR 620. Only STC of the slave DTSR is set upon the channel change. Host CPU 632 performs PES parsing of audio transport stream packets, decode and presentation of audio frames (on AC-97 codec or wave device), and continuous parsing and data processing of PSI sections monitoring real-time events like PID change, PCR discontinuity or splicing of audio stream. This activity by the host CPU 632 is part of the normal receive only mode of operation where a specified channel is being decoded and displayed. Specific systems and methods for supporting these processes are described in the patent application already incorporated by reference.

When in continuous time-shifting mode of operation, the host CPU 632 performs additional processing including: retrieval; multiplexing; time base corrections; storage of video audio, private and PSI/SI transport stream packets from multiple buffers 614 allocated in the memory space of the host CPU. In one embodiment, however, the master DTSR 620 is used to decode and display video stream as describe previously with reference to receive only mode. Transport packets from a common program are retrieved from the buffer 614 and provided to a digital storage media circular file system in a multiplexed manner. Multiplexing is performed by inserting audio, video, private, and PSI/SI transport stream packets to satisfy a group of relevant criteria.

Fundamental functions performed during continuous digital time shifting include: 1) Preserving of original ES_rate of each component stream; 2) Limiting PCR jitter of newly created single program multiplex; 3) Preserving VBV_delay value (the number of periods of a 90KHz clock derived from the 27MHz system clock that the VBV shall wait after receiving the final byte of the picture start code before decoding the picture) to insure non-interrupted MPEG video decode after initial VBV_delay time in constant bit-rate (CBR) stream environments; 4) Preventing underflow or overflow of elementary stream decoder buffers in accordance with the T_STD model defined in ISO/IEC 13818-1 standard; 5) providing PID values in the video or audio TS packets that were originally defined in the PMT section to be a video or audio PIDs. Alternatively, a new artificial

PCR stream can be separately created and injected as TS PCR packets at the rate of at least 10 times per second to create a new time base for decimated, time-shifted stream stored on the DSM. Whereby, the original PAT transport packet is modified or a new PAT packet is inserted into the stream instead of the original PAT section to indicate a single program only whose PMT section indicates video, audio, PCR and other PID that carry subtitles, program descriptions, etc. As a stable clock source, STC of the Master DTSR is used to measure elapsed time between two PCR samples; 6) Providing PTS values in the video, audio or private data streams by using STC of the Master DTSR as elapsed time counter; and 7) Initializing STC of the playback DTSR device to a first available PCR value encoded in the stream saved on DSM media, immediately after channel change.

While in part-time digital time-shifting mode, the host CPU 632 performs some additional processing like retrieval and de-multiplexing of the single program transport stream created in continuous time digital time-shifting mode during a storage process. Generally, the playback of the stored program is combined with continued transport stream de-multiplexing and recording of the real-time transport stream. Such a mode of operation is the most intensive mode of operation because the host CPU 632 must create/store a multiplexed single program transport stream from a continued reception of a live broadcast; and retrieve and de-multiplex saved content from a digital storage media while performing transport stream de-multiplexing, audio decode, and bus mastering elementary stream video to the MPEG video decoder.

In one implementation, an MPEG decoder associated with the Master DTSR 610 is used to decode and display a video stream from a DSM media and receive private data, and PSI/SI sections from a live broadcast. In such a case, a video PID of the Master DTSR 610 is disabled, while video data with its PTS information is fed directly to the MPEG decoder using the system memory controller 630. However, PCR PID is programmed on a Master DTSR so that MPEG clock recovery continues from a live transport stream feed and is supplied to the STC counters of both the master DTSR 610 and the second DTSR 620. In one implementation, only the video PID is programmed into the Slave DTSR for retrieving live video stream and sending it to circular buffer on

the host system in the form of a full MPEG-2 transport stream packets, while the Master DTSR is used to buffer the non-video components of a specific program.

In another embodiment, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of a digital time shifting. In the second embodiment, a first DTSR is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID of the first DTSR is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR can be used in all 3 modes to receive video, audio, private data and PSI/SI sections, all utilizing auxiliary PID filters and received as full MPEG-2 transport packets arriving in the single memory queue. This way, the temporal order of a stream and validity of the T-STD decoder model is inherently preserved. Also, the amount of the host DRAM memory required for queue allocation is less than in the first case. In both embodiments, a quality digital stream time shifting at the transport packet level is achieved.

In yet another operating mode, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of digital time shifting by storing PES layers as a basic format of the audio/video data saved on a DSM. In PES operating mode, two hardware embodiments are possible, the same as in TP operating mode.

In a first hardware embodiment, the first DTSM is used as a combo device, to achieve playback of live or stored MPEG video and reception of audio, private & PSI/SI content. The second device is used only to receive and de-multiplex MPEG-2 video transport stream and retrieve MPEG-2 elementary stream from a live broadcast. Upon retrieval of ES video, PES packets are formed and stored on the DSM media.

In the second hardware embodiment, the first DTSM is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR is used in all 3 time-shifting modes to receive audio, private data, PSI/SI sections, by utilizing auxiliary PID filters to store

the transport packets to a single memory queue. That way, a temporal order of a stream and validity of T-STD decoder model is already preserved.

In yet another time shifting embodiment, the video is de-multiplexed to the level of elementary stream and stored at the bit-stream buffer of the MPEG video decoder physically allocated in the frame memory. The MPEG video stream is then retrieved from this buffer by a software processing thread running on a host CPU. Every time a picture start code is found in the video bit-stream buffer, a full compressed MPEG picture, in the form of elementary stream, is sent to the system memory buffer by DMA. One such method is disclosed in patent application (990135) which is hereby incorporated herein by reference.

Before storing the full compressed MPEG picture in the DSM, a PES packet header is added. The audio stream is de-multiplexed and decoded by the host CPU. In a similar fashion as the video, prior to audio decoding, the audio frames are packetized into PES packets. Essential information from the PSI/SI/private data tables is decoded and stored in a pure source form on a DSM. This way, further reduction of the host DRAM memory requirements for queue allocation and memory on the DSM media is reduced. An advantage of this mode is reduction of CPU cycles needed for A/V playback of stored data due to the PES format of audio/video data. PES de-multiplexing is done in place, passing pointers to the payload of PES packets that contain video or audio frames, other implementations required they be sent by DMA to the video decoder before they were decoded on host CPU (MPEG or AC-3 audio). As a result, the host CPU doesn't move any raw audio or video data, and host CPU utilization is reduced in order of magnitude compared to TS playback operating mode.

In the foregoing specification, the invention has been described with reference to specific embodiments. However, one of ordinary skill in the art appreciates that various modifications and changes can be made without departing from the scope of the present invention as set forth in the claims below. For example, the specific time-shifting implementation has been described as with reference to a specific transport stream demultiplexer, and described in a previous applications which have been incorporated by

reference. Different transport stream demultiplexers and method of implementing specific aspects of the present invention can be used as well. Likewise, specific partitions between hardware and software implementions have been described, which can vary depending upon the implemented demultiplexer. For example, the video stream parser can be designed to support routing the parsed video data to a circular buffer that is accessible by the system memory controller. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of present invention. In the claims, means-plus-function clause(s), if any, cover the structures described herein that perform the recited function(s). The mean-plus-function clause(s) also cover structural equivalents and equivalent structures that perform the recited function(s). Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any element(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature or element of any or all the claims.

WHAT IS CLAIMED IS:

1. A method comprising the steps of:

receiving a multiplexed packetized data stream that carries real-time multimedia programs;

during a first time:

storing a first portion of the packetized data stream representing video data and timing data of a program;

setting a system time indicator to a stored system time value, wherein the stored system time value is based on a portion of the timing data of the first portion of the packetized data stream;

during a second time:

incrementing the system time indicator;

retrieving the video data of the first portion of the packetized data stream for video decoding; and

storing a second portion of the packetized data stream representing video data and timing data of the program.

2. The method of claim 1, wherein

the step of storing the first portion of the packetized data stream includes the first portion of the packetized data stream representing audio data of the program;

the step of storing the second portion of the packetized data stream includes the second portion of the packetized data stream representing audio data of the program;

the method further including the step of

during the second time

the step of accessing the audio data of the first portion of the packetized data stream for audio playback.

3. The method of claim 1, wherein the multiplexed packetized data stream is a

multiplexed packetized data stream that substantially meets an MPEG2 specification.

4. The method of claim 3, wherein the step of storing the first portion includes storing transport stream packets.

5. The method of claim 4, wherein the step of storing the first portion includes the sub-steps of

   determining transport stream packets containing data associated with the program; and

   storing the transport stream packets containing data associated with the program after the step of determining.

6. The method of claim 3, wherein the step of storing the first portion includes storing packetized elementary stream (PES) packets.

7. The method of claim 6, wherein the step of storing the first portion includes the sub-steps of

determining transport stream packets containing data associated with the program; and

storing PES packets based upon the transport stream packets containing data associated with the program after the step of determining.

8. The method of claim 1, wherein the step of storing the first portion of the transport stream includes the timing data including synchronization information used for playing the program back at a real time program bit-rate.

9. The method of claim 1 wherein the step of incrementing the system time indicator includes incrementing the system time indicator based upon a signal generated from multiplexed packetized data stream data received after the first time.

10. The method of claim 1 further comprising the step of:
decoding the video data of the first portion to provide a decoded video stream.

11. The method of claim 10, wherein the steps of receiving a multiplexed packetized data stream and decoding the video data are performed by an integrated semiconductor device.

12. The method of claim 10 further comprising the step of:
providing the decoded video stream for display at a play back rate.

13. The method of claim 12 wherein the play back rate is a real time rate.

14. The method of claim 12 wherein the step of providing the decoded video stream for display includes determining the play back rate based upon clock recovery data of the first portion of the transport stream, wherein the play back rate will vary

depending upon a rate at which the first portion of the transport stream data is provided to a decoder during the step of decoding.

15. The method of claim 12 wherein the step of providing the decoded video stream for display includes determining the play back rate based upon timing data received from the multiplexed packetized data stream after the first time.

16. The method of claim 15, wherein the timing data received from the multiplexed packetized data stream after the first time is associated with a current real-time data stream.

17. The method of claim 12, wherein the play back rate is faster than a real time rate.

18. A method comprising the steps of:

determining a mode of operation;

during a first mode of operation:

receiving a multiplexed packetized data stream at a first demultiplexer;

selecting a first program from the multiplexed packetized data stream;

decoding a video portion of the first program for display;

during a second mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing the first program;

during a third mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing a first program portion of the first program;

providing the first program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the first program portion;

decoding the video portion of the first program portion for display; and

storing a second program portion of the first program simultaneous to the step of decoding.

19. The method of claim 18, further comprising during the third mode of operation the steps of:

providing the second program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the second program portion; and

decoding the video portion of the second program portion for display.

20. The method of claim 18 further comprising, during the third mode of operation, the steps of:

incrementing a counter associated with the second demultiplexer based upon a signal generated using a live feed of the multiplexed packetized data stream as it is received at the first demultiplexer.

21. A system comprising:

a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs;

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;

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;

a first clock recovery module having an input coupled to the first input node, and an output, wherein the 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 it is stored in the storage device;

a decoder having a first input coupled to the output of the first clock recovery system to receive the clock, a second input coupled the data port of the storage device to receive the select packets, and an output to provide decoded real-time data

22. The system of claim 21, wherein the first clock recovery module further generates the clock based upon data transmitted in packets of a currently received multiplexed packetized data stream.

23. The system of claim 21, wherein the first clock recovery module further generates the clock based upon multiplexed packetized data stream data stored in the storage device.

24. The system of claim 21, wherein the decoder includes a video decoder.

25. The system of claim 24, wherein the decoder includes an audio decoder.

26. The system of claim 21 further comprising:

a second transport stream demultiplexer having an input coupled to the data port of the storage device;

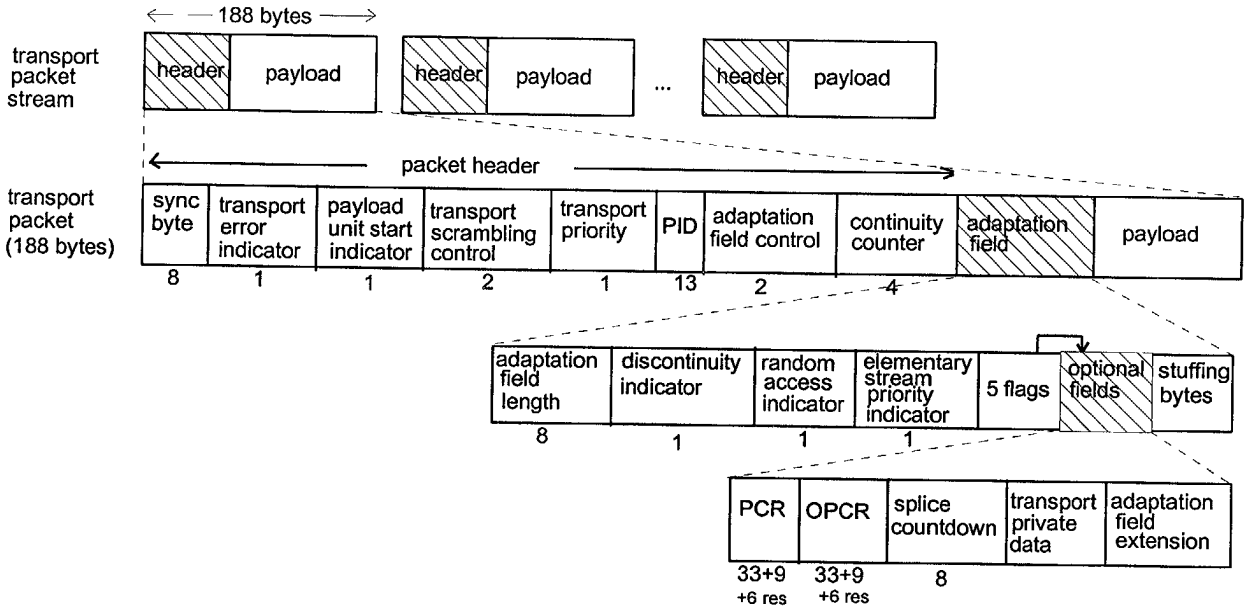
27. The system of claim 26 further comprising:

a second clock recovery module having an input coupled to the data port of the storage device to allow STC setting based on a stored system time.

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

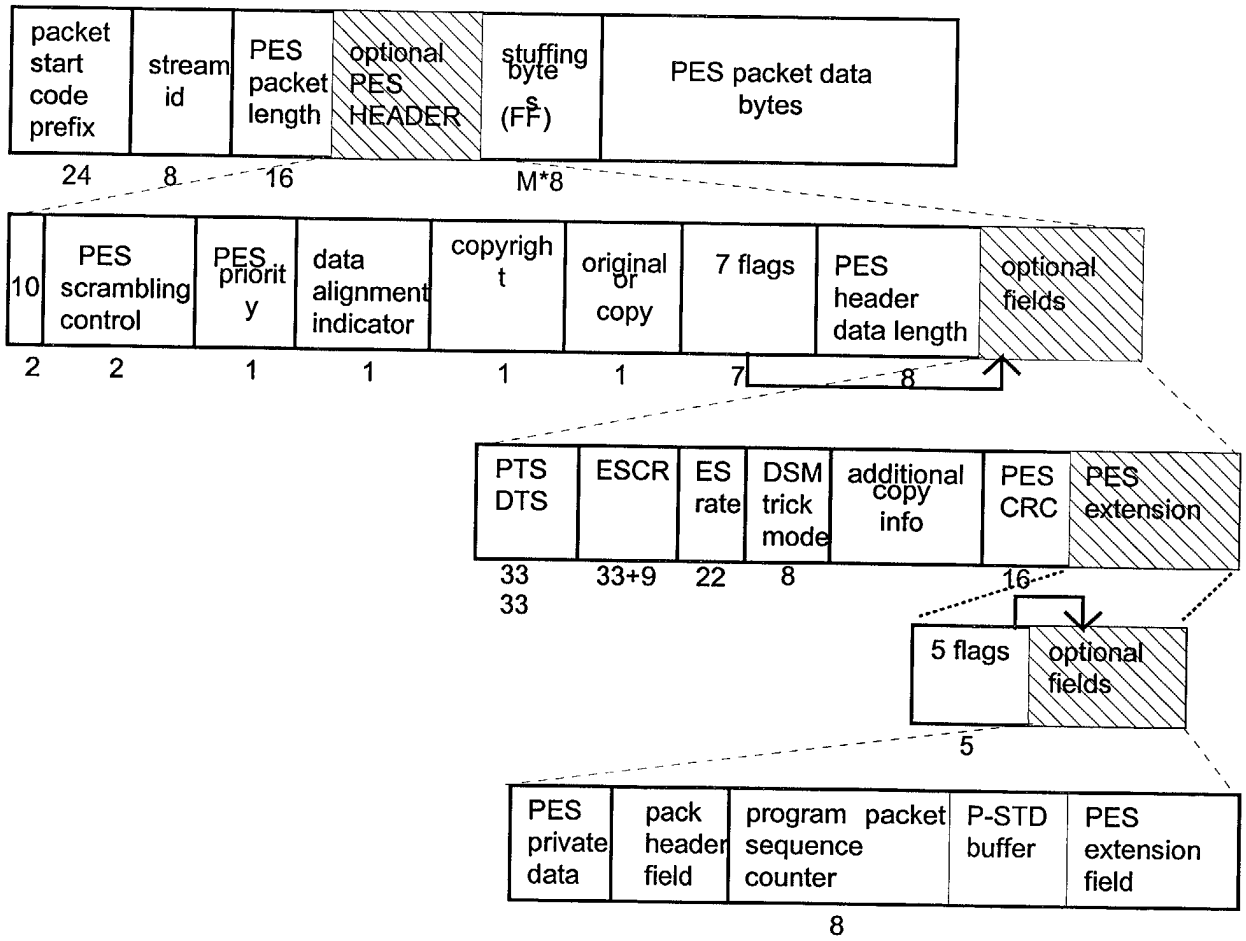
Abstract Of The Disclosure

A multiplexed packetized data stream carrying real-time multimedia programs is received at a first hardware demultiplexer. Based on a user input, a video and timing portion of a program associated with the multiplexed packetized data stream can be stored for subsequent display. One type of subsequent display is time shifted display, where the stored portion of the program is played back while new portions of the program are being stored. During time shifted play back, a second hardware demultiplexer can be used, so that one demultiplexer stores new data and maintains a current clock value while the other decodes and displays the stored data.



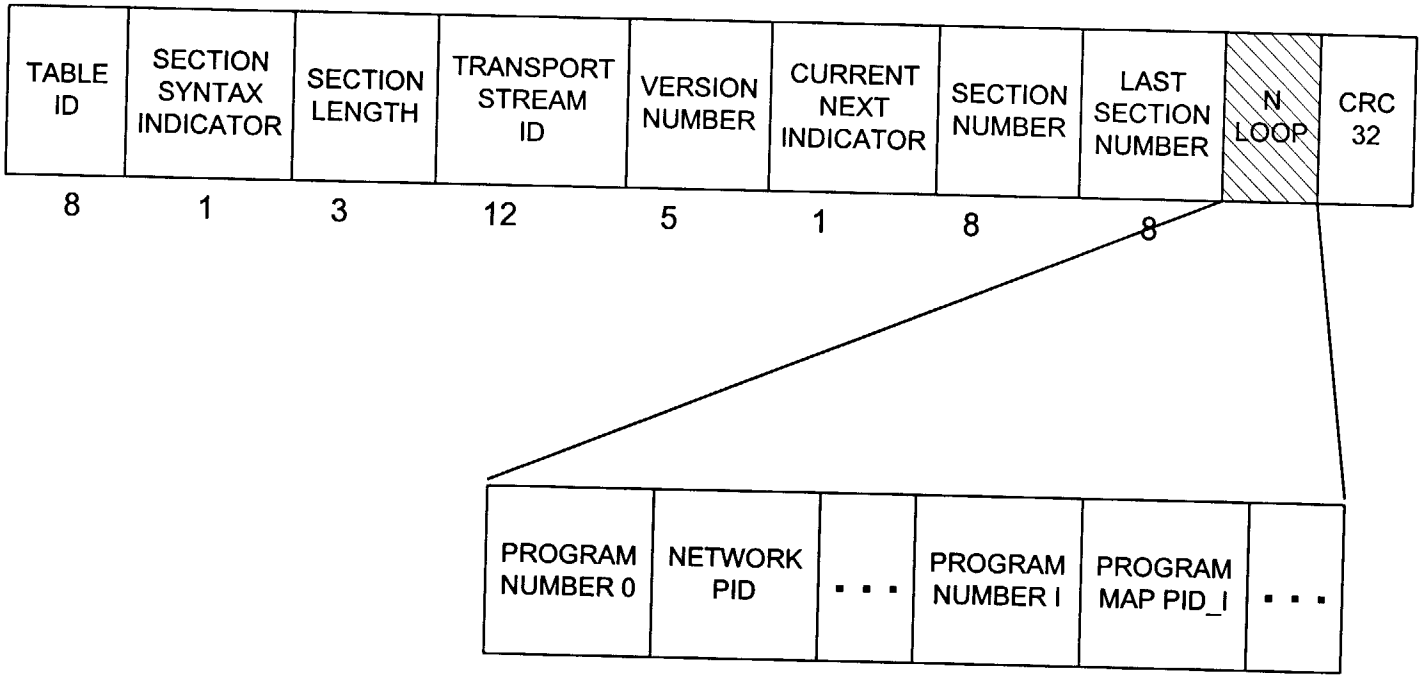
--PRIOR ART--

FIGURE 1



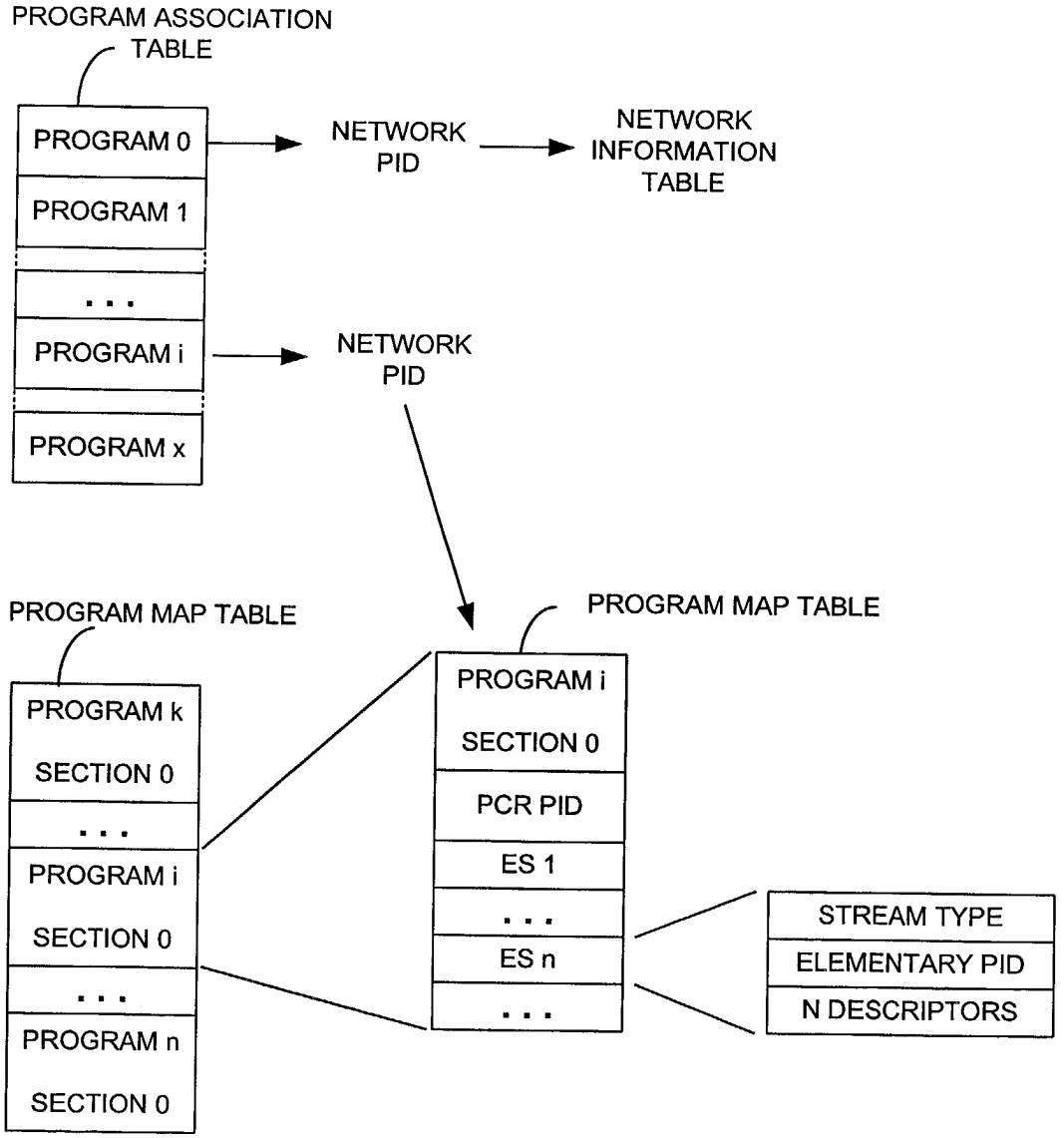
--PRIOR ART--

FIGURE 2



--PRIOR ART--

FIGURE 3



--PRIOR ART--

FIGURE 4

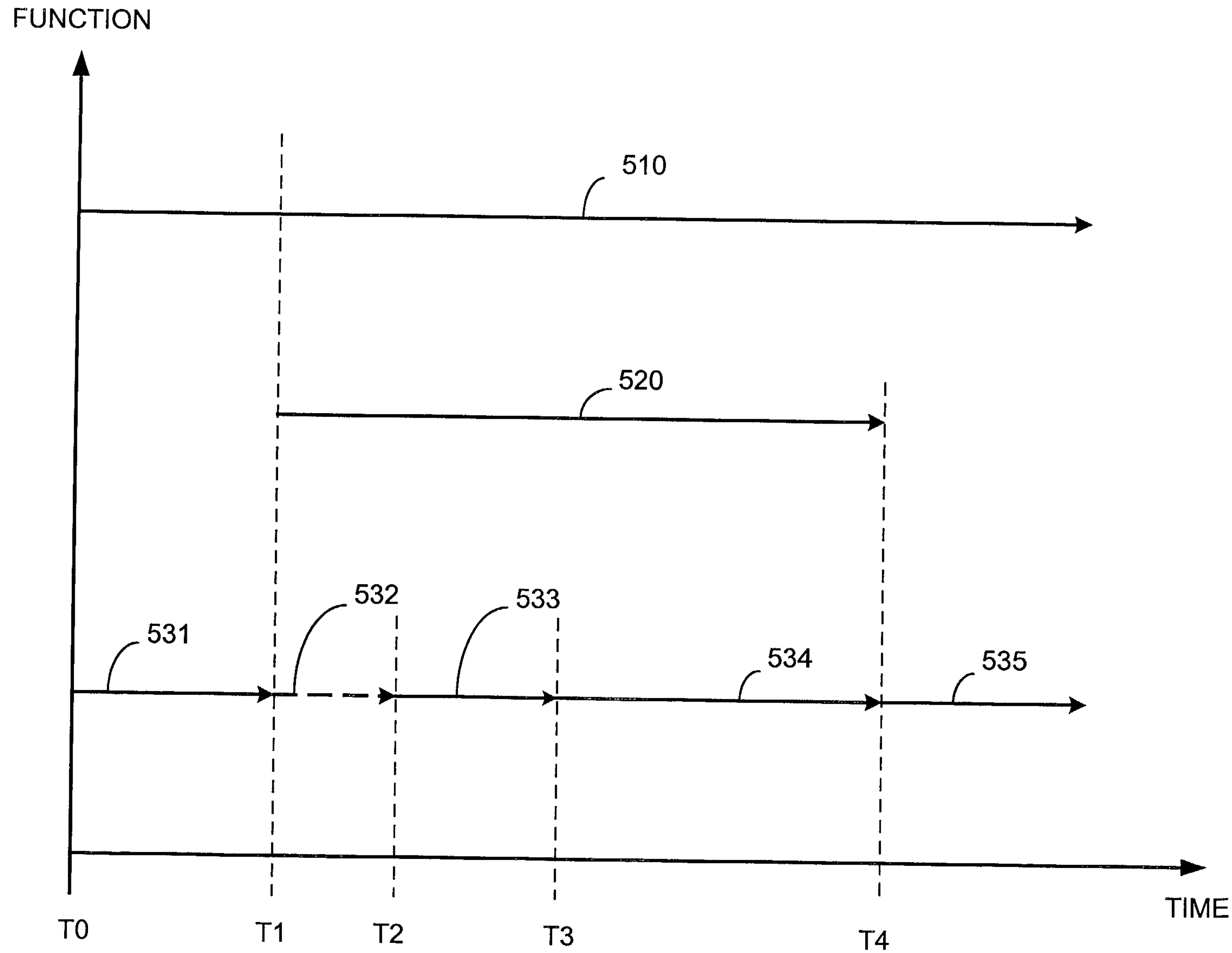


FIGURE 5

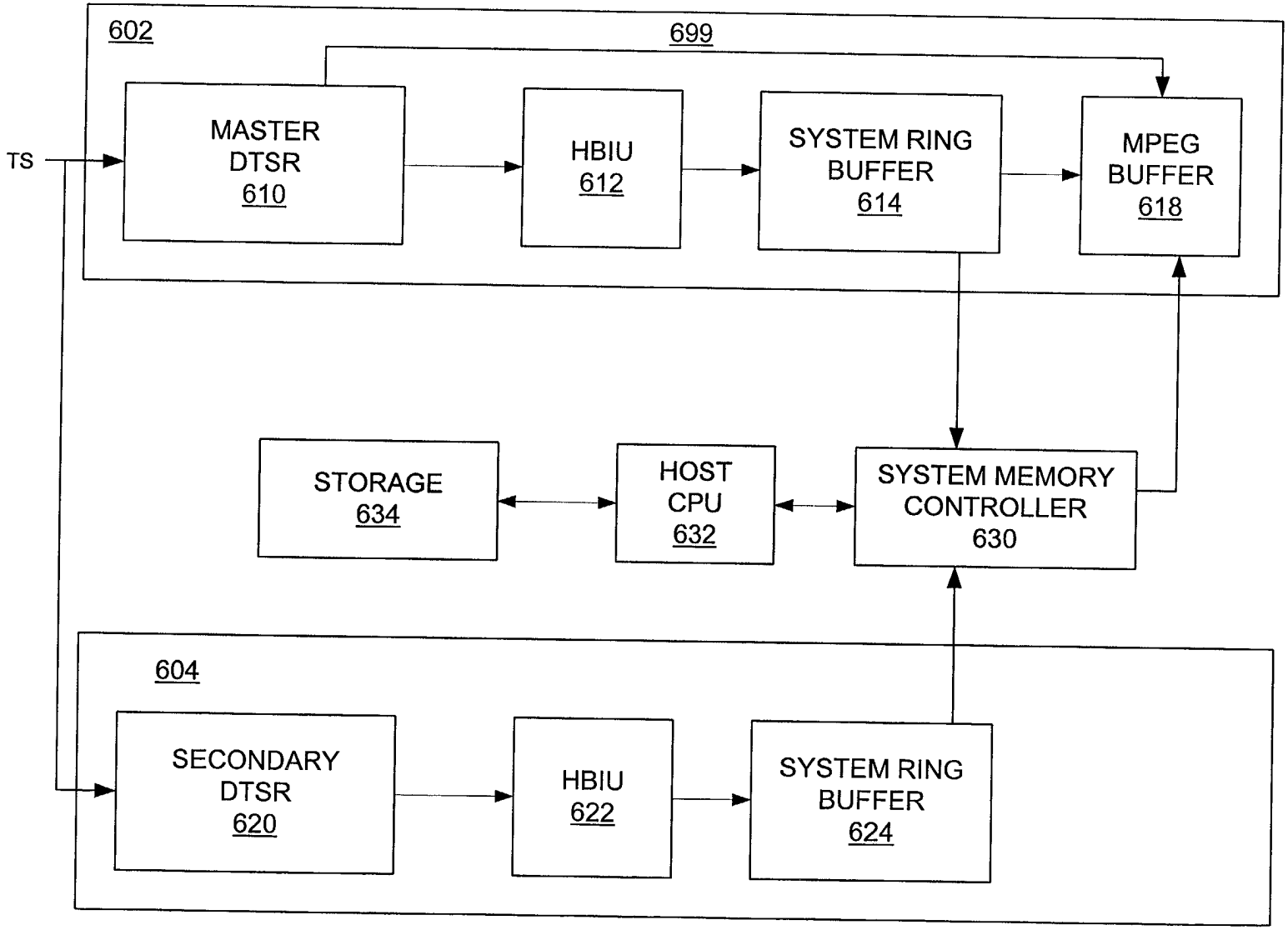


Figure 6

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing, OR
☐ **Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)**

Attorney Docket Number ATI0000690
First Named Inventor Branko Kovacevic
COMPLETE IF KNOWN
Application Number
Filing Date
Group Art Unit
Examiner Name

As a below named inventor, I hereby declare that:
My residence, post office address, and citizenship are as stated below next to my name.
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

the specification of which:
☒ is attached hereto.
☐ was file on (MM/DD/YYYY) as United States Application Number or PCT International Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Data (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Name	Registration Number	Name	Registration Number
J. Gustav Larson	39,263	Sally Daub	41,478

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: **Simon Fakhoury Tangalos Frantz & Galasso**
P.O. Box 26503
Austin, Texas 78755-0503
Telephone: 512-336-8957
Facsimile: 512-336-9155

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])			Family Name or Surname	
Branko			Kovacevic	
Inventor's Signature	Branko Kovacevic		Date	OCTOBER 26, 2000.
Residence	City: Willowdale	State: Ontario	Country: Canada	Citizenship: Canadian
Post Office Address	60 Clipper Road, Suite 1402			
City: Willowdale	State: Ontario	ZIP:	Country: Canada	

☒ Additional inventors are being named on the _____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

JC925 U.S. PTO
09/707060
11/06/00

ISSUE CLASSIFICATION	
Class	Subclass

C

PATENT NUMBER

U.S. UTILITY Patent Application

O.I.P.E.	PATENT DATE
SCANNED NC Ed(2) Q.A. UB	

APPLICATION NO.	CONT/PRIOR	CLASS	SUBCLASS	ART UNIT	EXAMINER
09/707060		386	46	2615	Onuaku

APPLICANTS: Branko Kovacevic

TITLE: System for digital time shifting and method thereof

PTO-2040 12/99

ISSUING CLASSIFICATION

ORIGINAL		CROSS REFERENCE(S)						
CLASS	SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					
INTERNATIONAL CLASSIFICATION								
			☐ Continued on Issue Slip Inside File Jacket					

☐ TERMINAL DISCLAIMER	DRAWINGS			CLAIMS ALLOWED	
	Sheets Drwg.	Figs. Drwg.	Print Fig.	Total Claims	Print Claim for O.G.
☐ The term of this patent subsequent to ________ (date) has been disclaimed.	(Assistant Examiner) (Date)			NOTICE OF ALLOWANCE MAILED	
☐ The term of this patent shall not extend beyond the expiration date of U.S Patent. No. ________	(Primary Examiner) (Date)			ISSUE FEE: Amount Due	Date Paid
☐ The terminal ____ months of this patent have been disclaimed.	(Legal Instruments Examiner) (Date)			ISSUE BATCH NUMBER	

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The information disclosed herein may be restricted. Unauthorized disclosure may be prohibited by the United States Code Title 35, Sections 122, 181 and 368. Possession outside the U.S. Patent & Trademark Office is restricted to authorized employees and contractors only.

Form PTO-436A (Rev. 6/99)

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[redacted]

SEARCHED

Class	Sub.	Date	Exmr.
386	46 48 68 104	9/25/04	Leo
348	493.1	9/25/04	Leo
360	39 48	9/25/04	Leo
369	32.01	9/25/04	Leo

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.

SEARCH NOTES
(INCLUDING SEARCH STRATEGY)

	Date	Exmr.
Thai Tran 386	9/25/04	Leo
Thai Tran 348	↓	↓
Andy Sniezek 360		
Thang Tran 369		

(RIGHT OUTSIDE)

ISSUE SLIP STAPLE AREA (for additional cross references)

POSITION	INITIALS	ART NO.	DATE
FEE DETERMINATION			
O.I.P.E. CLASSIFIER		43	11/29/00
FORMALITY REVIEW	CM	71632	12/8/00
RESPONSE FORMALITY REVIEW			

INDEX OF CLAIMS

✔	Rejected	N	Non-elected
=	Allowed	I	Interference
—	(Through numeral)... Canceled	A	Appeal
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Claim Final	Claim Original	Date
	1	9/28/00
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If more than 150 claims or 10 actions staple additional sheet here

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11-07-00

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ATI000069
Patent Application

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Branko Kovacevic

Entitled: SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Box PATENT APPLICATION Assistant Commissioner of Patents Washington, D.C. 20231	CERTIFICATE OF MAILING BY EXPRESS MAIL "EXPRESS MAIL" Mailing Label No. EL579093813US Date of Deposit 11/06/00 I hereby certify that this paper or fee is being deposited with the U.S. Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to : Box PATENT APPLICATION Assistant Commissioner of Patents, Washington, D.C. 20231 Type or Print Name Martha Rocha Martha Rocha Signature

Dear Sir:

REQUEST FOR FILING A NATIONAL PATENT APPLICATION

Transmitted herewith for filing, please find the following:

__X__ 1. Specification, claims and abstract of the above-referenced patent application having __23__ pages.

__X__ 2. __6__ sheet(s) of drawing(s) (__X__ formal / __ informal) comprising Figures __1__ through __6__.

__X__ 3. Declaration and executed Power of Attorney's (__X__ signed ___ unsigned).

_____ 3A. No filing fee, Oath, or Declaration is enclosed pursuant to 37 C.F.R 1.53(d).

____ 4. Information Disclosure Statement along with Form PTO-1449 and references.

____ 5. This is a: ____ Continuation-In-Part; ____ Divisional; ____ Continuation; ____substitute Application (MPEP 201.09) of Application Serial No. ____ filed ____; ____ reissue of U.S. Patent No. ____ filed on ____.

An extension to extend the life of the above prior Application to at least the date of filing hereof

(One box must be marked)

(a)____ is concurrently being filed in that prior Application,

(b)____ was previously filed in that prior Application,

(c)____ is not necessary for copendency.

SRL 6/25

__X__ 6. Attached is an assignment to **ATI Technologies ~~Inc.~~** Please return the recorded assignment to the undersigned.

____ 7. Priority is claimed under 35 U.S.C. § 119 based on filing in _____.

	Application No.	Filing Date
(1)		
(2)		
(3)		

____ (No.) Certified copy (copies) ____ are attached; or ____ were previously filed on ____.

____ 8. Attached: ___ (No.) verified statement(s) establishing "small entity" status under 37 CFR § 1.9 and 1.27.

__X__ 9. Attached:

__X__ Return Postcard
____ (Other)

____ 10. Preliminary Amendment:

Prior to a first Office Action, kindly amend the Application as follows:

11. The following Filing Fee calculation is based on the claims filed less any claims canceled by the Preliminary Amendment of Item 10.

					SMALL ENTITY RATE		LARGE ENTITY RATE		
	BASIC FEE				$355	OR	$710	=	$710.00
	NUMBER FILED			NUMBER EXTRA					
	TOTAL CLAIMS 27	-20	=	7 (at least 0)	x 9	OR	x 18	=	$126.00
	INDEP. CLAIMS 3	-3	=	0 (at least 0)	x 40	OR	x 80	=	$ 00.00
	If any proper multiple dependent claim (ignore improper) is present (Enter $0.00 if this is a reissue application.)				+$135	OR	+$270	=	+$___
	If assignment is x'd (item 6), add recording fee $40.00								+$ 40.00
	Attached is a Rule 47 Petition (inventor refuses to sign or cannot be reached) $130								+$
	TOTAL FILING FEE								**=$876.00**

____ 12. A check in the amount of ___ to cover the Filing Fee calculated in Item 11 is attached. Please charge any deficiency or credit any overpayment to ATI Technologies, Inc., PLC Deposit Account No. 50-0441.

__X__ 13. Please charge **ATI TECHNOLOGIES, INC.**, Deposit Account No. **50-0441** in the amount of **$ 876.00** the Filing Fee calculated in Item 11. This sheet is attached in duplicate.

__X__ 14. The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and may be required under 37 CFR 1.16-1.18 (missing or insufficiencies only) now or hereafter relative to this application and for the resulting Official Document under 37 CFR 1.20, and to have and cause any necessary petition for extension of time to be filed and any fees necessary to be paid for said extension of time OR credit any overpayment to ATI TECHNOLOGIES, INC., Deposit Account No. 50-0441 , for which purpose a duplicate copy of this sheet is attached.

Respectfully submitted,
Branko Kovacevic

11-6-2000
Date

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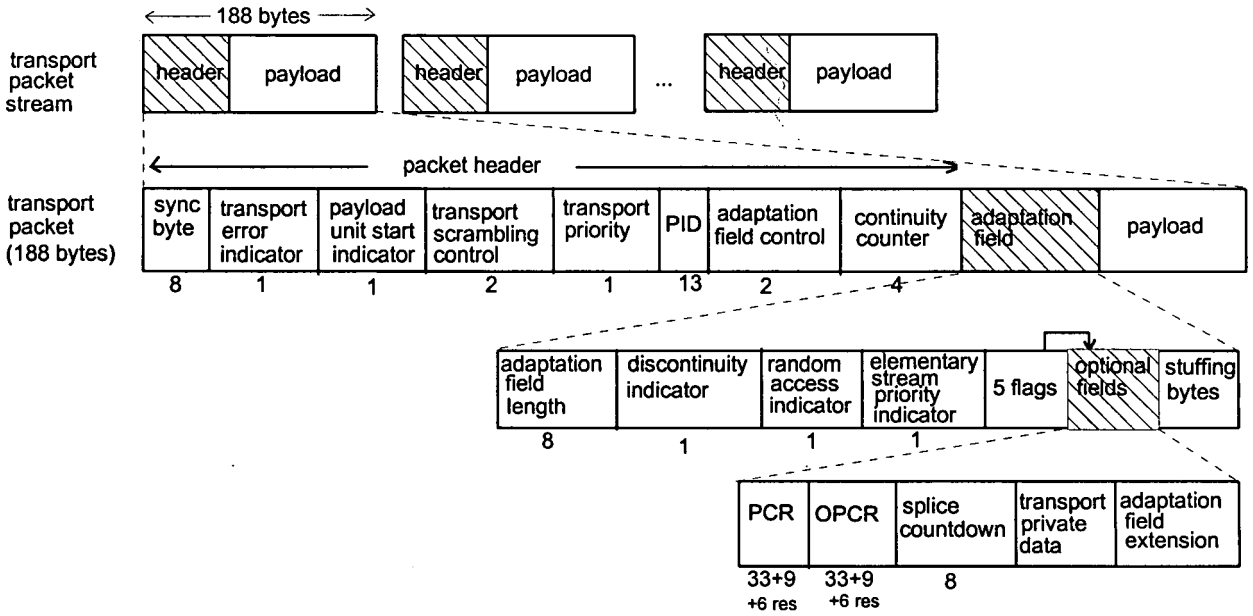
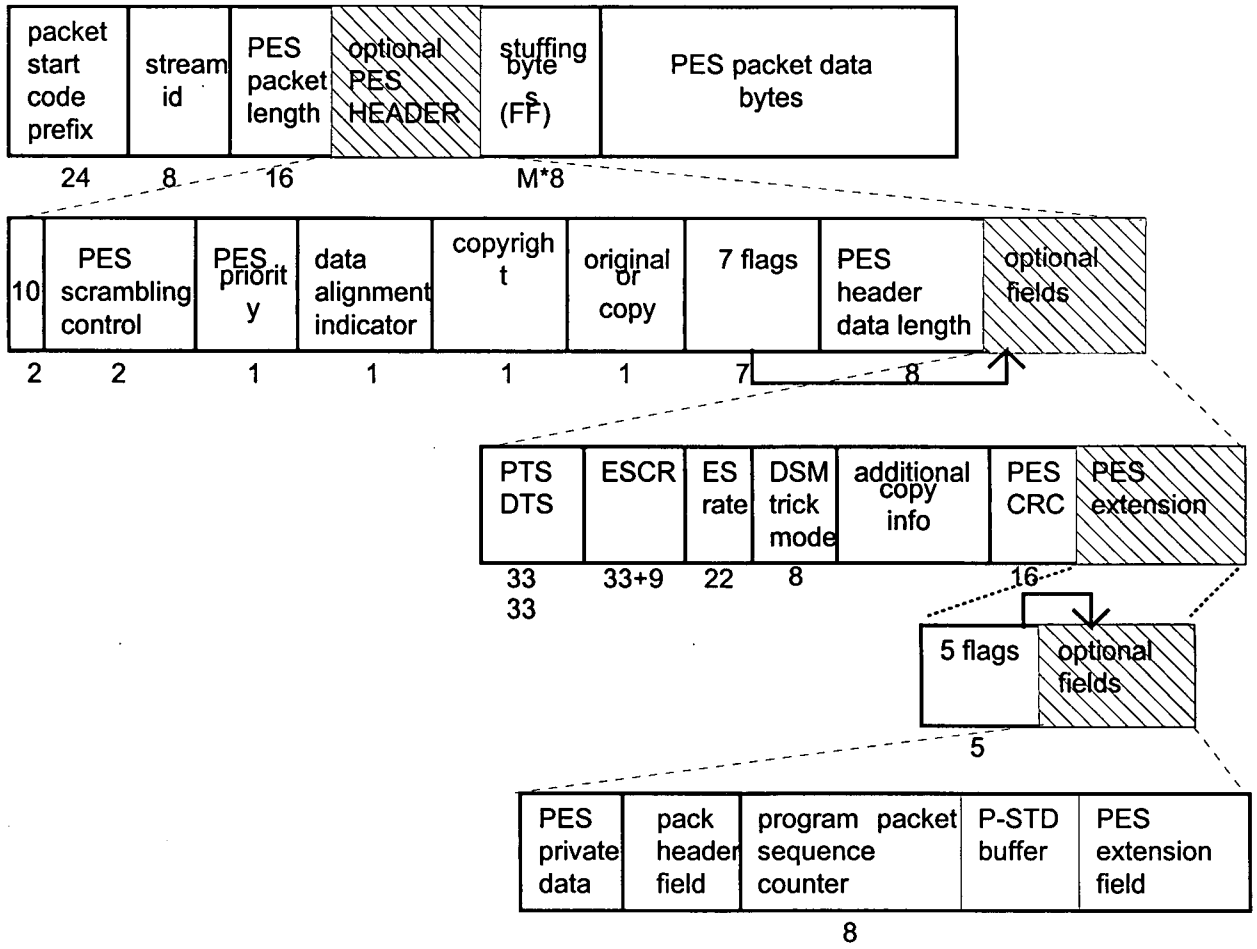


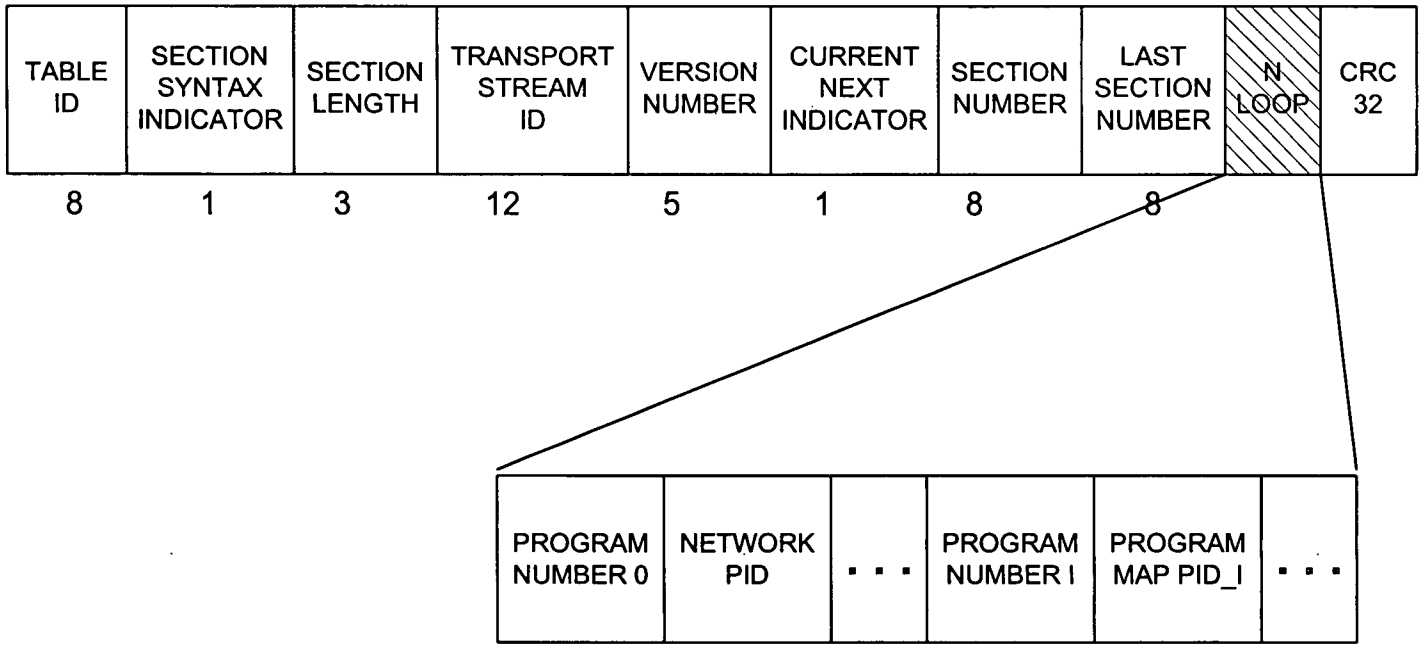
--PRIOR ART--

FIGURE 1



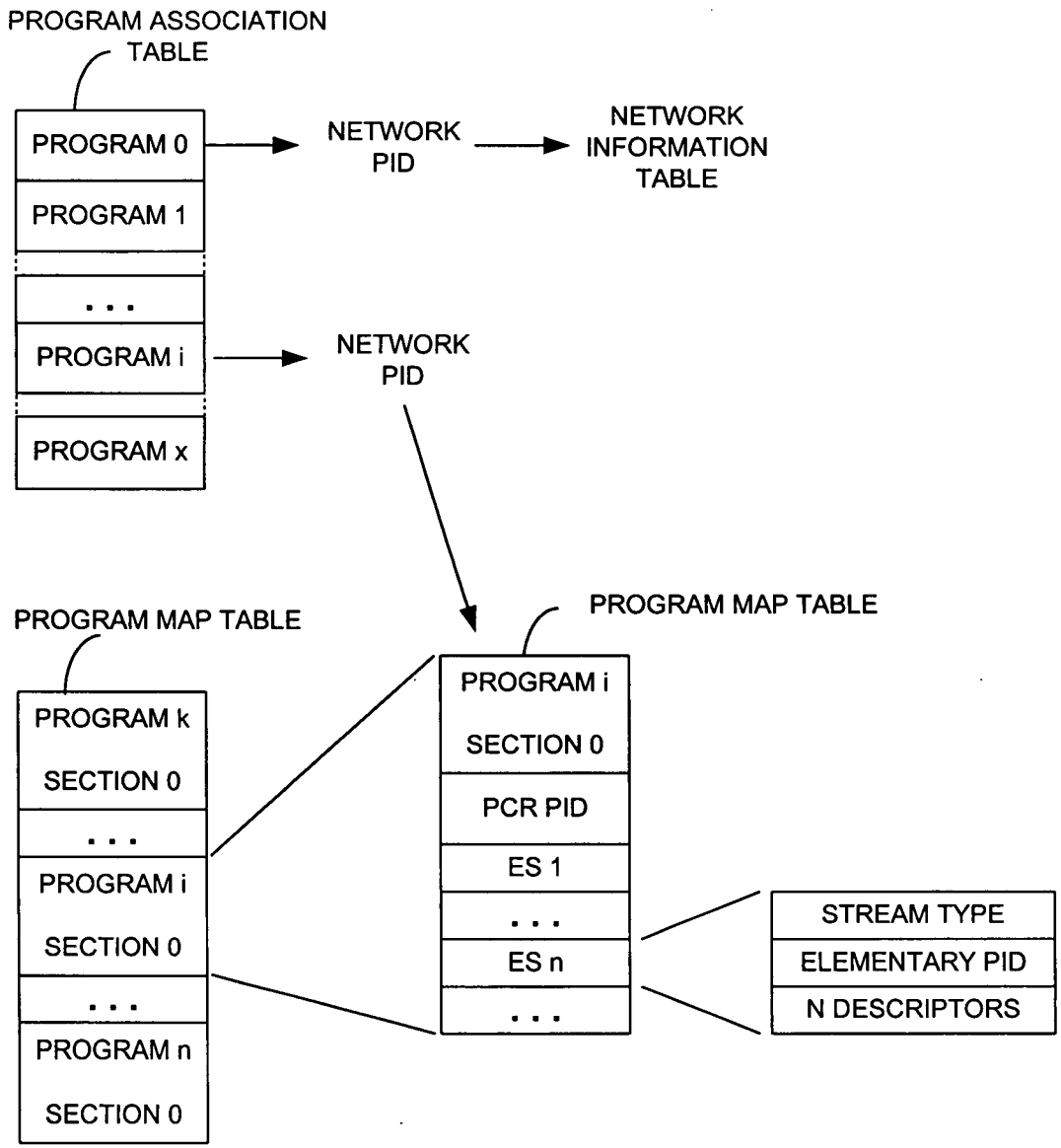
--PRIOR ART--

FIGURE 2



--PRIOR ART--

FIGURE 3



--PRIOR ART--

FIGURE 4

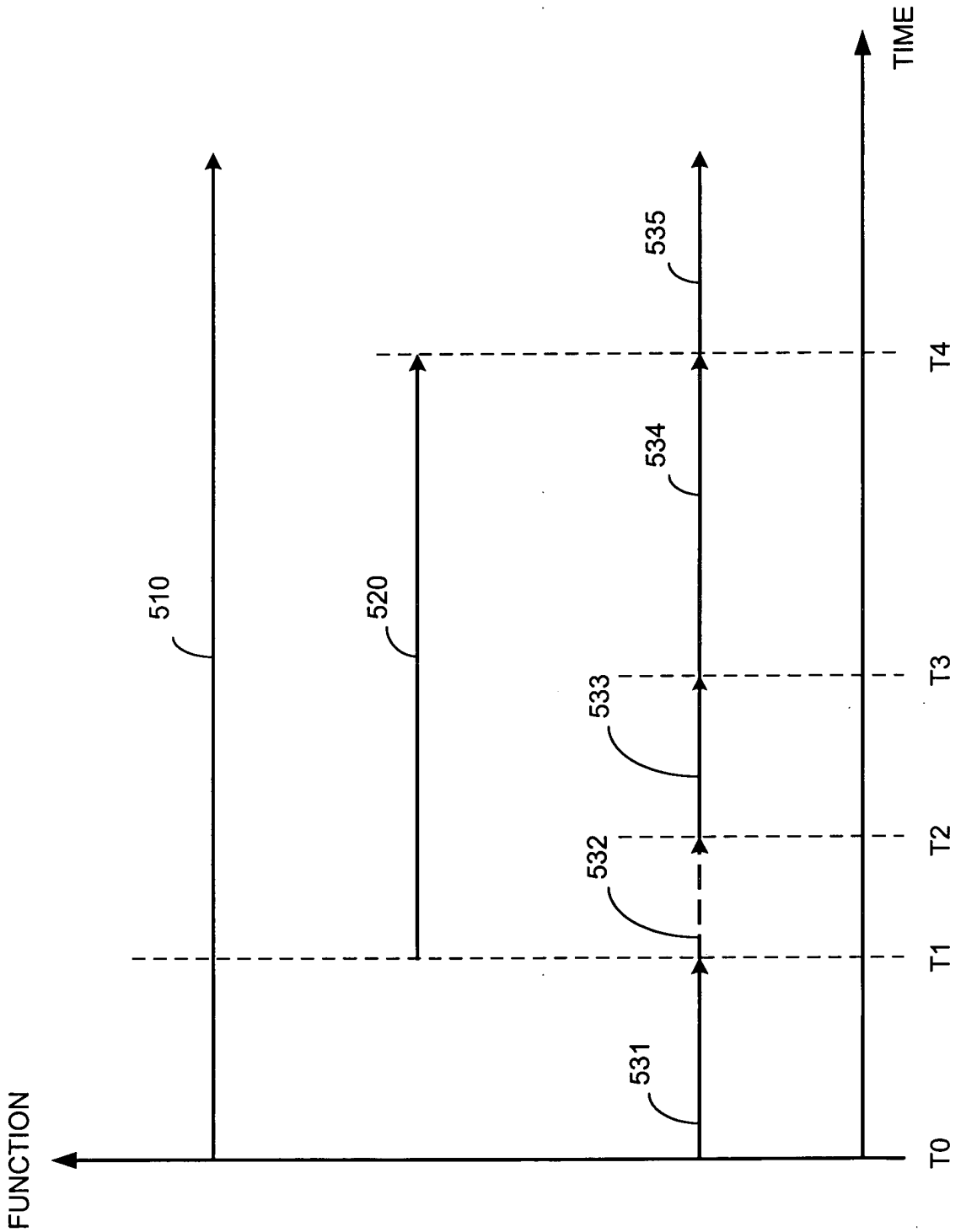


FIGURE 5

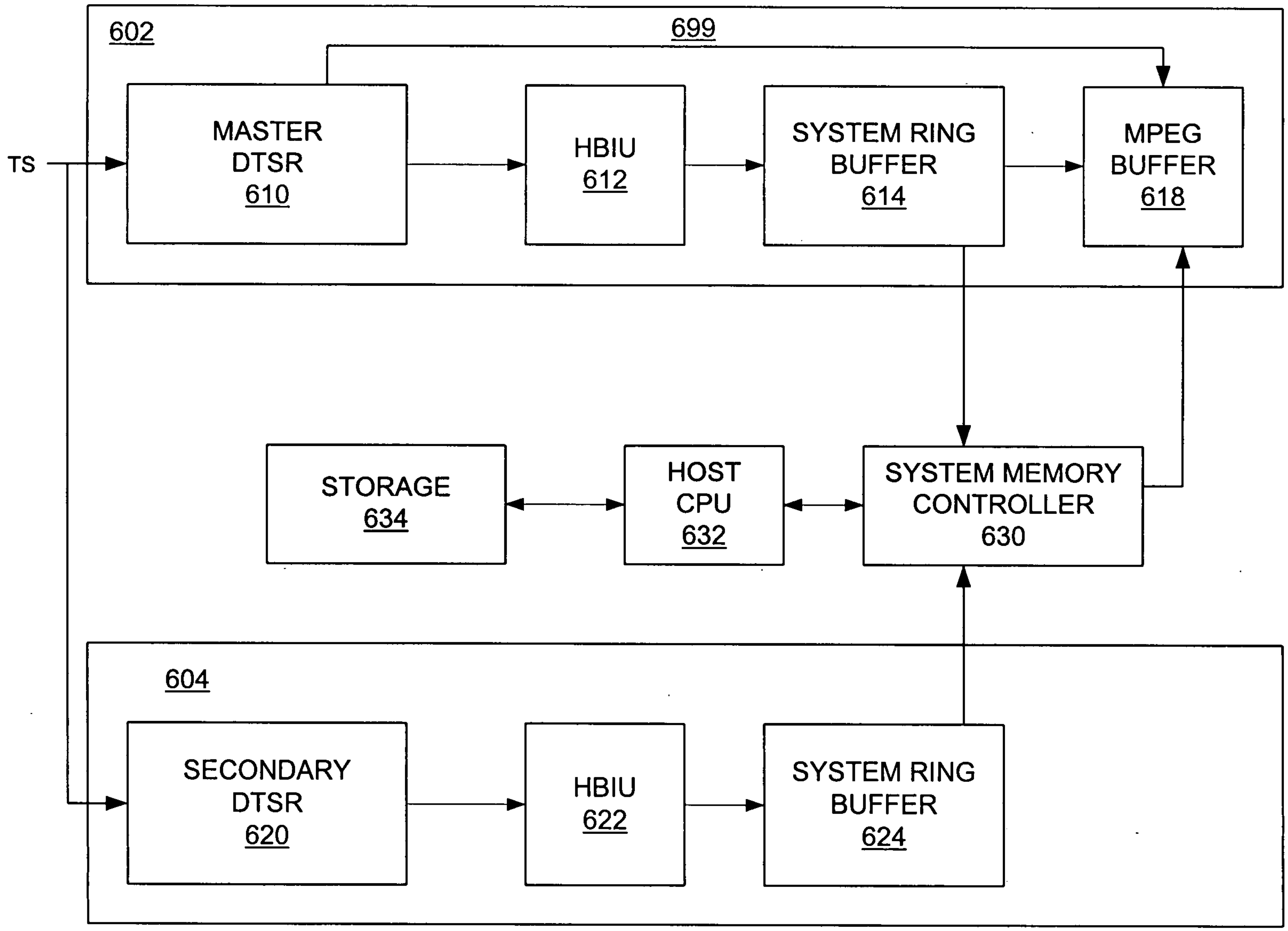


Figure 6

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

FILING OF A UNITED STATES PATENT APPLICATION

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

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SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Field Of The Invention

The present invention relates generally to time shifting of video data, and more specifically to time shifting of digital video data.

Background Of The Invention

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 addition 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. A digital signal stored directly can require a large amount of storage space, even when only a few minutes of video are captured. The digital signal can be compressed to reduce the amount of storage space required. However, compressing a video signal requires additional processing power, resulting in additional costs.

As the use of digital video data becomes increasingly common, a method and apparatus for time shifting a digital program that is more efficient than those known in art would be advantageous. 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) 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.

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.

A transport stream consists of fixed length packets based on 4 bytes of header followed by 184 bytes of data payload, where data payload is obtained by partitioning larger data blocks. For example, an elementary stream (ES) is a set of data generally consisting of compressed data from a single source, such as a video or audio source, with some additional ancillary data for identification, characterization and synchronization. ES streams are first packetized into either constant length or variable length Packetized Elementary Stream packets (PES packets) consisting of a header and payload. Each PES packet header starts with start code (ox000001) followed with the stream_id byte identifying type of ES underneath.

PES packets from various elementary streams are merged together to form a program (service) with its own system time clock (STC). All ES component streams within one program are synchronized have periodic PTS stamps corresponding to the STC counter to indicate the proper timing for each ES.

The relatively long and most often variable length PES packets are further packetized into shorter TS packets having a constant size of 188 bytes. A small and constant TS packet size makes error recovery easier and faster. Usually, the transport

stream carries several programs, each with its own STC. 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.

Each TS PSI table is sent in sections, usually occupying one or more TS packets. Four types of PSI tables exist: 1) Program Association Table (PAT) listing unique program_number (as an identifier of each program in one multiplex) and PID of the PMT table; 2) Program Map Table (PMT) listing PIDs of all component streams making a given program. PMT may be constructed for each program separately or be common for a group of programs; 3) Conditional Access Table (CAT) identifying PID of Entitlement Management Messages and ID of used conditional access system if any scrambling of TS or PES packets is done; 4) Private Table carrying Network Information Table (NIT) or private data.

The Hierarchical structure which exists between ES streams, PES and TP packets is illustrated in prior art Figure 1-4.

A method and apparatus for efficient time shifting of multiplexed packetized data streams, such as a packet stream, would be advantageous.

Brief Description Of The Drawings

Figures 1-4 illustrate various information associated with an MPEG transport stream of the prior art.

Figure 5 illustrates in graphical form a time line indicating various modes of operation in accordance with the present invention;

Figure 6 illustrates in block diagram form a specific embodiment of a system having to digital transport stream receivers in accordance with the present invention.

Detailed Description Of The Drawings

A specific method and apparatus is disclosed describing a time shifting technique. In one embodiment, the disclosed time shifting technique can be based upon a hardware transport stream demultiplexer that interfaces to a transport stream. The hardware demultiplexer application assists in the extraction and parsing of a multiplexed packetized data stream, such as a MPEG-2 Transport Stream (TS) multiplex. One such hardware demultiplexer is disclosed in pending patent application (990135), which is hereby incorporated herein by reference. The disclosed hardware transport core is used to filter component streams into 15 memory ring buffers, one allocated in the frame memory for the dedicated MPEG-2 video decoder and others in the system memory for the dedicated software parser. It can demultiplex the most frequent transport packets of video stream into an Elementary Stream (ES) by monitoring the first packet identifier (PID) of each TS packet. This flexible filter can be set to extract private data from the adaptation field (AF) or from the PES packet header. Thirty-one other PIDs can be simply filtered and routed to a common (joint) or individual memory buffers for subsequent software processing on the host processor. The basic idea of a time shifting is shown in Figure 5.

Figure 5 illustrates three functions performed by a time shifting system. A first function is to receive a live broadcast stream 510. According to the graph of Figure 5, the live broadcast stream is continuously received during the time represented in Figure 5.

A second function of a time shifting system is to record a specific program after a user activates the time shifting feature. Vector 520 of Figure 5 indicates when a specific program is being recorded by the time shifting system.

A third function of the time shifting system is to display the specific program. Vector 530 of Figure 5 indicates when a specific program is being played back. Specifically, vector portion 531 represents the time where the program is being displayed directly from the live broadcast stream. Vector portion 532 represents the time that the user is unable to view the program, i.e. the user is away from the television. Therefore, in

one embodiment, during this time no program is displayed. In an alternate embodiment, the live feed can continue to be displayed, even though the program is being recorded.

Vector 533 represents the time during which the time-shifted program, which has been stored, is being replayed at a normal playback rate. Note that during this time, the live program feed continues to be recorded for future time shifted play back.

Vector 534 represents a time during which the time shifted program is being replayed at a faster than normal replay rate. By being able to playback at a faster than normal rate, it is possible to catch-up to the live broadcast stream.

The receive-only mode of vector 31 represents where the digital transport stream receiver (DTSR) is receiving a live broadcast and demultiplexing one program of a plurality of programs available in the live broadcast stream. This will be referred to as **Transparent Mode** indicating the transport stream is accessed immediately and not saved. Therefore, from the point of view of digital storage media (DSM), the received data is transparent.

Note that the PAT table is constantly acquired, in transparent mode, and other modes, so that version number change or PMT table PID change for a currently viewed program can be detected. If such a change occurs during the live broadcast of a program, PIDs will be reprogrammed for video and splicing with be handled.

A Continuous Time Shifting Mode occurs during vectors 532-534. Continuous time shifting mode occurs when time shifting is selected by the viewer to store part or all of a program for later viewing after a short or long intermission. During continuous time shifting mode, a selected program from a given multiplex is received and stored on a hard disk, or other storage media, in the form of full transport stream packets or PES packets.

A Part-Time Time-Shifting Mode, when selected by the viewer, allows for replay of a time shifted program or fast forward (FF) replay of a time shifted program at user defined FF speed. In Figure 5 this is represented as vectors 533 and 534. In a

specific embodiment discussed herein, this time-shifting mode is the most demanding mode of the 3 described modes because: the host CPU system is receiving and storing a real time event; at the same time, the host CPU is retrieving saved stream data from the disk; simultaneously with first two operations, the host CPU is performing transport stream de-multiplexing of video, audio, private and PSI/SI data on a host CPU; and at the same time the host CPU is restoring PCR/PTS time-base information as described later.

For some digital television applications, time-shifting may be considered a peak event that occurs sometimes or occasionally. However, some users may depend on it all the time, up to the end of the current program once it was started. For those users, typical operating state of the system is time shifting, de-coupled from the live stream. Time shifting of the digital transport stream should offer the same quality as from the live broadcast (source stream).

Systems suitable for time-shifting need to simultaneously receive and decode a transport stream and handle incoming source stream (to process all PSI and SI data) and record incoming source stream as a full entity or just its one program. Time shifting allows the viewer to step away from the TV monitor without missing any of the program parts. One embodiment of time shifting includes storing all transport packets received on the transport stream. Another embodiment of time shifting that is more efficient includes: 1) selecting just the transport packets of interest (PSI, SI, video, audio and data packets) that constitute one program event to minimize the bit-rate of the recorded stream, to minimize the bandwidth through the host bus interface unit, and to minimize hard disk head movement (if any); 2) increasing the amount of storage and useful life of the hard disk; and 3) assuring that the amount of data that needs to be processed by the host processor is received and stored as: transport stream packets; PES packets of video, audio, data, PSI and SI content, de-multiplexed transport; or PES packets of video and audio and bus master compressed video into the video bit-stream buffer of the MPEG video decoding device.

Selection of just one time shifted program reduces the potentially high bit-rate of a transport stream multiplex to a manageable size, suitable for storage on current 10GB hard disk units (two hours of 10Mbps stream). Obviously, a large disk drive is needed to allow any reasonable length of time shifting. In time shifting mode where time shifted material is simultaneously received and stored, the bit-rate of the host bus-interface unit (HBIU) needs to be double a system where the HBIU is only responsible for playing a single program stream. Generally the bandwidth needed is calculated to be approximately 20Mbps instead 10Mbps.

Because closed or proprietary systems, such as set-top boxes, usually do not share the hard disk drive with other systems, very specialized disk drives for audio-video applications with specialized interfaces can be used. Hard drive features that would be advantageous include: 1) Increasing access speeds and sustained sequence transfers in two directions; 2) Having deferred re-calibration of drive heads to prevent glitches or latencies during playback; 3) Having head offsets to prevent losing a revolution when going from side to side on a platter; 4) Supporting on the fly error correction; and 5) Having embedded multi-disk drive units that decrease access latencies.

The operating system can play a significant role in the efficient use of the drive by accessing most frequent video data in large blocks and decreasing seek time. Generally, larger read/write blocks increase efficiency of data storage and retrieval. Sometimes they can cause unwanted glitches by increasing latency during access.

The first time shifting mode of operation is a receive-only mode. During receive-only mode of operation a master digital time shifting receiver (DTSR) 610, of Figure 6, is programmed to receive and parse transport stream packets matching video and PCR PIDs. A host CPU 632 is assisting MPEG-2 clock recovery, and the same recovered clock data is supplying Master DTSR 610 and the Secondary DTSR 620. In one embodiment, the recovered clock is provided to the secondary DTSR 620 registers through the use of the system memory controller 630. Also, the Master DTSR 610 is programmed to perform PID filtering of audio, private, and PSI/SI PIDs programmed in the auxiliary PID registers. Secondary DTSR 620 is programmed for PID filtering

operations on Video PID programmed on a first auxiliary PID register. However, since the receiver is in receive-only mode, the video transport packets in the ring buffer 624 are disregarded. The clock recovery algorithm is suppressed on the secondary DTSR 620. Only STC of the slave DTSR is set upon the channel change. Host CPU 632 performs PES parsing of audio transport stream packets, decode and presentation of audio frames (on AC-97 codec or wave device), and continuous parsing and data processing of PSI sections monitoring real-time events like PID change, PCR discontinuity or splicing of audio stream. This activity by the host CPU 632 is part of the normal receive only mode of operation where a specified channel is being decoded and displayed. Specific systems and methods for supporting these processes are described in the patent application already incorporated by reference.

When in continuous time-shifting mode of operation, the host CPU 632 performs additional processing including: retrieval; multiplexing; time base corrections; storage of video audio, private and PSI/SI transport stream packets from multiple buffers 614 allocated in the memory space of the host CPU. In one embodiment, however, the master DTSR 620 is used to decode and display video stream as describe previously with reference to receive only mode. Transport packets from a common program are retrieved from the buffer 614 and provided to a digital storage media circular file system in a multiplexed manner. Multiplexing is performed by inserting audio, video, private, and PSI/SI transport stream packets to satisfy a group of relevant criteria.

Fundamental functions performed during continuous digital time shifting include: 1) Preserving of original ES_rate of each component stream; 2) Limiting PCR jitter of newly created single program multiplex; 3) Preserving VBV_delay value (the number of periods of a 90KHz clock derived from the 27MHz system clock that the VBV shall wait after receiving the final byte of the picture start code before decoding the picture) to insure non-interrupted MPEG video decode after initial VBV_delay time in constant bit-rate (CBR) stream environments; 4) Preventing underflow or overflow of elementary stream decoder buffers in accordance with the T_STD model defined in ISO/IEC 13818-1 standard; 5) providing PID values in the video or audio TS packets that were originally defined in the PMT section to be a video or audio PIDs. Alternatively, a new artificial

PCR stream can be separately created and injected as TS PCR packets at the rate of at least 10 times per second to create a new time base for decimated, time-shifted stream stored on the DSM. Whereby, the original PAT transport packet is modified or a new PAT packet is inserted into the stream instead of the original PAT section to indicate a single program only whose PMT section indicates video, audio, PCR and other PID that carry subtitles, program descriptions, etc. As a stable clock source, STC of the Master DTSR is used to measure elapsed time between two PCR samples; 6) Providing PTS values in the video, audio or private data streams by using STC of the Master DTSR as elapsed time counter; and 7) Initializing STC of the playback DTSR device to a first available PCR value encoded in the stream saved on DSM media, immediately after channel change.

While in part-time digital time-shifting mode, the host CPU 632 performs some additional processing like retrieval and de-multiplexing of the single program transport stream created in continuous time digital time-shifting mode during a storage process. Generally, the playback of the stored program is combined with continued transport stream de-multiplexing and recording of the real-time transport stream. Such a mode of operation is the most intensive mode of operation because the host CPU 632 must create/store a multiplexed single program transport stream from a continued reception of a live broadcast; and retrieve and de-multiplex saved content from a digital storage media while performing transport stream de-multiplexing, audio decode, and bus mastering elementary stream video to the MPEG video decoder.

In one implementation, an MPEG decoder associated with the Master DTSR 610 is used to decode and display a video stream from a DSM media and receive private data, and PSI/SI sections from a live broadcast. In such a case, a video PID of the Master DTSR 610 is disabled, while video data with its PTS information is fed directly to the MPEG decoder using the system memory controller 630. However, PCR PID is programmed on a Master DTSR so that MPEG clock recovery continues from a live transport stream feed and is supplied to the STC counters of both the master DTSR 610 and the second DTSR 620. In one implementation, only the video PID is programmed into the Slave DTSR for retrieving live video stream and sending it to circular buffer on

the host system in the form of a full MPEG-2 transport stream packets, while the Master DTSR is used to buffer the non-video components of a specific program.

In another embodiment, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of a digital time shifting. In the second embodiment, a first DTSR is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID of the first DTSR is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR can be used in all 3 modes to receive video, audio, private data and PSI/SI sections, all utilizing auxiliary PID filters and received as full MPEG-2 transport packets arriving in the single memory queue. This way, the temporal order of a stream and validity of the T-STD decoder model is inherently preserved. Also, the amount of the host DRAM memory required for queue allocation is less than in the first case. In both embodiments, a quality digital stream time shifting at the transport packet level is achieved.

In yet another operating mode, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of digital time shifting by storing PES layers as a basic format of the audio/video data saved on a DSM. In PES operating mode, two hardware embodiments are possible, the same as in TP operating mode.

In a first hardware embodiment, the first DTSM is used as a combo device, to achieve playback of live or stored MPEG video and reception of audio, private & PSI/SI content. The second device is used only to receive and de-multiplex MPEG-2 video transport stream and retrieve MPEG-2 elementary stream from a live broadcast. Upon retrieval of ES video, PES packets are formed and stored on the DSM media.

In the second hardware embodiment, the first DTSM is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR is used in all 3 time-shifting modes to receive audio, private data, PSI/SI sections, by utilizing auxiliary PID filters to store

the transport packets to a single memory queue. That way, a temporal order of a stream and validity of T-STD decoder model is already preserved.

In yet another time shifting embodiment, the video is de-multiplexed to the level of elementary stream and stored at the bit-stream buffer of the MPEG video decoder physically allocated in the frame memory. The MPEG video stream is then retrieved from this buffer by a software processing thread running on a host CPU. Every time a picture start code is found in the video bit-stream buffer, a full compressed MPEG picture, in the form of elementary stream, is sent to the system memory buffer by DMA. One such method is disclosed in patent application (990135) which is hereby incorporated herein by reference.

Before storing the full compressed MPEG picture in the DSM, a PES packet header is added. The audio stream is de-multiplexed and decoded by the host CPU. In a similar fashion as the video, prior to audio decoding, the audio frames are packetized into PES packets. Essential information from the PSI/SI/private data tables is decoded and stored in a pure source form on a DSM. This way, further reduction of the host DRAM memory requirements for queue allocation and memory on the DSM media is reduced. An advantage of this mode is reduction of CPU cycles needed for A/V playback of stored data due to the PES format of audio/video data. PES de-multiplexing is done in place, passing pointers to the payload of PES packets that contain video or audio frames, other implementations required they be sent by DMA to the video decoder before they were decoded on host CPU (MPEG or AC-3 audio). As a result, the host CPU doesn't move any raw audio or video data, and host CPU utilization is reduced in order of magnitude compared to TS playback operating mode.

In the foregoing specification, the invention has been described with reference to specific embodiments. However, one of ordinary skill in the art appreciates that various modifications and changes can be made without departing from the scope of the present invention as set forth in the claims below. For example, the specific time-shifting implementation has been described as with reference to a specific transport stream demultiplexer, and described in a previous applications which have been incorporated by

reference. Different transport stream demultiplexers and method of implementing specific aspects of the present invention can be used as well. Likewise, specific partitions between hardware and software implementions have been described, which can vary depending upon the implemented demultiplexer. For example, the video stream parser can be designed to support routing the parsed video data to a circular buffer that is accessible by the system memory controller. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of present invention. In the claims, means-plus-function clause(s), if any, cover the structures described herein that perform the recited function(s). The mean-plus-function clause(s) also cover structural equivalents and equivalent structures that perform the recited function(s). Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any element(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature or element of any or all the claims.

WHAT IS CLAIMED IS:

1. A method comprising the steps of:

receiving a multiplexed packetized data stream that carries real-time multimedia programs;

during a first time:

storing a first portion of the packetized data stream representing video data and timing data of a program;

setting a system time indicator to a stored system time value, wherein the stored system time value is based on a portion of the timing data of the first portion of the packetized data stream;

during a second time:

incrementing the system time indicator;

retrieving the video data of the first portion of the packetized data stream for video decoding; and

storing a second portion of the packetized data stream representing video data and timing data of the program.

2. The method of claim 1, wherein

the step of storing the first portion of the packetized data stream includes the first portion of the packetized data stream representing audio data of the program;

the step of storing the second portion of the packetized data stream includes the second portion of the packetized data stream representing audio data of the program;

the method further including the step of

during the second time

the step of accessing the audio data of the first portion of the packetized data stream for audio playback.

3. The method of claim 1, wherein the multiplexed packetized data stream is a

multiplexed packetized data stream that substantially meets an MPEG2 specification.

4. The method of claim 3, wherein the step of storing the first portion includes storing transport stream packets.

5. The method of claim 4, wherein the step of storing the first portion includes the sub-steps of

determining transport stream packets containing data associated with the program; and

storing the transport stream packets containing data associated with the program after the step of determining.

6. The method of claim 3, wherein the step of storing the first portion includes storing packetized elementary stream (PES) packets.

7. The method of claim 6, wherein the step of storing the first portion includes the sub-steps of

determining transport stream packets containing data associated with the program; and

storing PES packets based upon the transport stream packets containing data associated with the program after the step of determining.

8. The method of claim 1, wherein the step of storing the first portion of the transport stream includes the timing data including synchronization information used for playing the program back at a real time program bit-rate.

9. The method of claim 1 wherein the step of incrementing the system time indicator includes incrementing the system time indicator based upon a signal generated from multiplexed packetized data stream data received after the first time.

10. The method of claim 1 further comprising the step of:
decoding the video data of the first portion to provide a decoded video stream.

11. The method of claim 10, wherein the steps of receiving a multiplexed packetized data stream and decoding the video data are performed by an integrated semiconductor device.

12. The method of claim 10 further comprising the step of:
providing the decoded video stream for display at a play back rate.

13. The method of claim 12 wherein the play back rate is a real time rate.

14. The method of claim 12 wherein the step of providing the decoded video stream for display includes determining the play back rate based upon clock recovery data of the first portion of the transport stream, wherein the play back rate will vary

depending upon a rate at which the first portion of the transport stream data is provided to a decoder during the step of decoding.

15. The method of claim 12 wherein the step of providing the decoded video stream for display includes determining the play back rate based upon timing data received from the multiplexed packetized data stream after the first time.

16. The method of claim 15, wherein the timing data received from the multiplexed packetized data stream after the first time is associated with a current real-time data stream.

17. The method of claim 12, wherein the play back rate is faster than a real time rate.

18. A method comprising the steps of:

determining a mode of operation;

during a first mode of operation:

receiving a multiplexed packetized data stream at a first demultiplexer;

selecting a first program from the multiplexed packetized data stream;

decoding a video portion of the first program for display;

during a second mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing the first program;

during a third mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing a first program portion of the first program;

providing the first program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the first program portion;

decoding the video portion of the first program portion for display; and

storing a second program portion of the first program simultaneous to the step of decoding.

19. The method of claim 18, further comprising during the third mode of operation the steps of:

providing the second program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the second program portion; and

decoding the video portion of the second program portion for display.

20. The method of claim 18 further comprising, during the third mode of operation, the steps of:

incrementing a counter associated with the second demultiplexer based upon a signal generated using a live feed of the multiplexed packetized data stream as it is received at the first demultiplexer.

21. A system comprising:

a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs;

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;

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;

a first clock recovery module having an input coupled to the first input node, and an output, wherein the 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 it is stored in the storage device;

a decoder having a first input coupled to the output of the first clock recovery system to receive the clock, a second input coupled the data port of the storage device to receive the select packets, and an output to provide decoded real-time data

22. The system of claim 21, wherein the first clock recovery module further generates the clock based upon data transmitted in packets of a currently received multiplexed packetized data stream.

23. The system of claim 21, wherein the first clock recovery module further generates the clock based upon multiplexed packetized data stream data stored in the storage device.

24. The system of claim 21, wherein the decoder includes a video decoder.

25. The system of claim 24, wherein the decoder includes an audio decoder.

26. The system of claim 21 further comprising:

a second transport stream demultiplexer having an input coupled to the data port of the storage device;

27. The system of claim 26 further comprising:

a second clock recovery module having an input coupled to the data port of the storage device to allow STC setting based on a stored system time.

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Abstract Of The Disclosure

A multiplexed packetized data stream carrying real-time multimedia programs is received at a first hardware demultiplexer. Based on a user input, a video and timing portion of a program associated with the multiplexed packetized data stream can be stored for subsequent display. One type of subsequent display is time shifted display, where the stored portion of the program is played back while new portions of the program are being stored. During time shifted play back, a second hardware demultiplexer can be used, so that one demultiplexer stores new data and maintains a current clock value while the other decodes and displays the stored data.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing, OR
☐ **Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)**

Attorney Docket Number ATI0000690
First Named Inventor Branko Kovacevic
COMPLETE IF KNOWN
Application Number
Filing Date
Group Art Unit
Examiner Name

As a below named inventor, I hereby declare that:
My residence, post office address, and citizenship are as stated below next to my name.
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

the specification of which:
☒ is attached hereto.
☐ was file on (MM/DD/YYYY) as United States Application Number or PCT International Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Data (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Name	Registration Number	Name	Registration Number
J. Gustav Larson	39,263	Sally Daub	41,478

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: **Simon Fakhoury Tangalos Frantz & Galasso**
P.O. Box 26503
Austin, Texas 78755-0503
Telephone: 512-336-8957
Facsimile: 512-336-9155

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])			Family Name or Surname	
Branko			**Kovacevic**	
Inventor's Signature	Branko Kovacevic		**Date**	OCTOBER 26, 2000.
Residence	**City:** Willowdale	**State:** Ontario	**Country:** Canada	**Citizenship:** Canadian
Post Office Address	**60 Clipper Road, Suite 1402**			
City: Willowdale	**State:** Ontario	**ZIP:**	**Country:** Canada	

☒ Additional inventors are being named on the _____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

Bib Data Sheet

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/707,060	11/06/2000 RULE _	386	2615	ATI000069

APPLICANTS

Branko Kovacevic, Willowdale, CANADA;

** CONTINUING DATA **********

** FOREIGN APPLICATIONS **********

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 02/08/2001

Foreign Priority claimed ☐ yes ☐ no 35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance Verified and Acknowledged Examiner's Signature Initials	STATE OR COUNTRY CANADA	SHEETS DRAWING 6	TOTAL CLAIMS 27	INDEPENDENT CLAIMS 3

ADDRESS

Simon Fakhoury Tangalos Frantz & Galasso PLC
P O Box 26503
Austin ,TX 78755-0503

TITLE

System for digital time shifting and method thereof

FILING FEE RECEIVED		
836	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

11/08/2000 WABRHAM1 00000079 500441 09707060

01 FC:101 710.00 CH
02 FC:103 126.00 CH

PTO-1556
(5/87)

*U.S. GPO: 1999-459-082/19144

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number: 09/107060

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	27 minus 20=	* 7
INDEPENDENT CLAIMS	3 minus 3 =	* —
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=		OR	X$18=	126.
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL		OR	TOTAL	836.

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

BEST AVAILABLE COPY

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

CLAIMS ONLY

SERIAL NO.	FILING DATE
APPLICANT(S)	

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
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TOTAL IND.	3					
TOTAL DEP.	24					
TOTAL CLAIMS	27					

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100						
TOTAL IND.						
TOTAL DEP.						
TOTAL CLAIMS						

* MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS

FORM PTO-2022 (1-98)

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

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Washington, D.C. 20231

CHANGE OF ADDRESS/POWER OF ATTORNEY

FILE LOCATION 26C1 SERIAL NUMBER 09707060 PATENT NUMBER

THE CORRESPONDENCE ADDRESS HAS BEEN CHANGED TO CUSTOMER # 34456

THE PRACTITIONERS OF RECORD HAVE BEEN CHANGED TO CUSTOMER # 34456

THE FEE ADDRESS HAS BEEN CHANGED TO CUSTOMER # 34456

ON 12/06/02 THE ADDRESS OF RECORD FOR CUSTOMER NUMBER 34456 IS:

TOLER & LARSON, L.L.P.
PO BOX 29567
AUSTIN TX 78755-9567

AND THE PRACTITIONERS OF RECORD FOR CUSTOMER NUMBER 34456 ARE:

38342 39263

PTO INSTRUCTIONS: PLEASE TAKE THE FOLLOWING ACTION WHEN THE CORRESPONDENCE ADDRESS HAS BEEN CHANGED TO CUSTOMER NUMBER: RECORD, ON THE NEXT AVAILABLE CONTENTS LINE OF THE FILE JACKET, 'ADDRESS CHANGE TO CUSTOMER NUMBER'. LINE THROUGH THE OLD ADDRESS ON THE FILE JACKET LABEL AND ENTER ONLY THE 'CUSTOMER NUMBER' AS THE NEW ADDRESS. FILE THIS LETTER IN THE FILE JACKET. WHEN ABOVE CHANGES ARE ONLY TO FEE ADDRESS AND/OR PRACTITIONERS OF RECORD, FILE LETTER IN THE FILE JACKET.
THIS FILE IS ASSIGNED TO GAU 2615.

PTO/SB/21 (05-03)
Approved for use through 04/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

2615
#3
S 1
08-26-03

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/707,060
Filing Date	11/06/2000
First Named Inventor	Branko D. Kovacevic
Art Unit	2615
Examiner Name	Christopher O. Onuak
Total Number of Pages in This Submission: 2 + 2 refs.	Attorney Docket Number: 1376.0000690

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☑ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/ Incomplete Application
  - ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
- ☐ After Allowance communication to Group
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to Group **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please Identify below):

Return Receipt Postcard
2 cited references

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	J. Gustav Larson, Reg. No. 39,263
Signature	J. Gustav Larson
Date	7-21-03

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below.

Typed or printed name	Katrina Prati		
Signature	Katrina Prati	Date	7-23-03

Refine Search

Search Results -

Term	Documents
DELAY$	0
DELAY	292787
DELAYA	30
DELAYABCD	1
DELAYABILITY	3
DELAYABLE	69
DELAYABLY	16
DELAYACCEL	2
DELAYACT	1
DELAYACTION	1
DELAYACTIONS	3
(L17 AND DELAY$).USPT.	1

There are more results than shown above. Click here to view the entire set.

Database:

- US Pre-Grant Publication Full-Text Database
- US Patents Full-Text Database
- US OCR Full-Text Database
- EPO Abstracts Database
- JPO Abstracts Database
- Derwent World Patents Index
- IBM Technical Disclosure Bulletins

Search: L23

Refine Search

Recall Text | Clear | Interrupt

Search History

DATE: Saturday, September 25, 2004 Printable Copy Create Case

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	DB=USPT; PLUR=YES; OP=OR		

L23	l17 and delay$	1	L23
L22	L21 and while	0	L22
L21	L17 and simultaneous$	1	L21
L20	L17 and ("being recorded")	0	L20
L19	l17 and "being"	0	L19
L18	L17 and (being near1 record$)	0	L18
L17	6792000.pn.	1	L17
L16	L15 and MPEG$	10	L16
L15	L14 and stream$	10	L15
L14	L13 and multiplex$	10	L14
L13	L12 and audio	22	L13
L12	L11 and video	23	L12
L11	L10 and program$1	23	L11
L10	L9 and clock$	24	L10
L9	L8 and (time$ or tim$)	33	L9
L8	L7 and packet$	33	L8
L7	L6 and receiv$	243	L7
L6	L5 and ((simultaneous$) near4 (reproduc$ or playback or play$) near4 (record))	305	L6
L5	L4 and ((simultaneous$) same (reproduc$ or playback or play$) same (record))	1937	L5
L4	L3 and simultaneous$	17327	L4
L3	L2 and (reproduc$ or playback or play$)	45943	L3
L2	L1 and record$	67898	L2
L1	386/$.ccls. or 348/$.ccls. or 725/$.ccls. or 360/$.ccls. or 369/$.ccls.	117109	L1

END OF SEARCH HISTORY

Refine Search

Search Results -

Term	Documents
SHIFT$	0
SHIFT	323341
SHIFTA	7
SHIFTAABLY	1
SHIFTAB	1
SHIFTABE	2
SHIFTABELE	1
SHIFTABIE	1
SHIFTABILITY	308
SHIFTABILITY-AS	1
SHIFTABILITY-NAMELY	1
(L13 AND SHIFT$).USPT.	0

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- US Patents Full-Text Database
- US OCR Full-Text Database
- EPO Abstracts Database
- JPO Abstracts Database
- Derwent World Patents Index
- IBM Technical Disclosure Bulletins

Search:

Refine Search

Recall Text | Clear | Interrupt

Search History

DATE: Monday, September 27, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT; PLUR=YES; OP=OR			
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L14	l13 and increment$	0	L14
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L12	l10 and increment$	0	L12
L11	l10 and shift$	0	L11
L10	5923925.pn.	1	L10
L9	l1 and shift$	0	L9
L8	L7 and count$	0	L8
L7	6792000.pn.	1	L7
L6	L1 and increment$	1	L6
L5	L4 and increment$	1	L5
L4	L2 and tim$	1	L4
L3	L2 andf tim$	2419703	L3
L2	L1 and simultaneous$	1	L2
L1	5521922.pn.	1	L1

END OF SEARCH HISTORY

Freeform Search

Database: US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Term: L1 and decod$

Display: 10 **Documents in Display Format:** FULL **Starting with Number** 1

Generate: ○ **Hit List** ◉ **Hit Count** ○ **Side by Side** ○ **Image**

Search Clear Interrupt

Search History

DATE: Monday, September 27, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
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L18	l1 and rate$	0	L18
L17	l1 and integrat$	1	L17
L16	l1 and MPEG$	1	L16
L15	l1 and (real near1 time$)	1	L15
L14	l1 and delay$	1	L14
L13	l12 and delay$	1	L13
L12	L8 and chang$	1	L12
L11	L8 and increas$	0	L11
L10	L8 and increment$	0	L10
L9	L8 and indicat$	0	L9
L8	L7 and clock$	1	L8
L7	l1 and (tim$ or time$)	1	L7
L6	l1 and sound$	1	L6

L5	l1 and audio	1	L5
L4	L1 and packetized	0	L4
L3	L1 and packet$	1	L3
L2	L1 and elememtary	0	L2
L1	6792000.pn.	1	L1

END OF SEARCH HISTORY

Freeform Search

Database: US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Term: L4 and (normal$ or standard$)

Display: 10 **Documents in Display Format:** FULL **Starting with Number** 1

Generate: ○ **Hit List** ◉ **Hit Count** ○ **Side by Side** ○ **Image**

Search Clear Interrupt

Search History

DATE: Wednesday, September 29, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT; PLUR=YES; OP=OR			
L5	L4 and (normal$ or standard$)	1	L5
L4	l1 and view$	1	L4
L3	L2 and (fast$ or medium or record$)	1	L3
L2	L1 and ((stor$ near1 device$) or (stor$) or (reproduc$ or playback or play$))	1	L2
L1	6233389.pn.	1	L1

END OF SEARCH HISTORY

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/707,060	11/06/2000	Branko Kovacevic	ATI000069	5798

34456 7590 10/04/2004

TOLER & LARSON & ABEL L.L.P.
5000 PLAZA ON THE LAKE STE 265
AUSTIN, TX 78746

EXAMINER	
ONUAKU, CHRISTOPHER O	
ART UNIT	**PAPER NUMBER**
2616	4

DATE MAILED: 10/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/707,060	KOVACEVIC, BRANKO	
	Examiner	Art Unit	
	Christopher O. Onuaku	2616	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *18-20* is/are allowed.

6)☒ Claim(s) *1-17 and 21-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *3*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 21-27 are rejected under 35 U.S.C. 102(e) as being anticipated by Morinaga et al (US 6,792,000).

Regarding claim 21, Morinaga et al disclose a data processing apparatus/method and a data recording medium that are capable of simultaneous recording and reproducing of a digital satellite broadcast program, comprising:

a) a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs (see Fig.1, antenna 11, tuner 12; col.3, lines 4-12);

b) 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 (see Fig.1, demultiplexer 18; col.3, line 13 to col.4, line 43);

c) 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 (see Fig.1; hard disk drive 15 which includes the hard disk 42; col.3, line 13 to col.4, line 43);

d) a first clock recovery module having an input coupled to the first input node, and an output, wherein the 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 it is stored in the storage device (see time added by the receiver 22 based on the clock generated by means of the cycle timer 27 to the TS packet supplied from the PID parser 21, and supplies it to an input FIFO 23, wherein the time stamp is synchronous with the clock generated by means of the cycle timer 27; col.4, lines 14-32); and

e) a decoder having a first input coupled to the output of the first clock recovery system 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 (see AV decoder 19; hard disk drice 15, the cycle timer 27; col.3, line 50 to col.4, line 43).

Regarding claim 22, Morinaga et al disclose wherein the first clock recovery module further generates the clock based upon data transmitted in packets of a currently received multiplexed packetized data stream (see cycle timer 27 of Fig.1; col.4, lines 13-32).

Regarding claim 23, Morinaga et al disclose wherein the first clock recovery module further generates the clock based upon multiplexed packetized data stream data stored in the storage device (see cycle timer 27 of Fig.1; col.4, line 44 to col.5, line 3).

Regarding claims 24&25, Morinaga et al disclose wherein the decoder includes a video decoder and wherein the decoder includes an audio decoder (see AV decoder 19 of Fig.1; col.3, lines 54-65).

Regarding claim 26, Morinaga et al disclose a second transport stream demultiplexer having an input coupled to the data port of the storage device (see Fig.1&2; AV decoder 19 and hard disk drive 15 which includes the hard disk 42; col.5, lines 4-14), here examiner reads the processing of the TS packet reproduced from the hard disk drive 15 by the AV decoder 19 as the 'second' decoder processing, because the Av decoder 19 is adapted to process both the TS packet received from antenna 11 and tuner 12 and the TS packet reproduced from the hard disk drive 15.

Regarding claim 27, Morinaga et al disclose a second clock recovery module having an input coupled to the data port of the storage device to allow STC setting based on the stored system time (see Fig.1&2, cycle timer 27; col.5, line 44 to col.5, line 13), here during the reproduction process the cycle timer 27 performs the clocking and

timing function as during the recording function, and this time the examiner reads the cycle timer 27 as the 'second' clock recovery module.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-13,15&16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morinaga et al (US 6,792,000) in view of Fujinami et al (US 5,521,922).

Regarding claim 1, Morinaga et al disclose a data processing apparatus/method and a data recording medium that are capable of simultaneous recording and reproducing of a digital satellite broadcast program, comprising the method comprising:

a) receiving a mnultiplexed packetized data stream that carries real-time multimedia programs (see Fig.1, antenna 11, tuner 12; col.3, lines 4-12);

b) storing a first portion of the packetized data stream representing video data and timing of a program (see Fig.1, hard disk drive 42; col.3, line 66 to col.4, line 43);

c) setting a system time indicator (clock) to a stored system time value, wherein the stored system time value is based on a portion of the timing data of the first portion of the packetized data stream (see time added by the receiver 22 based on the clock generated by means of the cycle timer 27 to the TS packet supplied from the PID parser

21, and supplies it to an input FIFO 23, wherein the time stamp is synchronous with the clock generated by means of the cycle timer 27; col.4, lines 14-32);

d) retrieving the video data of the first portion of the packetized data stream for video decoding (see Fig.1, had disk controller 41; hard disk drive 42, AV decoder 19; col.4, line 44 to col.5, line 13 and Fig.2; col.10, lines 1-32);

e) storing a second portion of the packetized data stream representing video data and timing data of the program (see Fig.1&2; col.9, lines 48-67).

Here, examiner reads the claimed first portion of the packetized data stream representing the video data as that portion of the received data stream that has been recorded and the second portion as that portion of the data stream that is yet to be recorded in a data stream that is simultaneously being recorded and reproduced, as Morinaga et al disclose.

Morinaga et al fail to explicitly disclose the method comprising incrementing the system time indicator. Fujinami et al teach a data multiplexer adapted for reproducing time-division multiplex data recorded on an optical disk or the like and separating the same into video data and audio data, comprising the STC register 26 which counts 90-kHz clock pulses outputted from the clock generator 27 (system time indicator) and increments its storage value to generate an STC (system time clock) signal (see Fig.1A&4A; col.1, lines 55-64; col.2, lines 35-42 and col.6, line 61 to col.7, line 6)

It would have been obvious to modify Morinaga et al by realizing Moronaga with a system time clock, as taught by Fujinami, in order, for example, to provide the means

to count the clock pulses outputted from the clock generator to increment the system clock.

Regarding claim 2, the claimed limitations of claim 2 are accommodated in the discussions of claim 1 above since in the processing of simultaneous recording and reproducing of Morinaga, both audio (sound) and video (AV) and recorded and reproduced (see col.3, lines 54-65).

Regarding claim 3, Morinaga et al disclose the method comprising wherein the multiplexed data stream is a multiplexed packetized data stream that substantially meets an MPEG2 specifications (see col.3, lines 60-65).

Regarding claim 4, Morinaga et al disclose the method comprising wherein the the step of storing the first portion includes storing transport stream packets (see col.9, lines 48-67).

Regarding claim 5, Morinaga et al disclose the method comprising wherein the step of storing the first portion includes the sub steps of determining transport stream packets containing data associated with the program and storing the transport stream packets containing data associated with the program after the step of determining (see Fig.6A-6I, control data ; col.10, lines 37-56).

Regarding claim 6, Morinaga et al disclose the method comprising wherein the step of storing the first portion includes storing packetized elementary stream (PES) packets (see col.9, lines 48-67), here examiner reads the transport stream (TS) packets as PES packets.

Regarding claim 7, the claimed limitations of claim 7 are accommodated in the discussions of claims 5&6 above.

Regarding claim 8, Morinaga et al disclose the method wherein the step of storing the first portion of the transport stream includes the timing data including synchronization information used for playing the program back at a real time program bit-rate (see time stamp, col.4, lines 13-67 and col.13, lines 6-11).

Regarding claim 9, Morinaga modified with the time counting (incrementing) means of Fujinami, it would have been obvious that wherein the step of incrementing the system time indicator includes incrementing the system time indicator based upon a signal generated from multiplexed packetized data stream data received after the first time since the recording and reproducing system of Morinaga processed received multiplexed transport stream, and during the process of recording and reproducing audio/video data stream, wherein the already recorded data stream is the first data, any time increments would be based on the already recorded AV data, and also since the

system of Morinaga would then be able to access the control data of the recorded AV data.

Regarding claim 10, Moronaga discloses the method of decoding the video data of the first portion to provide a decoded video stream (see Fig.1&2; AV decoder 19; col.3, lines 60-65; col.10, lines 21-26), here the resultant AV data from the AV decoder 16 are supplied to the monitor (not shown, thereby the image and sound (audio) of the digital satellite broadcast program are reproduced (displayed) on the monitor).

Regarding claim 11, Morinaga et al disclose the method wherein the step of receiving a multiplexed packetized data stream and decoding the video data are performed by an integrated semiconductoer device (MV Link-IC 16 and PHY-IC 17 of Fig.1&2; col.3, lines 19-32).

Regarding claim 12, Morinaga et al disclose the method comprising the step of providing the decoded video stream for display at a play back rate (see col.3, lines 60-65; col.10, lines 21-26).

Regarding claim 13, Morinaga et al disclose the method wherein the the play back rate is a real time rate (see col.5, lines 58-63 and col.13 lines 6-12).

Regarding claim 15, Morinaga et al disclose the method wherein the step of providing the decoded video stream for display includes determining the playback rate based upon timing data received from the multiplexed packetized data stream after the first time (see col.5, lines 58-63 and col.13 lines 6-12), here the play back rate is based on the real time rate, since Morinaga is processing real time data stream.

Regarding claim 16, Morinaga et al disclose the method wherein the timing data received from the multiplexed packetized data stream after the first time is associated with a current real time data stream (see col.5, lines 58-63 and col.13 lines 6-12), here the play back rate is based on the current real time rate, since Morinaga is processing current real time data stream.

5. Claims 14&17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morinaga et al in view of Fujinami et al and further in view of Barton et al (US 6,233,389).

Regarding claim 14, Morinaga and Fujinami disclose the method wherein the providing the decoded video data for display includes determining the playback rate based upon the clock recover data of the first portion (the recorded portion) of the transport stream (see col.12, line 56 to col.13, 11).

Morinaga and Fujinami fail to explicitly disclose the method wherein the playback rate will vary depending upon a rate at which the first portion (the recorded portion) of the transport stream data is provided to a decoder during the decoding function.

Barton et al teach time shifting of television broadcast signals, including the real time capture, storage, and display of television broadcast signals wherein a user can be watching one program while another stream is being stored (see col.4, lines 15-23, and wherein the stored program can be retrieved at a variable rate, including at a rate faster than the stored rate (see col.8, lines 19-38; col.9, lines 33-47). Playing back a stored program at a variable rate provides the desirable advantage of providing special reproduction capability to a playback system.

It would have been obvious to further modify Morinaga by realizing Morinaga with variable reproduction capability, as taught by Barton, since this provides the desirable advantage of providing special reproduction capability to a playback system.

Regarding claim 17, Barton further teaches the method wherein the playback rate is faster than a real time rate (see col.8, lines 19-38; col.9, lines 33-47.

Allowable Subject Matter

6. Claims 18-20 are allowable over the prior art of record.

7. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 18, the invention relates to time shifting of video data, including time shifting of digital video data.

The closest references Morinaga et al (US 6,792,000) disclose a data processing apparatus/method and a data recording medium that are capable of simultaneous recording and reproducing of a digital satellite broadcast program, and Fujinami et al (US 5,521,922) teach a data multiplexer adapted for reproducing time-division multiplex data recorded on an optical disk or the like and separating the same into video data and audio data.

However, Morinaga et al and Fujinami et al fail to explicitly disclose a method comprising the steps of during a third mode of operation receiving the multiplexed packetized data stream at the first demultiplexer, selecting the first program from the multiplexed packetized data stream, storing a first program portion of the first program, providing the first program portion to a second demultiplexer, selecting at the second demultiplexer a video portion of the first program portion, decoding the video portion of the first program portion for display, and storing a second program portion of the first program simultaneous to the step of decoding.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Yoshio et al (US 5,936,925) teach a recording apparatus for recording the information onto the information recording medium, and a reproducing apparatus for reproducing the information from the information record medium.

Ueki (US 6,751,170) teach an information-signal recording apparatus and an information-signal reproducing apparatus, including an information-signal recording medium.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher O. Onuaku whose telephone number is (703) 308-7555. The examiner can normally be reached on M-F 8:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's Acting supervisor, Thai Tran, can be reached on 703-305-4725. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

COO

9/30/04

THAI TRAN
PRIMARY EXAMINER

Notice of References Cited	Application/Control No. 09/707,060	Applicant(s)/Patent Under Reexamination KOVACEVIC, BRANKO	
	Examiner Christopher O. Onuaku	Art Unit 2616	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,792,000	09-2004	Morinaga et al.	386/124
	B	US-5,521,922	05-1996	Fujinami et al.	348/423.1
	C	US-6,233,389	05-2001	Barton et al.	386/68
	D	US-5,936,925	08-1999	Yoshio et al.	360/39
	E	US-6,751,170	06-2004	Ueki, Yasuhiro	369/32.01
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

PTO/SB/08B (04-03)
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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 1

	Complete if Known
Application Number	09/707,060
Filing Date	11-06-2000
First Named Inventor	Branko D. Kovacevic
Art Unit	~~2615~~ 2616
Examiner Name	Christopher O. Onuak
Attorney Docket Number	1376.0000690

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
hco	AA	"Transmission of Non-Telephone Signals," Information Technology--Generic Coding of Moving Pictures and Associated Audio Information: Systems, ITU-T Recommendation H.222.0, 07/95, 120 pp.	
hco	BB	"Information Technology--Generic Coding of Moving Pictures and Associated Audio Information--Part 3: Audio," ISO/IEC 13818-3, Second Edition, 1998-04-15, 116 pp.	

Examiner Signature	CHRISTOPHER ONUAKU	Date Considered	9/25/04

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 120 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, Washington, DC 20231.**

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Branko KOVACEVIC		
Title:	SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF		
App. No.:	09/707,060	Filed:	11/06/2000
Examiner:	ONUAKU, Christopher	Group Art Unit:	2616
Customer No.:	34456	Confirmation No.:	5798
Atty. Dkt. No.:	1376-0000690		

Mail Stop AMENDMENT
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

RESPONSE TO OFFICE ACTION

Dear Sir:

In response to the Office Action mailed October 4, 2004, please amend the above-identified application as follows:

Claim Amendments begin on page 2.

Remarks begin on page 8.

CERTIFICATE OF TRANSMISSION/MAILING
I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to the Commissioner for Patents on December 22, 2004

Molly K. Harrison
Typed or Printed Name

Molly K Harrison
Signature

IN THE CLAIMS:

Please amend claims 1, 2, 4-12, 14, 15, 18-21 and 26 as indicated in the following.

Claims Listing:

1. (Currently Amended) A method comprising ~~the steps of~~:

receiving a multiplexed packetized data stream that carries real-time multimedia programs;

during a first time:

storing a first portion of the packetized data stream representing video data and timing data of a program;

setting a system time indicator to a stored system time value, wherein the stored system time value is based on a portion of the timing data of the first portion of the packetized data stream;

during a second time:

incrementing the system time indicator;

retrieving the video data of the first portion of the packetized data stream for video decoding; and

storing a second portion of the packetized data stream representing video data and timing data of the program.

2. (Currently Amended) The method of claim 1, wherein

~~the step of~~ storing the first portion of the packetized data stream includes the first portion of the packetized data stream representing audio data of the program;

~~the step of~~ storing the second portion of the packetized data stream includes the second portion of the packetized data stream representing audio data of the program;

the method further including: ~~the step of~~

during the second time:

~~the step of~~ accessing the audio data of the first portion of the packetized data stream for audio playback.

3. (Original) The method of claim 1, wherein the multiplexed packetized data stream is a multiplexed packetized data stream that substantially meets an MPEG2 specification.

4. (Currently Amended) The method of claim 3, wherein ~~the step of~~ storing the first portion includes storing transport stream packets.

5. (Currently Amended) The method of claim 4, wherein ~~the step of~~ storing the first portion includes: ~~the sub-steps of~~

determining transport stream packets containing data associated with the program; and

storing the transport stream packets containing data associated with the program after the step of determining.

6. (Currently Amended) The method of claim 3, wherein ~~the step of~~ storing the first portion includes storing packetized elementary stream (PES) packets.

7. (Currently Amended) The method of claim 6, wherein ~~the step of~~ storing the first portion includes: ~~the sub-steps of~~

determining transport stream packets containing data associated with the program; and

storing PES packets based upon the transport stream packets containing data associated with the program after the step of determining.

8. (Currently Amended) The method of claim 1, wherein ~~the step of~~ storing the first portion of the transport stream includes the timing data including synchronization information used for playing the program back at a real time program bit-rate.

9. (Currently Amended) The method of claim 1, wherein ~~the step of~~ incrementing the system time indicator includes incrementing the system time indicator based upon a signal generated from multiplexed packetized data stream data received after the first time.

10. (Currently Amended) The method of claim 1 further comprising ~~the step of~~:

decoding the video data of the first portion to provide a decoded video stream.

11. (Currently Amended) The method of claim 10, wherein ~~the steps of~~ receiving a multiplexed packetized data stream and decoding the video data are performed by an integrated semiconductor device.

12. (Currently Amended) The method of claim 10 further comprising ~~the step of~~:

providing the decoded video stream for display at a play back rate.

13. (Original) The method of claim 12 wherein the play back rate is a real time rate.

14. (Currently Amended) The method of claim 12, wherein ~~the step of~~ providing the decoded video stream for display includes determining the play back rate based upon clock recovery data of the first portion of the transport stream, wherein the play back rate ~~will vary~~varies depending upon a rate at which the first portion of the transport stream data is provided to a decoder during the step of decoding.

15. (Currently Amended) The method of claim 12 wherein ~~the step of~~ providing the decoded video stream for display includes determining the play back rate based upon timing data received from the multiplexed packetized data stream after the first time.

16. (Original) The method of claim 15, wherein the timing data received from the multiplexed packetized data stream after the first time is associated with a current real-time data stream.

17. (Original) The method of claim 12, wherein the play back rate is faster than a real time rate.

18. (Currently Amended) A method comprising ~~the steps of~~:
determining a mode of operation;
during a first mode of operation:
receiving a multiplexed packetized data stream at a first demultiplexer;
selecting a first program from the multiplexed packetized data stream;
decoding a video portion of the first program for display;
during a second mode of operation:
receiving the multiplexed packetized data stream at the first demultiplexer;
selecting the first program from the multiplexed packetized data stream;
storing the first program;
during a third mode of operation:
receiving the multiplexed packetized data stream at the first demultiplexer;
selecting the first program from the multiplexed packetized data stream;
storing a first program portion of the first program;
providing the first program portion to a second demultiplexer;
selecting at the second demultiplexer a video portion of the first program portion;
decoding the video portion of the first program portion for display; and
storing a second program portion of the first program simultaneous to the step of decoding.

19. (Currently Amended) The method of claim 18, further comprising:
during the third mode of operation ~~the steps of~~:
providing the second program portion to a second demultiplexer;
selecting at the second demultiplexer a video portion of the second program portion; and
decoding the video portion of the second program portion for display.

20. (Currently Amended) The method of claim 18 further comprising:[[,]]
during the third mode of operation~~, the steps of~~:
incrementing a counter associated with the second demultiplexer based upon a signal generated using a live feed of the multiplexed packetized data stream as it is received at the first demultiplexer.

21. (Currently Amended) A system comprising:

a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs;

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;

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;

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 it is stored in the storage device; and

a decoder having a first input coupled to the output of the first clock recovery ~~system~~ module to receive the clock, a second input coupled the data port of the storage device to receive the select packets, and an output to provide decoded real-time data.

22. (Original) The system of claim 21, wherein the first clock recovery module further generates the clock based upon data transmitted in packets of a currently received multiplexed packetized data stream.

23. (Original) The system of claim 21, wherein the first clock recovery module further generates the clock based upon multiplexed packetized data stream data stored in the storage device.

24. (Original) The system of claim 21, wherein the decoder includes a video decoder.

25. (Original) The system of claim 24, wherein the decoder includes an audio decoder.

26. (Currently Amended) The system of claim 21 further comprising:

a second transport stream demultiplexer having an input coupled to the data port of the storage device.[[;]]

27. (Original) The system of claim 26 further comprising:

a second clock recovery module having an input coupled to the data port of the storage device to allow STC setting based on a stored system time.

REMARKS

The Office Action dated October 4, 2004 has been received and carefully considered. Claims 1, 2, 4-12, 14, 15, 18-21 and 26 have been amended to address various informalities and to remove "step of" phrasing. These amendments do not narrow the scope of the claims. Reconsideration of the outstanding rejections in the present application is respectfully requested in view of the following remarks.

Allowability of Claims 18-20

The Applicant notes with appreciation the indication at page 11 of the Office Action that claims 18-20 are allowed.

Anticipation Rejection of Claims 21-27

At page 2 of the Office Action, claims 21-27 were rejected under 35 U.S.C. § 102(e) as being anticipated by Morinaga (U.S. Patent No. 6,792,000). This rejection is respectfully traversed.

Claim 21, from which claims 22-27 depend, recites, in part, the limitations of a first clock recovery module having an input coupled to a 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 a multiplexed packetized data stream before it is stored in a storage device, and a decoder having a first input coupled to the output of the first clock recovery module to receive the clock, a second input coupled the data port of the storage device to receive the select packets, and an output to provide decoded real-time data. The Examiner asserts that Figure 1 of Morinaga and the passages of Morinaga at col. 3, line 13 to col. 4, line 43, col. 4, lines 14-32, and col. 3, line 50 to col. 4, line 43 disclose these limitations. *Office Action*, p. 3. Specifically, the Examiner asserts that the limitations of the clock recovery module of claim 21 are anticipated as Morinaga allegedly discloses "time added by the receiver 22 based on the clock generated by means of the cycle timer 27 to the TS packet supplied from the PID parser 21, and supplies it to an input FIFO 23, wherein the time stamp is synchronous with the clock generated by means of the cycle timer 27." *Id.* The Examiner also asserts that Morinaga discloses the limitations of the decoder of claim 21 as Morinaga allegedly discloses an AV decoder 19, a hard disk driver 15, and the cycle timer 27. *Id.*

It is respectfully submitted that the cited passages of Morinaga do not disclose or suggest a clock recovery module to generate a clock at its output *based upon received timing information transmitted in packets of a multiplexed packetized data stream* as recited by claim 21. As disclosed by Morinaga, "the cycle timer 27 supplies the clock *having a predetermined frequency* to the receiver 22 and the transmitter 26, and the receiver 22 adds the time stamp that is synchronous with the clock generated by means of the cycle timer 27 to the TS packet supplied from the PID parser 21 and supplies it to the FIFO 23." *Morinaga*, col. 4, lines 23-28. Thus, Morinaga teaches that the cycle timer 27 has a predetermined frequency and therefore fails to disclose or suggest that the cycle timer 27 bases its clock on timing information obtained from the packetized data stream. This is collaborated by Figure 1 of Morinaga, which illustrates cycle timer 27 without any inputs by which it could receive timing information from the received transport stream output by the descrambler 13.

As Morinaga fails to disclose a clock recovery module having an output to provide a clock based upon received timing information as recited by claim 21, Morinaga necessarily fails to disclose or suggest a decoder having a first input coupled to the output of such a clock recovery module to receive such a clock as also recited by claim 21. As noted by Morinaga, the cycle timer 27 (which the Examiner incorrectly equates to the clock recovery module of claim 21) "supplies the clock having a predetermined frequency to the receiver 22 and the transmitter 26," but, as illustrated by Figure 1 of Morinaga, the AV decoder 19 does not have an input coupled to an output of the cycle timer 27. Accordingly, even if it is assumed, *arguendo*, that the cycle timer 27 were analogous to the clock recovery module of claim 21, Morinaga fails to disclose or suggest that the output of the cycle timer 27 is coupled to an input of the AV decoder 19 consistent with the limitations of claim 21.

Therefore, it is respectfully submitted that the Office Action fails to establish that Morinaga discloses or suggests each and every limitation of claim 21, as well as each and every limitation of claims 22-27 at least by virtue of their dependency from claim 21. Moreover, these claims recite additional limitations neither disclosed nor suggested by the cited references. For example, with regard to claim 26, the Examiner states that "the processing of the TS packet reproduced from the hard disk driver 15 by the AV decoder [is read] as the 'second' decoder processing, because the Av decoder 19 is adapted to process both the TS packet receiver from antenna 11 and tuner 12 and the TS packet reproduced from the hard disk driver 15." Office

Action, p. 4. However, the Applicant notes that claim 26 recites the limitations of "a second transport stream multiplexer," not a "second decoder" as inferred by the Examiner. It is respectfully submitted that the Office Action fails to establish that Morinaga discloses a second transport stream multiplexer as recited by claim 27.

In view of the foregoing, it is respectfully submitted that the anticipation rejection of claims 21-27 is improper at this time and withdrawal of this rejection therefore is respectfully requested.

Obviousness Rejection of Claims 1-17

At page 5 of the Office Action, claims 1-13, 15 and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Morinaga in view of Fujinami (U.S. Patent No. 5,521,922). At page 10 of the Office Action, claims 14 and 17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Morinaga in view of Fujinami and further in view of Barton (U.S. Patent No. 6,233,389). These rejections are respectfully traversed.

Claim 1, from which claims 2-17 depend, recites, in part, the limitations of setting a system time indicator to a stored system time value, wherein the stored system time value is based on a portion of the timing data of a first portion of a packetized data stream. The Examiner relies on the cycle timer 27 and the related passages of Morinaga as allegedly disclosing these limitations. *Office Action*, p. 5-6. However, as similarly noted above, the Applicant respectfully submits that Morinaga fails to disclose or suggest that the clock output by the cycle timer 27 of Morinaga is based in any way on timing information received in the transport stream output by the descrambler 13, much less that a system time indicator of Morinaga is set to a stored system time value based on such timing information. Although the Office Action relies on Fujinami as disclosing the limitations of incrementing a system time indicator and on Barton as disclosing the limitations of a variable playback rate, the Office Action does not assert that either of Fujinami or Barton disclose or suggest the limitations of setting a system time indicator to a stored system time value, wherein the stored system time value is based on a portion of the timing data of a first portion of a packetized data stream as recited by claim 1. Accordingly, it is respectfully submitted that the Office Action fails to establish that the proposed combinations of Morinaga, Fujinami and Barton disclose or suggest each and every limitation of claim 1, as well as each and every limitation of claims 2-17 at least

by virtue of their dependency from claim 1. Moreover, these claims recite additional limitations neither disclosed nor suggested by the cited references.

In view of the foregoing, it is respectfully submitted that the obviousness rejections of claims 1-17 are improper at this time and withdrawal of these rejections therefore is respectfully requested.

Conclusion

The Applicant respectfully submits that the present application is in condition for allowance, and an early indication of the same is courteously solicited. The Examiner is respectfully requested to contact the undersigned by telephone at the below listed telephone number in order to expedite resolution of any issues and to expedite passage of the present application to issue, if any comments, questions, or suggestions arise in connection with the present application.

The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 50-0441.

Respectfully submitted,

22 December 2004
Date

Ryan S. Davidson, Reg. No. 51,596,
On Behalf Of
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2616 TFW

PTO/SB/21 (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission: 12

Application Number	09/707,060
Filing Date	November 6, 2000
First Named Inventor	Branko KOVACEVIC
Art Unit	2616
Examiner Name	Christopher ONUAKU
Attorney Docket Number	1376-000690

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☑ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☑ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please Identify below):
  Return Receipt Postcard

Remarks

CUSTOMER NO.: 34456

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	TOLER, LARSON & ABEL, LLP		
Signature			
Printed name	Ryan S. Davidson		
Date	22 December 2004	Reg. No.	51,596

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature	Molly K. Harrison		
Typed or printed name	Molly K. Harrison	Date	12-22-2004

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number: 09/707060

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	27 minus 20=	* 7
INDEPENDENT CLAIMS	3 minus 3 =	* —
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=		OR	X$18=	126
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL		OR	TOTAL	836

CLAIMS AS AMENDED - PART II

12/7/09

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 27	Minus	** 27	= —
Independent	* 3	Minus	*** 3	= ✓
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

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X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
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* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

ISSUE SLIP STAPLE AREA (for additional cross references)

POSITION	INITIALS	NO.	DATE
FEE DETERMINATION			
O.I.P.E. CLASSIFIER		43	11/29/00
FORMALITY REVIEW	CM	71632	12/8/0
RESPONSE FORMALITY REVIEW			

INDEX OF CLAIMS

✔ ..... Rejected
= ..... Allowed
— (Through numeral)... Canceled
÷ ..... Restricted
N ..... Non-elected
I ..... Interference
A ..... Appeal
O ..... Objected

Claim Final	Claim Original	Date
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If more than 150 claims or 10 actions staple additional sheet here

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Freeform Search

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IBM Technical Disclosure Bulletins

Term: L19 and receiv$

Display: 10 **Documents in Display Format:** FULL **Starting with Number** 1

Generate: ○ **Hit List** ◉ **Hit Count** ○ **Side by Side** ○ **Image**

Search Clear Interrupt

Search History

DATE: Friday, May 20, 2005 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT; PLUR=YES; OP=OR			
L20	L19 and receiv$	87	L20
L19	L18 and (reproduc$ or playback or play$)	88	L19
L18	L17 and record$	95	L18
L17	L16 and clock$	109	L17
L16	L15 and ((transport$ near2 stream$) or (TS))	159	L16
L15	L14 and video$	241	L15
L14	L13 and audio	247	L14
L13	L12 and program$1	274	L13
L12	L11 and time$	366	L12
L11	L10 and header$	368	L11
L10	L9 and packet$	539	L10
L9	(386/46,48,68,124 or 348/423.1 or 360/39,48 or 369/32.01).ccls.	3177	L9
L8	L7 and head$	0	L8
L7	l2 and packet$	1	L7
L6	l5 and time$	1	L6
L5	l2 and PMT	1	L5

L4	l1 and PMT	0	L4
L3	L2 and (control$ near1 data)	1	L3
L2	6792000.pn.	1	L2
L1	5802244.pn.	1	L1

END OF SEARCH HISTORY

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IBM Technical Disclosure Bulletins

Term: l4 and set$

Display: 10 **Documents in Display Format:** FULL **Starting with Number** 1

Generate: ○ **Hit List** ◉ **Hit Count** ○ **Side by Side** ○ **Image**

Search Clear Interrupt

Search History

DATE: Tuesday, May 24, 2005 Printable Copy Create Case

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L7	L6 and receiv$	1	L7
L6	6011899.pn.	1	L6
L5	l4 and set$	101	L5
L4	L3 and ((timestamp$ or timecode$ or time-stamp$ or time-code$) or (time near1 stamp$) or (time near1 code$))	105	L4
L3	L2 and header$	156	L3
L2	L1 and packet$	196	L2
L1	(386/98 or 348/423.1).ccls.	337	L1

END OF SEARCH HISTORY

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/707,060	11/06/2000	Branko Kovacevic	ATI000069	5798

34456 7590 06/15/2005

TOLER & LARSON & ABEL L.L.P.
5000 PLAZA ON THE LAKE STE 265
AUSTIN, TX 78746

EXAMINER	
ONUAKU, CHRISTOPHER O	
ART UNIT	**PAPER NUMBER**
2616	

DATE MAILED: 06/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/707,060	KOVACEVIC, BRANKO	
	Examiner	Art Unit	
	Christopher Onuaku	2616	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 December 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *18-20* is/are allowed.

6)☒ Claim(s) *1-17 and 21-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claims 1-17&21-27 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 21-27 are rejected under 35 U.S.C. 102(e) as being anticipated by Suzuki (US 6,148,135).

Regarding claim 21, Suzuki discloses a video and audio synchronization controller for decoding coded video and audio data and for synchronizing video data with audio data and a video decoding device in the video and audio reproducing device for preventing the video buffer memory from becoming empty (underflow) or full (overflow), comprising:

a) a first input node to receive a multiplexed packetized data stream that carries real-time multimedia programs (see Fig.4, video and audio separator 2 which receives coded video and audio data 1; col.8, lines 35-60);

b) 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 (see Fig.4, video and audio separator 2 which receives coded video and audio data 1; col.8, lines 35-60; and col.9, lines 20-32), here video and audio packets are disclosed and each packet has a frame header, and each video and audio packet header includes vide presentation time stamp

c) 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 (see Fig.4; video buffer memory 45 and audio buffer memory 25; col.8, line 61 to col.9, line 14);

d) a first clock recovery module having an input coupled to the first input node, and an output, wherein the 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 it is stored in the storage device (see Fig.1; system counter 101; system clock reference 3 and system tine clock 102; col.10, lines 6-55); and

e) a decoder having a first input coupled to the output of the first clock recovery system 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 (see Fig.4; video decoder 50 and audio decoder 30; col.8, line 61 to col.9, line 14).

Regarding claim 22, Suzuki discloses wherein the first clock recovery module further generates the clock based upon data transmitted in packets of a currently received multiplexed packetized data stream (see Fig.1; system time counter 101 and system clock reference 3; col.10, lines 6-55).

Regarding claim 23, Suzuki discloses wherein the first clock recovery module further generates the clock based upon multiplexed packetized data stream data stored in the storage device (see Fig.1; system time counter 101 and system clock reference 3; col.10, lines 6-55), here the SCR 3, the video time stamp and the video data packet are received by the video and audio separator 2 and stored in the video buffer memory, for example.

Regarding claims 24&25, Suzuki discloses wherein the decoder includes a video decoder and wherein the decoder includes an audio decoder (see Fig.; video decoder 50 and audio decoder 30; col.8, line 61 to col.9, line 14).

Regarding claim 26, Suzuki discloses a second transport stream demultiplexer having an input coupled to the data port of the storage device (see Fig.14; and audio and video separator 2; video buffer memory 45 and audio buffer memory 25; col.8, line

36 to col.9, line 14) here Suzuki discloses that the receiver of Fig.4 can be used to receive video and audio from satellite or cable communication lines, and in any of the cases the audio and video separator 2 serves as a 'second' demultiplexer.

Regarding claim 27, Suzuki discloses a second clock recovery module having an input coupled to the data port of the storage device to allow STC setting based on the stored system time (see Fig.1, system time clock counter 101 and STC 102, wherein the system time clock counter counts up the the updated system time clock (STC) 102 by setting to the count of the system clock reference 3 which is inckuded in the header of the video frame; col.10, lines 32-55).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki (US 6,148,135).

Regarding claim 1, Suzuki discloses a video and audio synchronization controller for decoding coded video and audio data and for synchronizing video data with audio data and a video decoding device in the video and audio reproducing device for

preventing the video buffer memory from becoming empty (underflow) or full (overflow), comprising the method of:

a) receiving a mnultiplexed packetized data stream that carries real-time multimedia programs (see Fig.4 which is used as a receiver that receives video and audio data pasckets; col.8, lines 49-60);

b) storing a first portion of the packetized data stream representing video data and timing of a program (see Fig.4, video buffer memory 45; col.8, lines 61-67), here video buffer memory stores the received video data;

c) setting a system time indicator (clock) to a stored system time value, wherein the stored system time value is based on a portion of the timing data of the first portion of the packetized data stream (see Fig.1, selector 110, system time counter 101, video synchronization comparator 109 and audio synchronization comparator 103; col.10, lines 6-23), here the selector 110 selects either the system clock reference (SCR) 3 or the delayed video time stamp (V-TS) 49. The system time counter sets the timing according to the output from the selector 110, counts the clocks, and generates and outputs the system time clock (STC) 102;

d) incrementing the system time indicator (see col.10, lines 33-55), here selector 110, selects SCR 3 and updates system time counter 101 by the count of the system clock reference 3. The system clock reference 3 is contained in the headers of the respective frames in the coded video and audio data, and is a reference clock transmitted from the transmitting terminal to provide the system with the absolute time periodically;

d) retrieving the video data of the first portion of the packetized data stream for video decoding (see Fig.4, col.8, line 61 to col.9, line 3), here the coded video data 41 and video time stamp 42, stored in the video buffer memory 45, are output from the video buffer memory 45 to the video decoder 50, and in col.11, lines 10-48, the decoding process is detailed.

Suzuki fails to explicitly disclose storing a second portion of the packetized data stream representing video data and timing data of the program, which examiner reads as the output of the video decoder 50 of Fig.4. Official Notice is taken that it would have been obvious to modify Suzuki by adding a storage means to Suzuki in order to store the decoded video and timing data output of the video decoder 50

Regarding claim 2, Suzuki discloses the method wherein:

a) storing the first portion of the packetized data stream includes the first portion of the packetized data stream representing audio data of the program (Fig.4; audio buffer memory 25; col.9, lines 4-14);

b) as discussed in claim 1 above, Suzuki fails to explicit disclose storing the second portion of the packetized data stream includes the second portion of the pascketized data stream representing audio data of the program. Official Notice is taken that it would have been obvious to modify Suzuki by adding a storage means to Suzuki in order to store the decoded audio and timing data output of the audio decoder 30.

Suzuki further discloses accessing the audio data of the first portion of the packetized data stream for audio playback (see Fig.4, audio buffer memory 25 and

audio decoder 30 and delayed coded audio data 28 which is retrieved (played back) from the audio buffer memory 25 and output to the audio decoder 30; col.9, lines 4-14)

Regarding claim 3, Suzuki discloses the method comprising wherein the multiplexed data stream is a multiplexed packetized data stream that substantially meets an MPEG2 specifications (see col.3, lines 34-42; and col.8, lines 12-13).

Regarding claim 4, Suzuki discloses the method comprising wherein the step of storing the first portion includes storing transport stream packets (see col.3, lines 34-42; and col.9, lines 20-32).

Regarding claim 5, Suzuki discloses the method comprising wherein the step of storing the first portion includes the sub steps of determining transport stream packets containing data associated with the program and storing the transport stream packets containing data associated with the program after the step of determining (see Fig.4, audio and video separator 2, and video time stamp; col.8, lines 49-67).

Regarding claim 6, Suzki disclose the method comprising wherein the step of storing the first portion includes storing packetized elementary stream (PES) packets (see col.3, lines 34-42 and col.9, lines 20-32), here examiner reads MPEG coded video signal stream and video and audio packets as PES packets.

Regarding claim 7, the claimed limitations of claim 7 are accommodated in the discussions of claims 5&6 above.

Regarding claim 8, Suzuki discloses the method wherein the step of storing the first portion of the transport stream includes the timing data including synchronization information used for playing the program back at a real time program bit-rate (see video and audio time col.12, line 42 to col.13, line 8).

Regarding claim 9, Suzuki discloses wherein incrementing the system time indicator includes incrementing the system time indicator based upon a signal generated from multiplexed packetized data stream data received after the first time (see Fig.1; selector 110, system clock reference 3 and system time counter 101; col.10, lines 33-55), here the selector 110 selects the system clock reference, and updates the system time counter 101 by the count of the system clock reference 3.

Regarding claim 10, Suzuki discloses the method of decoding the video data of the first portion to provide a decoded video stream (see Fig.4; video decoder 50; col.8, line 61 to col.9, line 3).

6. Claims 11-13,15&16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki in view of Morinaga et al (US 6,792,000).

Regarding claim 11, Suzuki fails to explicitly disclose the method wherein receiving a multiplexed packetized data stream and decoding the video data are performed by an integrated semiconductor device. Morinaga et al teach a data processing apparatus/method and a data recording medium that are capable of simultaneous recording and reproducing of a digital satellite broadcast program, wherein when the received transport stream is to be reproduced, the switch 31 selects the received transport stream from among two transports supplied thereto and supplies it to an MVLink-IC (MVLink-IC integrated circuit 16. The MVLink-IC 16 subjects the link layer processing to the output transport stream, and supplies it to PHY-IC 17. Otherwise, the MVLink-IC supplies the output transport stream to a DEMUX 18 (see Fig.1;(MV Link-IC 16 and PHY-IC 17 of Fig.1&2; col.3, lines 19-32). It would have been obvious to modify Suzuki by realizing Suzuki with an integrated semiconductor device, as taught by Morinaga, since this provides the desirable advantage of receiving and decoding packetized data stream using an integrated semiconductor device, as an alternate means of receiving and decoding packetized data stream.

Regarding claim 12, Morinaga et al further disclose the method comprising providing the decoded video stream for display at a play back rate (see col.3, lines 60-65; col.10, lines 21-26).

Regarding claim 13, Morinaga et al further disclose the method wherein the play back rate is a real time rate (see col.5, lines 58-63 and col.13 lines 6-12).

Regarding claim 15, Morinaga et al further disclose the method wherein providing the decoded video stream for display includes determining the playback rate based upon timing data received from the multiplexed packetized data stream after the first time (see col.5, lines 58-63 and col.13 lines 6-12), here the play back rate is based on the real time rate, since Morinaga is processing real time data stream.

Regarding claim 16, Morinaga et al further disclose the method wherein the timing data received from the multiplexed packetized data stream after the first time is associated with a current real time data stream (see col.5, lines 58-63 and col.13 lines 6-12), here the play back rate is based on the current real time rate, since Morinaga is processing current real time data stream.

7. Claims 14&17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki in view of Morinaga et al and further in view of Barton et al (US 6,233,389).

Regarding claim 14, Suzuki and Morinaga disclose the method wherein the providing the decoded video data for display includes determining the playback rate based upon the clock recover data of the first portion (the recorded portion) of the transport stream (see Morinaga col.12, line 56 to col.13, 11).

Suzuki and Morinaga fail to explicitly disclose the method wherein the playback rate will vary depending upon a rate at which the first portion (the recorded portion) of the transport stream data is provided to a decoder during the decoding function.

Barton et al teach time shifting of television broadcast signals, including the real time capture, storage, and display of television broadcast signals wherein a user can be watching one program while another stream is being stored (see col.4, lines 15-23, and wherein the stored program can be retrieved at a variable rate, including at a rate faster than the stored rate (see col.8, lines 19-38; col.9, lines 33-47). Playing back a stored program at a variable rate provides the desirable advantage of providing special reproduction capability to a playback system.

It would have been obvious to further modify Suzuki by realizing Suzuki with variable reproduction capability, as taught by Barton, since this provides the desirable advantage of providing special reproduction capability to a playback system.

Regarding claim 17, Barton further teaches the method wherein the playback rate is faster than a real time rate (see col.8, lines 19-38; col.9, lines 33-47.

Allowable Subject Matter

8. Claims 18-20 are allowable over the prior art of record.

9. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 18, the invention relates to time shifting of video data, including time shifting of digital video data.

The closest references Suzuki (US 6,148,135) discloses a video and audio synchronization controller for decoding coded video and audio data and for

synchronizing video data with audio data and a video decoding device in the video and audio reproducing device for preventing the video buffer memory from becoming empty (underflow) or full (overflow), and Morinaga et al (US 6,792,000) disclose a data processing apparatus/method and a data recording medium that are capable of simultaneous recording and reproducing of a digital satellite broadcast program.

However, Suzuki and Morinaga et al fail to explicitly disclose a method comprising the steps of during a third mode of operation receiving the multiplexed packetized data stream at the first demultiplexer, selecting the first program from the multiplexed packetized data stream, storing a first program portion of the first program, providing the first program portion to a second demultiplexer, selecting at the second demultiplexer a video portion of the first program portion, decoding the video portion of the first program portion for display, and storing a second program portion of the first program simultaneous to the step of decoding.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher O. Onuaku whose telephone number is (703) 308-7555. The examiner can normally be reached on M-F 8:30-6:00.

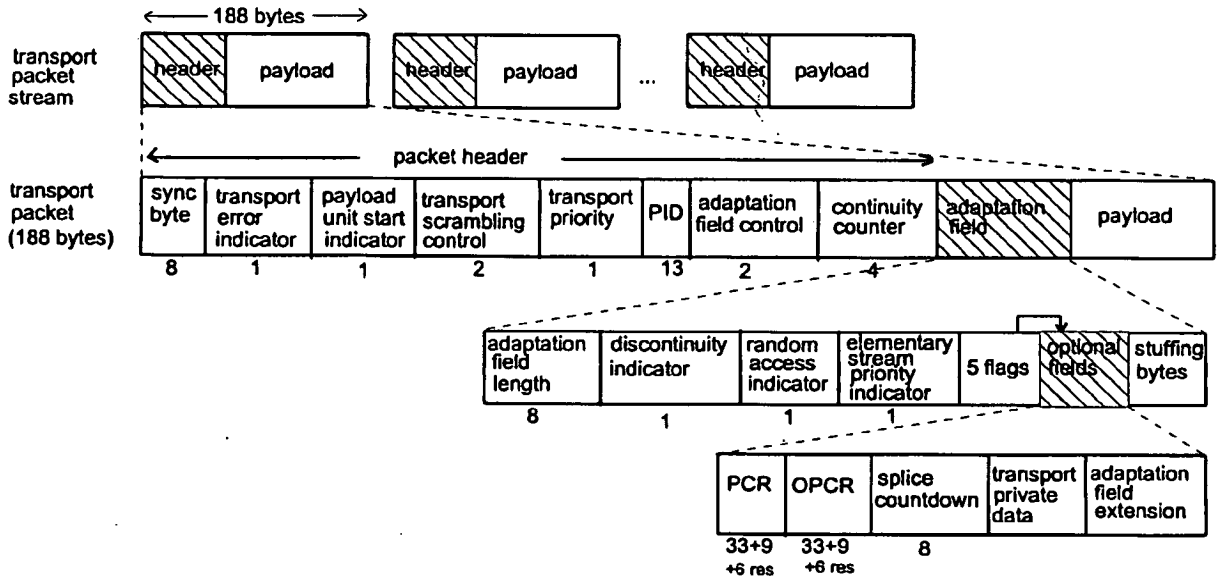
If attempts to reach the examiner by telephone are unsuccessful, the examiner's Acting supervisor, Thai Tran, can be reached on 703-305-4725. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

COO

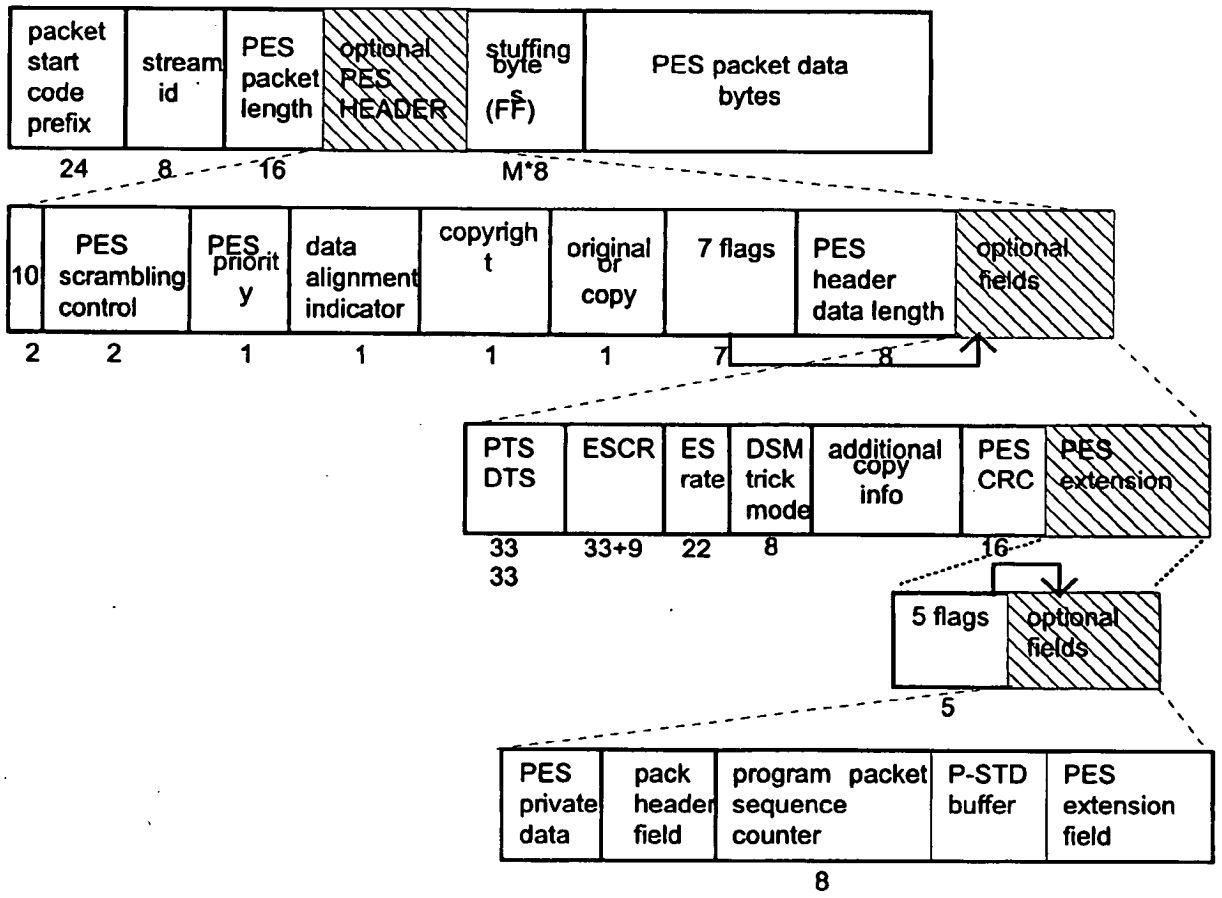
6/10/05.

James J. Groody
Supervisory Patent Examiner
Art Unit ~~262~~ 2616



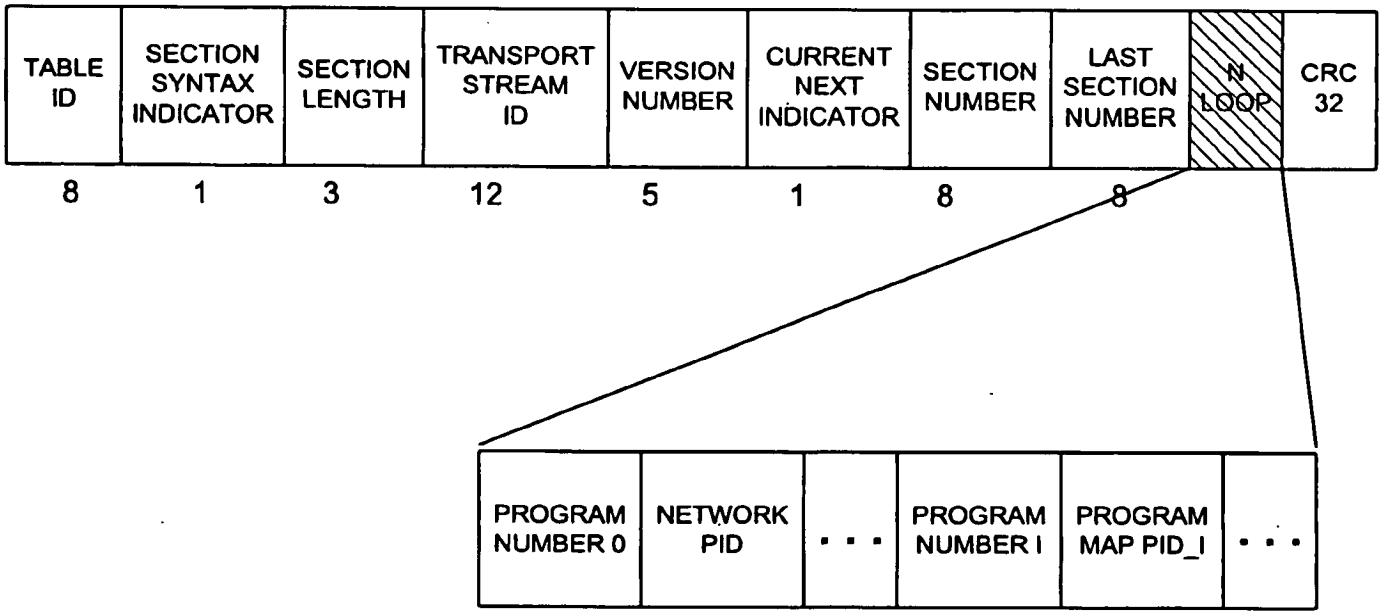
--PRIOR ART--

FIGURE 1



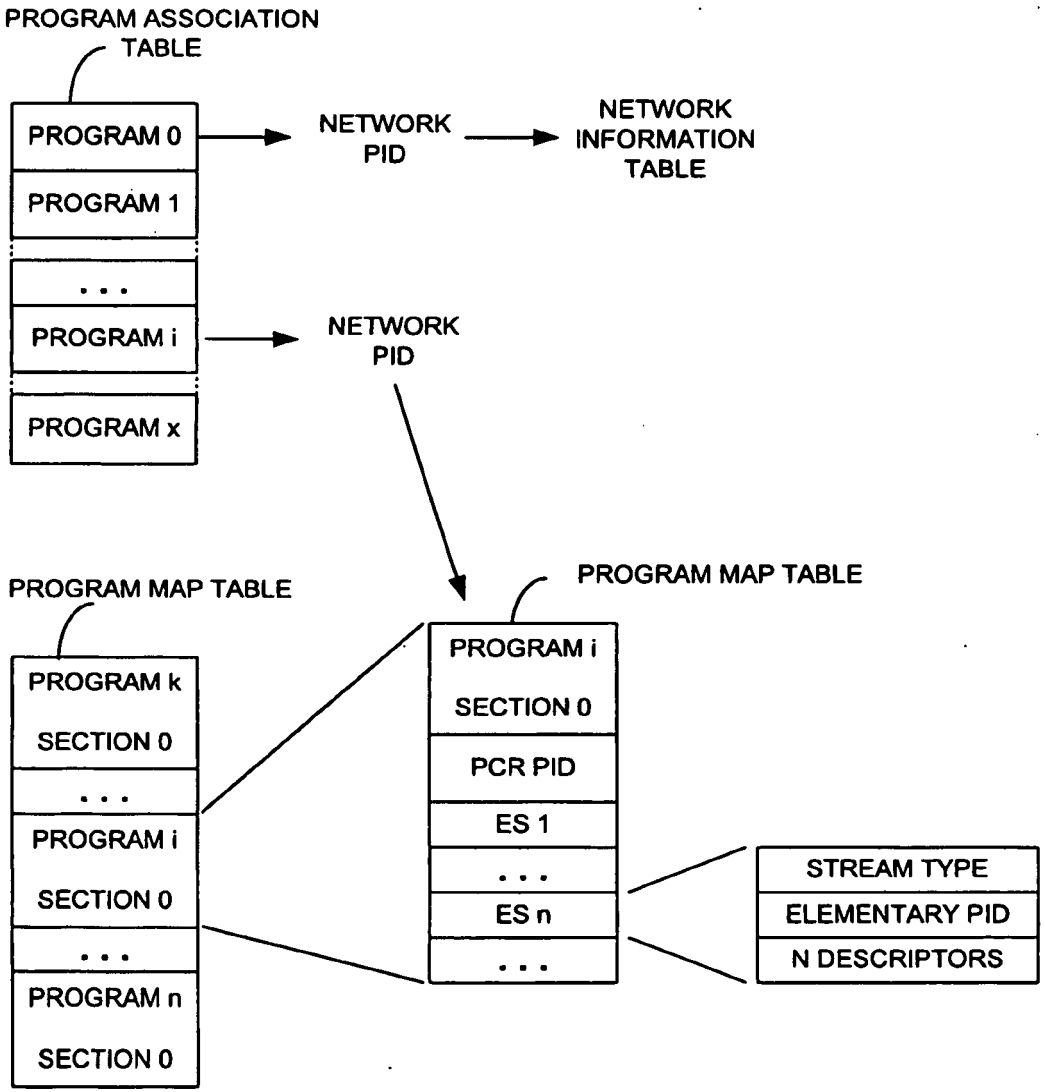
--PRIOR ART--

FIGURE 2



--PRIOR ART--

FIGURE 3



--PRIOR ART--

FIGURE 4

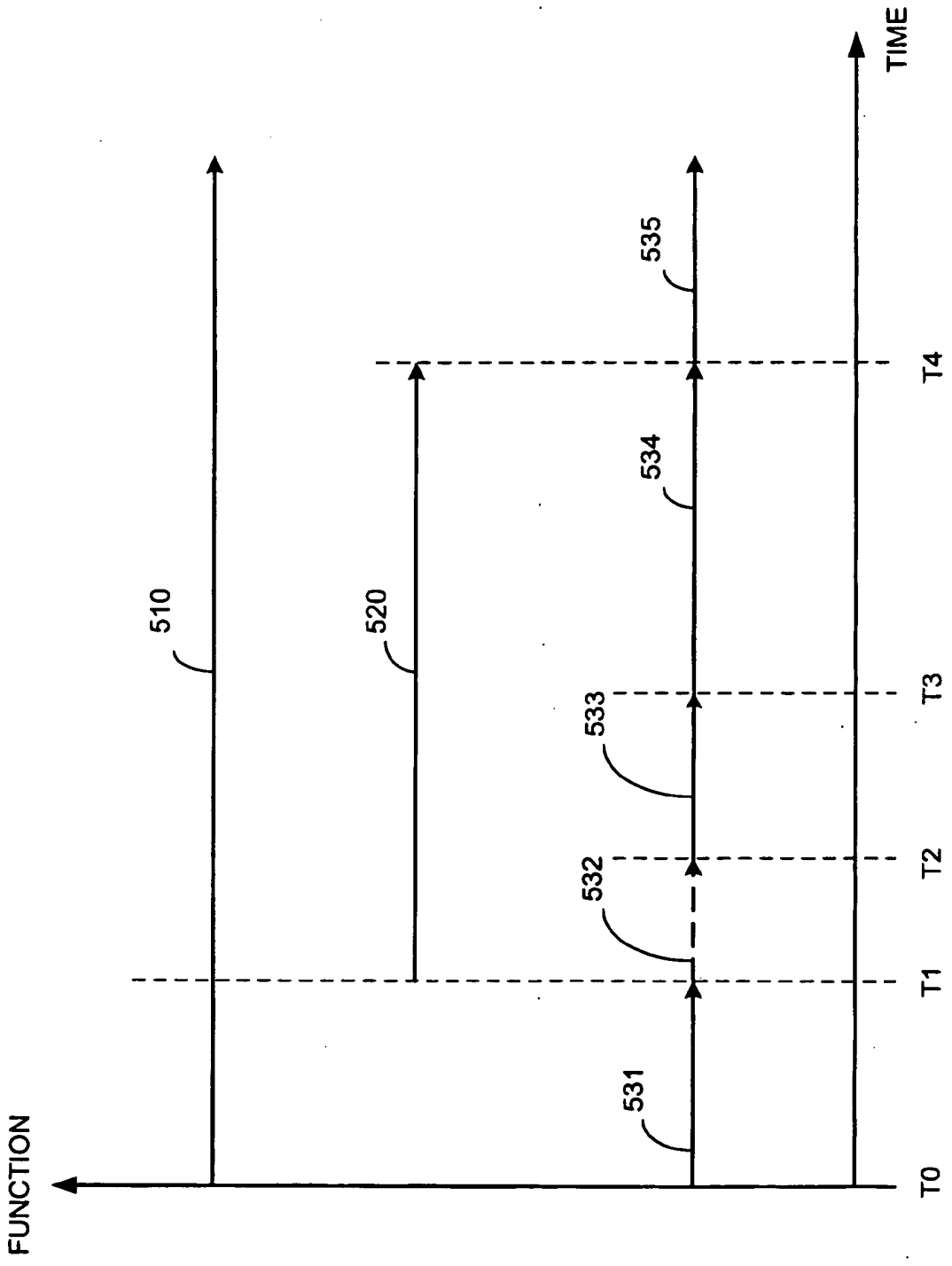


FIGURE 5

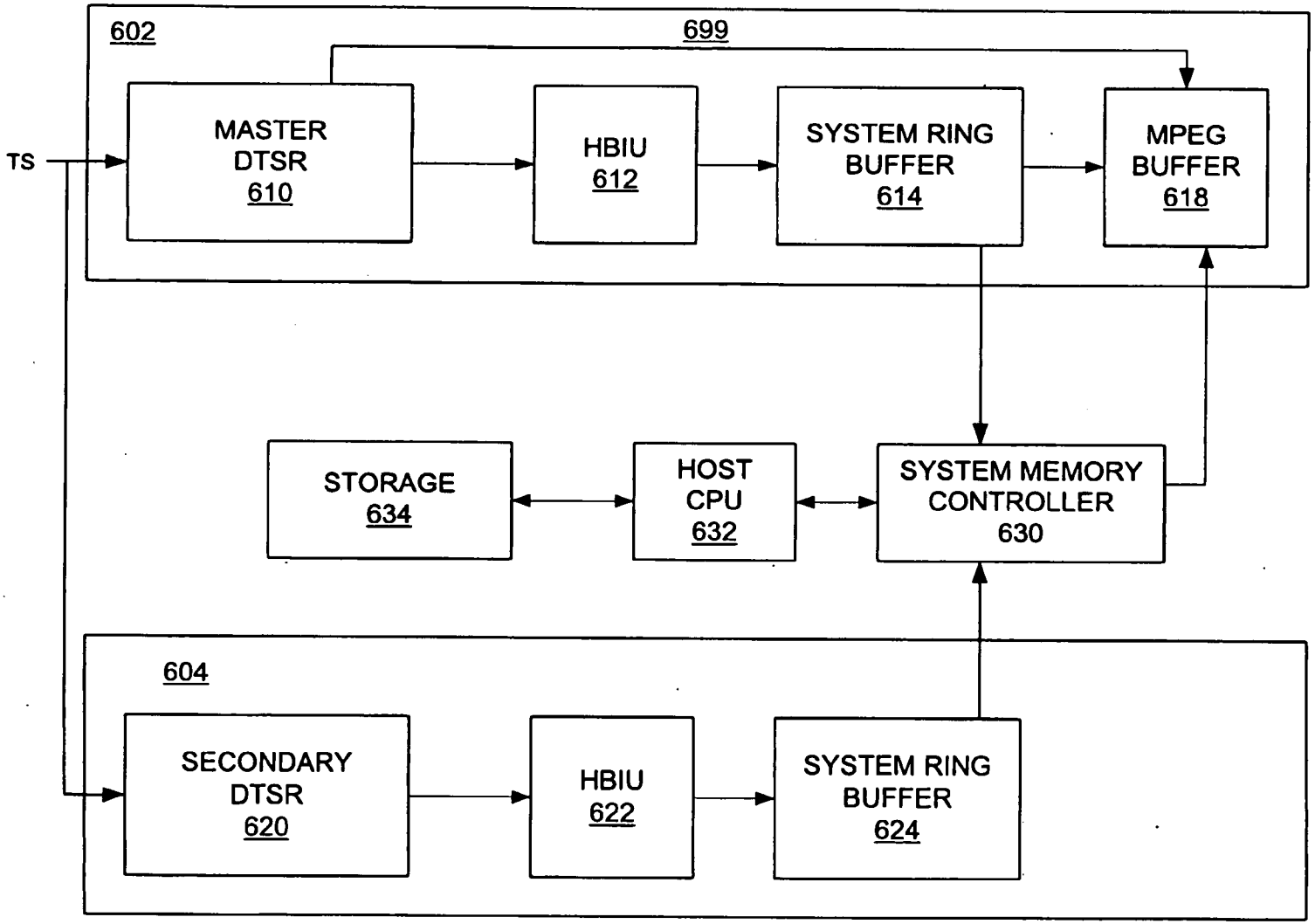


Figure 6

Notice of References Cited	Application/Control No. 09/707,060	Applicant(s)/Patent Under Reexamination KOVACEVIC, BRANKO	
	Examiner Christopher Onuaku	Art Unit 2616	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,148,135	11-2000	Suzuki, Mitsuyoshi	386/12
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
09/707,060	KOVACEVIC, BRANKO
Examiner	**Art Unit**
Christopher Onuaku	2616

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
Final	Original	6/10/05
	1	√
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Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination	
	09/707,060	KOVACEVIC, BRANKO	
	Examiner	Art Unit	
	Christopher Onuaku	2616	

SEARCHED			
Class	Subclass	Date	Examiner
386	12,46,48,68,124	5/24/2005	COO
348	423.1	5/24/2005	COO
360	39,48	5/24/2005	COO
369	32.01	5/24/2005	COO

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Thai Tran 386	5/24/2005	COO
Thai Tran 348	5/24/2005	COO
Andy Sniezek 360	5/24/2005	
Thang Tran 369	5/24/2005	COO

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Bib Data Sheet

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/707,060	11/06/2000 RULE -	386	~~2615~~ 2616	ATI000069

APPLICANTS

Branko Kovacevic, Willowdale, CANADA;

** CONTINUING DATA ********** none

** FOREIGN APPLICATIONS ********** none

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 02/08/2001

Foreign Priority claimed	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☑ no 35 USC 119 (a-d) conditions met ☐ yes ☑ no ☐ Met after Allowance Verified and Acknowledged Examiner's Signature Initials	CANADA	6	27	3

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P O Box 26503
Austin ,TX 78755-0503

TITLE

System for digital time shifting and method thereof

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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

FILING OF A UNITED STATES PATENT APPLICATION

SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

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SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

Field Of The Invention

The present invention relates generally to time shifting of video data, and more specifically to time shifting of digital video data.

Background Of The Invention

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 addition 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. A digital signal stored directly can require a large amount of storage space, even when only a few minutes of video are captured. The digital signal can be compressed to reduce the amount of storage space required. However, compressing a video signal requires additional processing power, resulting in additional costs.

As the use of digital video data becomes increasingly common, a method and apparatus for time shifting a digital program that is more efficient than those known in art would be advantageous. 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) 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.

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.

A transport stream consists of fixed length packets based on 4 bytes of header followed by 184 bytes of data payload, where data payload is obtained by partitioning larger data blocks. For example, an elementary stream (ES) is a set of data generally consisting of compressed data from a single source, such as a video or audio source, with some additional ancillary data for identification, characterization and synchronization. ES streams are first packetized into either constant length or variable length Packetized Elementary Stream packets (PES packets) consisting of a header and payload. Each PES packet header starts with start code (ox000001) followed with the stream_id byte identifying type of ES underneath.

PES packets from various elementary streams are merged together to form a program (service) with its own system time clock (STC). All ES component streams within one program are synchronized have periodic PTS stamps corresponding to the STC counter to indicate the proper timing for each ES.

The relatively long and most often variable length PES packets are further packetized into shorter TS packets having a constant size of 188 bytes. A small and constant TS packet size makes error recovery easier and faster. Usually, the transport

stream carries several programs, each with its own STC. 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.

Each TS PSI table is sent in sections, usually occupying one or more TS packets. Four types of PSI tables exist: 1) Program Association Table (PAT) listing unique program_number (as an identifier of each program in one multiplex) and PID of the PMT table; 2) Program Map Table (PMT) listing PIDs of all component streams making a given program. PMT may be constructed for each program separately or be common for a group of programs; 3) Conditional Access Table (CAT) identifying PID of Entitlement Management Messages and ID of used conditional access system if any scrambling of TS or PES packets is done; 4) Private Table carrying Network Information Table (NIT) or private data.

The Hierarchical structure which exists between ES streams, PES and TP packets is illustrated in prior art Figure 1-4.

A method and apparatus for efficient time shifting of multiplexed packetized data streams, such as a packet stream, would be advantageous.

Brief Description Of The Drawings

Figures 1-4 illustrate various information associated with an MPEG transport stream of the prior art.

Figure 5 illustrates in graphical form a time line indicating various modes of operation in accordance with the present invention;

Figure 6 illustrates in block diagram form a specific embodiment of a system having to digital transport stream receivers in accordance with the present invention.

Detailed Description Of The Drawings

A specific method and apparatus is disclosed describing a time shifting technique. In one embodiment, the disclosed time shifting technique can be based upon a hardware transport stream demultiplexer that interfaces to a transport stream. The hardware demultiplexer application assists in the extraction and parsing of a multiplexed packetized data stream, such as a MPEG-2 Transport Stream (TS) multiplex. One such hardware demultiplexer is disclosed in pending patent application (990135), which is hereby incorporated herein by reference. The disclosed hardware transport core is used to filter component streams into 15 memory ring buffers, one allocated in the frame memory for the dedicated MPEG-2 video decoder and others in the system memory for the dedicated software parser. It can demultiplex the most frequent transport packets of video stream into an Elementary Stream (ES) by monitoring the first packet identifier (PID) of each TS packet. This flexible filter can be set to extract private data from the adaptation field (AF) or from the PES packet header. Thirty-one other PIDs can be simply filtered and routed to a common (joint) or individual memory buffers for subsequent software processing on the host processor. The basic idea of a time shifting is shown in Figure 5.

Figure 5 illustrates three functions performed by a time shifting system. A first function is to receive a live broadcast stream 510. According to the graph of Figure 5, the live broadcast stream is continuously received during the time represented in Figure 5.

A second function of a time shifting system is to record a specific program after a user activates the time shifting feature. Vector 520 of Figure 5 indicates when a specific program is being recorded by the time shifting system.

A third function of the time shifting system is to display the specific program. Vector 530 of Figure 5 indicates when a specific program is being played back. Specifically, vector portion 531 represents the time where the program is being displayed directly from the live broadcast stream. Vector portion 532 represents the time that the user is unable to view the program, i.e. the user is away from the television. Therefore, in

one embodiment, during this time no program is displayed. In an alternate embodiment, the live feed can continue to be displayed, even though the program is being recorded.

Vector 533 represents the time during which the time-shifted program, which has been stored, is being replayed at a normal playback rate. Note that during this time, the live program feed continues to be recorded for future time shifted play back.

Vector 534 represents a time during which the time shifted program is being replayed at a faster than normal replay rate. By being able to playback at a faster than normal rate, it is possible to catch-up to the live broadcast stream.

The receive-only mode of vector 31 represents where the digital transport stream receiver (DTSR) is receiving a live broadcast and demultiplexing one program of a plurality of programs available in the live broadcast stream. This will be referred to as **Transparent Mode** indicating the transport stream is accessed immediately and not saved. Therefore, from the point of view of digital storage media (DSM), the received data is transparent.

Note that the PAT table is constantly acquired, in transparent mode, and other modes, so that version number change or PMT table PID change for a currently viewed program can be detected. If such a change occurs during the live broadcast of a program, PIDs will be reprogrammed for video and splicing with be handled.

A Continuous Time Shifting Mode occurs during vectors 532-534. Continuous time shifting mode occurs when time shifting is selected by the viewer to store part or all of a program for later viewing after a short or long intermission. During continuous time shifting mode, a selected program from a given multiplex is received and stored on a hard disk, or other storage media, in the form of full transport stream packets or PES packets.

A Part-Time Time-Shifting Mode, when selected by the viewer, allows for replay of a time shifted program or fast forward (FF) replay of a time shifted program at user defined FF speed. In Figure 5 this is represented as vectors 533 and 534. In a

specific embodiment discussed herein, this time-shifting mode is the most demanding mode of the 3 described modes because: the host CPU system is receiving and storing a real time event; at the same time, the host CPU is retrieving saved stream data from the disk; simultaneously with first two operations, the host CPU is performing transport stream de-multiplexing of video, audio, private and PSI/SI data on a host CPU; and at the same time the host CPU is restoring PCR/PTS time-base information as described later.

For some digital television applications, time-shifting may be considered a peak event that occurs sometimes or occasionally. However, some users may depend on it all the time, up to the end of the current program once it was started. For those users, typical operating state of the system is time shifting, de-coupled from the live stream. Time shifting of the digital transport stream should offer the same quality as from the live broadcast (source stream).

Systems suitable for time-shifting need to simultaneously receive and decode a transport stream and handle incoming source stream (to process all PSI and SI data) and record incoming source stream as a full entity or just its one program. Time shifting allows the viewer to step away from the TV monitor without missing any of the program parts. One embodiment of time shifting includes storing all transport packets received on the transport stream. Another embodiment of time shifting that is more efficient includes: 1) selecting just the transport packets of interest (PSI, SI, video, audio and data packets) that constitute one program event to minimize the bit-rate of the recorded stream, to minimize the bandwidth through the host bus interface unit, and to minimize hard disk head movement (if any); 2) increasing the amount of storage and useful life of the hard disk; and 3) assuring that the amount of data that needs to be processed by the host processor is received and stored as: transport stream packets; PES packets of video, audio, data, PSI and SI content, de-multiplexed transport; or PES packets of video and audio and bus master compressed video into the video bit-stream buffer of the MPEG video decoding device.

Selection of just one time shifted program reduces the potentially high bit-rate of a transport stream multiplex to a manageable size, suitable for storage on current 10GB hard disk units (two hours of 10Mbps stream). Obviously, a large disk drive is needed to allow any reasonable length of time shifting. In time shifting mode where time shifted material is simultaneously received and stored, the bit-rate of the host bus-interface unit (HBIU) needs to be double a system where the HBIU is only responsible for playing a single program stream. Generally the bandwidth needed is calculated to be approximately 20Mbps instead 10Mbps.

Because closed or proprietary systems, such as set-top boxes, usually do not share the hard disk drive with other systems, very specialized disk drives for audio-video applications with specialized interfaces can be used. Hard drive features that would be advantageous include: 1) Increasing access speeds and sustained sequence transfers in two directions; 2) Having deferred re-calibration of drive heads to prevent glitches or latencies during playback; 3) Having head offsets to prevent losing a revolution when going from side to side on a platter; 4) Supporting on the fly error correction; and 5) Having embedded multi-disk drive units that decrease access latencies.

The operating system can play a significant role in the efficient use of the drive by accessing most frequent video data in large blocks and decreasing seek time. Generally, larger read/write blocks increase efficiency of data storage and retrieval. Sometimes they can cause unwanted glitches by increasing latency during access.

The first time shifting mode of operation is a receive-only mode. During receive-only mode of operation a master digital time shifting receiver (DTSR) 610, of Figure 6, is programmed to receive and parse transport stream packets matching video and PCR PIDs. A host CPU 632 is assisting MPEG-2 clock recovery, and the same recovered clock data is supplying Master DTSR 610 and the Secondary DTSR 620. In one embodiment, the recovered clock is provided to the secondary DTSR 620 registers through the use of the system memory controller 630. Also, the Master DTSR 610 is programmed to perform PID filtering of audio, private, and PSI/SI PIDs programmed in the auxiliary PID registers. Secondary DTSR 620 is programmed for PID filtering

operations on Video PID programmed on a first auxiliary PID register. However, since the receiver is in receive-only mode, the video transport packets in the ring buffer 624 are disregarded. The clock recovery algorithm is suppressed on the secondary DTSR 620. Only STC of the slave DTSR is set upon the channel change. Host CPU 632 performs PES parsing of audio transport stream packets, decode and presentation of audio frames (on AC-97 codec or wave device), and continuous parsing and data processing of PSI sections monitoring real-time events like PID change, PCR discontinuity or splicing of audio stream. This activity by the host CPU 632 is part of the normal receive only mode of operation where a specified channel is being decoded and displayed. Specific systems and methods for supporting these processes are described in the patent application already incorporated by reference.

When in continuous time-shifting mode of operation, the host CPU 632 performs additional processing including: retrieval; multiplexing; time base corrections; storage of video audio, private and PSI/SI transport stream packets from multiple buffers 614 allocated in the memory space of the host CPU. In one embodiment, however, the master DTSR 620 is used to decode and display video stream as describe previously with reference to receive only mode. Transport packets from a common program are retrieved from the buffer 614 and provided to a digital storage media circular file system in a multiplexed manner. Multiplexing is performed by inserting audio, video, private, and PSI/SI transport stream packets to satisfy a group of relevant criteria.

Fundamental functions performed during continuous digital time shifting include: 1) Preserving of original ES_rate of each component stream; 2) Limiting PCR jitter of newly created single program multiplex; 3) Preserving VBV_delay value (the number of periods of a 90KHz clock derived from the 27MHz system clock that the VBV shall wait after receiving the final byte of the picture start code before decoding the picture) to insure non-interrupted MPEG video decode after initial VBV_delay time in constant bit-rate (CBR) stream environments; 4) Preventing underflow or overflow of elementary stream decoder buffers in accordance with the T_STD model defined in ISO/IEC 13818-1 standard; 5) providing PID values in the video or audio TS packets that were originally defined in the PMT section to be a video or audio PIDs. Alternatively, a new artificial

PCR stream can be separately created and injected as TS PCR packets at the rate of at least 10 times per second to create a new time base for decimated, time-shifted stream stored on the DSM. Whereby, the original PAT transport packet is modified or a new PAT packet is inserted into the stream instead of the original PAT section to indicate a single program only whose PMT section indicates video, audio, PCR and other PID that carry subtitles, program descriptions, etc. As a stable clock source, STC of the Master DTSR is used to measure elapsed time between two PCR samples; 6) Providing PTS values in the video, audio or private data streams by using STC of the Master DTSR as elapsed time counter; and 7) Initializing STC of the playback DTSR device to a first available PCR value encoded in the stream saved on DSM media, immediately after channel change.

While in part-time digital time-shifting mode, the host CPU 632 performs some additional processing like retrieval and de-multiplexing of the single program transport stream created in continuous time digital time-shifting mode during a storage process. Generally, the playback of the stored program is combined with continued transport stream de-multiplexing and recording of the real-time transport stream. Such a mode of operation is the most intensive mode of operation because the host CPU 632 must create/store a multiplexed single program transport stream from a continued reception of a live broadcast; and retrieve and de-multiplex saved content from a digital storage media while performing transport stream de-multiplexing, audio decode, and bus mastering elementary stream video to the MPEG video decoder.

In one implementation, an MPEG decoder associated with the Master DTSR 610 is used to decode and display a video stream from a DSM media and receive private data, and PSI/SI sections from a live broadcast. In such a case, a video PID of the Master DTSR 610 is disabled, while video data with its PTS information is fed directly to the MPEG decoder using the system memory controller 630. However, PCR PID is programmed on a Master DTSR so that MPEG clock recovery continues from a live transport stream feed and is supplied to the STC counters of both the master DTSR 610 and the second DTSR 620. In one implementation, only the video PID is programmed into the Slave DTSR for retrieving live video stream and sending it to circular buffer on

the host system in the form of a full MPEG-2 transport stream packets, while the Master DTSR is used to buffer the non-video components of a specific program.

In another embodiment, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of a digital time shifting. In the second embodiment, a first DTSR is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID of the first DTSR is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR can be used in all 3 modes to receive video, audio, private data and PSI/SI sections, all utilizing auxiliary PID filters and received as full MPEG-2 transport packets arriving in the single memory queue. This way, the temporal order of a stream and validity of the T-STD decoder model is inherently preserved. Also, the amount of the host DRAM memory required for queue allocation is less than in the first case. In both embodiments, a quality digital stream time shifting at the transport packet level is achieved.

In yet another operating mode, a different partition of the software tasks is possible on the host CPU 632 to achieve all three modes of digital time shifting by storing PES layers as a basic format of the audio/video data saved on a DSM. In PES operating mode, two hardware embodiments are possible, the same as in TP operating mode.

In a first hardware embodiment, the first DTSM is used as a combo device, to achieve playback of live or stored MPEG video and reception of audio, private & PSI/SI content. The second device is used only to receive and de-multiplex MPEG-2 video transport stream and retrieve MPEG-2 elementary stream from a live broadcast. Upon retrieval of ES video, PES packets are formed and stored on the DSM media.

In the second hardware embodiment, the first DTSM is used as a combo video-PCR only device, either to receive and decode video from a live broadcast or from a DSM media. The PCR PID is programmed always to match live broadcast, and full clock recovery is done by the first DTSR. A second DTSR is used in all 3 time-shifting modes to receive audio, private data, PSI/SI sections, by utilizing auxiliary PID filters to store

the transport packets to a single memory queue. That way, a temporal order of a stream and validity of T-STD decoder model is already preserved.

In yet another time shifting embodiment, the video is de-multiplexed to the level of elementary stream and stored at the bit-stream buffer of the MPEG video decoder physically allocated in the frame memory. The MPEG video stream is then retrieved from this buffer by a software processing thread running on a host CPU. Every time a picture start code is found in the video bit-stream buffer, a full compressed MPEG picture, in the form of elementary stream, is sent to the system memory buffer by DMA. One such method is disclosed in patent application (990135) which is hereby incorporated herein by reference.

Before storing the full compressed MPEG picture in the DSM, a PES packet header is added. The audio stream is de-multiplexed and decoded by the host CPU. In a similar fashion as the video, prior to audio decoding, the audio frames are packetized into PES packets. Essential information from the PSI/SI/private data tables is decoded and stored in a pure source form on a DSM. This way, further reduction of the host DRAM memory requirements for queue allocation and memory on the DSM media is reduced. An advantage of this mode is reduction of CPU cycles needed for A/V playback of stored data due to the PES format of audio/video data. PES de-multiplexing is done in place, passing pointers to the payload of PES packets that contain video or audio frames, other implementations required they be sent by DMA to the video decoder before they were decoded on host CPU (MPEG or AC-3 audio). As a result, the host CPU doesn't move any raw audio or video data, and host CPU utilization is reduced in order of magnitude compared to TS playback operating mode.

In the foregoing specification, the invention has been described with reference to specific embodiments. However, one of ordinary skill in the art appreciates that various modifications and changes can be made without departing from the scope of the present invention as set forth in the claims below. For example, the specific time-shifting implementation has been described as with reference to a specific transport stream demultiplexer, and described in a previous applications which have been incorporated by

reference. Different transport stream demultiplexers and method of implementing specific aspects of the present invention can be used as well. Likewise, specific partitions between hardware and software implementions have been described, which can vary depending upon the implemented demultiplexer. For example, the video stream parser can be designed to support routing the parsed video data to a circular buffer that is accessible by the system memory controller. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of present invention. In the claims, means-plus-function clause(s), if any, cover the structures described herein that perform the recited function(s). The mean-plus-function clause(s) also cover structural equivalents and equivalent structures that perform the recited function(s). Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any element(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature or element of any or all the claims.

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FACSIMILE COVER SHEET

DATE: 9/15/2005

TO: Examiner ONUAKU, Christopher
USPTO GPAU 2616

FAX NO.: 571-273-8300

FROM: Ryan S. Davidson
Reg. No.: 51,596

RE U.S. App. No.: 09/707,060, filed 11/06/2000

Applicant(s): Branko KOVACEVIC

Atty Dkt No.: ATI0000690 (1376-0000690)

Title: SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF

NO. OF PAGES (including Cover Sheet): 12

MESSAGE:

Attached please find:

☒ Transmittal Form (1 pg)
☒ Response to Non-Final Office Action (10 pgs)

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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission: 11

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First Named Inventor	Branko KOVACEVIC
Art Unit	2616
Examiner Name	ONUAKU, Christopher
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ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☑ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s) Replacement Sheets 1, 6
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Printed name	Ryan S. Davidson		
Date	15 September 2005	Reg. No.	51,596

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Branko KOVACEVIC		
Title:	SYSTEM FOR DIGITAL TIME SHIFTING AND METHOD THEREOF		
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Examiner:	ONUAKU, Christopher	Group Art Unit:	2616
Customer No.:	34456	Confirmation No.:	5798
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RESPONSE TO OFFICE ACTION

Dear Sir:

In response to the Office Action mailed June 15, 2005, please amend the above-identified application as follows:

Claim Amendments begin on page 2.

Remarks begin on page 8.

CERTIFICATE OF TRANSMISSION/MAILING
I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to the Commissioner for Patents on 9/15/05.

Ryan S. Davidson
Typed or Printed Name

Signature

IN THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims Listing:

1. (Previously Presented) A method comprising:
receiving a multiplexed packetized data stream that carries real-time multimedia programs;
during a first time:
storing a first portion of the packetized data stream representing video data and timing data of a program;
setting a system time indicator to a stored system time value, wherein the stored system time value is based on a portion of the timing data of the first portion of the packetized data stream;
during a second time:
incrementing the system time indicator;
retrieving the video data of the first portion of the packetized data stream for video decoding; and
storing a second portion of the packetized data stream representing video data and timing data of the program.

2. (Previously Presented) The method of claim 1, wherein
storing the first portion of the packetized data stream includes the first portion of the packetized data stream representing audio data of the program;
storing the second portion of the packetized data stream includes the second portion of the packetized data stream representing audio data of the program;
the method further including:
during the second time:
accessing the audio data of the first portion of the packetized data stream for audio playback.

3. (Original) The method of claim 1, wherein the multiplexed packetized data stream is a multiplexed packetized data stream that substantially meets an MPEG2 specification.

4. (Previously Presented) The method of claim 3, wherein storing the first portion includes storing transport stream packets.

5. (Previously Presented) The method of claim 4, wherein storing the first portion includes:

determining transport stream packets containing data associated with the program; and

storing the transport stream packets containing data associated with the program after the step of determining.

6. (Previously Presented) The method of claim 3, wherein storing the first portion includes storing packetized elementary stream (PES) packets.

7. (Previously Presented) The method of claim 6, wherein storing the first portion includes:

determining transport stream packets containing data associated with the program; and

storing PES packets based upon the transport stream packets containing data associated with the program after the step of determining.

8. (Previously Presented) The method of claim 1, wherein storing the first portion of the transport stream includes the timing data including synchronization information used for playing the program back at a real time program bit-rate.

9. (Previously Presented) The method of claim 1, wherein incrementing the system time indicator includes incrementing the system time indicator based upon a signal generated from multiplexed packetized data stream data received after the first time.

10. (Previously Presented) The method of claim 1 further comprising:

decoding the video data of the first portion to provide a decoded video stream.

11. (Previously Presented) The method of claim 10, wherein receiving a multiplexed packetized data stream and decoding the video data are performed by an integrated semiconductor device.

12. (Previously Presented) The method of claim 10 further comprising:
providing the decoded video stream for display at a play back rate.

13. (Original) The method of claim 12 wherein the play back rate is a real time rate.

14. (Previously Presented) The method of claim 12, wherein providing the decoded video stream for display includes determining the play back rate based upon clock recovery data of the first portion of the transport stream, wherein the play back rate varies depending upon a rate at which the first portion of the transport stream data is provided to a decoder during the step of decoding.

15. (Previously Presented) The method of claim 12 wherein providing the decoded video stream for display includes determining the play back rate based upon timing data received from the multiplexed packetized data stream after the first time.

16. (Original) The method of claim 15, wherein the timing data received from the multiplexed packetized data stream after the first time is associated with a current real-time data stream.

17. (Original) The method of claim 12, wherein the play back rate is faster than a real time rate.

18. (Previously Presented) A method comprising:

determining a mode of operation;

during a first mode of operation:

receiving a multiplexed packetized data stream at a first demultiplexer;

selecting a first program from the multiplexed packetized data stream;

decoding a video portion of the first program for display;

during a second mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing the first program;

during a third mode of operation:

receiving the multiplexed packetized data stream at the first demultiplexer;

selecting the first program from the multiplexed packetized data stream;

storing a first program portion of the first program;

providing the first program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the first program portion;

decoding the video portion of the first program portion for display; and

storing a second program portion of the first program simultaneous to the step of decoding.

19. (Previously Presented) The method of claim 18, further comprising:

during the third mode of operation:

providing the second program portion to a second demultiplexer;

selecting at the second demultiplexer a video portion of the second program portion; and

decoding the video portion of the second program portion for display.