A STORAGE MEDIUM UNIT AND VIDEO SERVICE SYSTEM HAVING A STAGGER RECORDING

Conventional cable tv systems deliver video data from a distribution company through a cable to a number of monitors of viewers. Although nowadays many programs are distributed through many channels by each cable tv company, the user or viewer has to wait until the desired program is started and transmitted through a selected channel.

Recently, also interactive video systems have been proposed. in such interactive video system a viewer can chose a desired movie to be displayed on a monitor. In such video-on-demand system a direct connection to the monitor or end device of a user is established, whereafter a demanded movie can be viewed by the end user.

In this known system it is however virtually impossible to upscale the system after it has been established e.g. at a distribution company. When the number of members for such a system increases ad the number of demanded videos is increased, a new interactive video system has to be built.

The present invention provides a storage medium unit for recording of storing data, wherein the data are divided in a predetermined number of data groups, wherein the first portion of the data groups are memorized on every N (N=1,2,3,...) track of a recording medium and the remaining portions of the data groups are memorized on remaining tracks of the recording medium.

The storage medium unit according to the present invention provides for an interactive video system wherein the waiting time for a video-on-demand request can be reduced.

The present invention also provides a video service system comprising

- a storage medium unit for recording video data, wherein said video data are divided in a predetermined number of data groups, wherein the predetermined number of data groups are recorded in a sequence different from the original sequence; and

at least one ATM switch supplied with the data group from the storage medium unit for delivering a continuous video data stream to a plurality of end devices by switching virtual channels.

The ATM switch provides for delivering a continuous video data stream. The basics and standards of ATM (Asynchronous Transfer Mode) are laid down in recommendations I.150 and I.327 as published on March 1993 by the International Telecommunication Union. ATM is generally used for addressing a specific packet-oriented transfer mode which uses asynchronous time division multiplexing techniques. The multiplexed information flow is organized into blocks of fixed size called cells. A cell consists of an information field and a header. The primary role of the header is to identify cells belonging to the same virtual channel within the asynchronous time division multiplex.

Further details, features and advantages of the present invention will be described in the following referring to the next drawings with shell diagrammatic representations of embodiments of the present invention, and wherein

Fig. 1 is a representation of an entire system for information on demand;

Fig. 2 is a representation of a first embodiment of a storage medium unit;

Fig. 3 is a representation of a second embodiment of a storage medium unit;

Fig. 4 is a schematic representation of control and data flow in the storage medium unit shown in Fig. 2 and 3;

Fig. 5 is a representation of a third embodiment of a storage medium unit;

Fig. 6 is a representation of a storage medium unit corresponding to the storage medium unit shown in Fig. 2, with a resulting flow of data groups;

Fig. 7 is a diagram of the timing of an ATM interface in the storage medium unit;

Fig. 8 is a representation of an embodiment of the navigation system shown in Fig. 1;

Fig. 9 is a representation of an embodiment of the end user device shown in Fig. 1;

Fig. 10 is a representation of an embodiment of the system manager shown in Fig. 1;

Fig. 11 is a diagram showing basic reproducing functions with staggered recording;

Fig. 12 is a diagram showing a mosaic menu function;

Figs. 13, 14 and 14A show respective record formats of record tracks on a MO disc;

Fig. 15 shows a representation of reproduction of data recorded in a staggered format according to Fig. 14;

Fig. 16 shows an example of multicasting;

Fig. 17 is a diagram of an example of a sequence of communication steps in a system according to the present invention; and

Fig. 18 is a diagram of another example of a sequence of communication steps in a preferred embodiment of the system according to the present invention.

The following description in which reference is made to the figures, describes a combination of hardware and software; it should be understood that some hardware components may be combined into a single hardware component such as a CPU where functions are time multiplexed. It should also be understood that connections between logic (software) units can be more complex than is shown schematically in the figures.

Fig. 1 shows an entire configuration of a preferred embodiment of an interactive communication system according to the present invention, comprising, : an ATM switch 1 (as example only: ForeRunner™ ASX-200 of Fore

Systems Inc., Warrendale, Pennsylvania, USA) ; storage medium units 20 (SMU); end devices 40; a system manager 60 and navigation devices 30. ATM switch 1 connects the storage medium units 20, the end devices 40, the system manager 60 and the navigation devices 30 to each other, selectively, by using virtual channel connections and data is transferred to and from these components in a form of ATM packets consisting of a 5 byte cell header including routing information and a 48 byte information field through ATM user/network interfaces provided between each device and ATM switch 1. ATM switch 1 has a conversion table of routing information such as Virtual Channel Identifier and by changing the routing information of each incoming ATM packet to the routing information designating the output virtual channel, the ATM packet can be transferred to the correct destination. ATM switches are known and further explanation is omitted here.

The interactive communication system will be explained below, specifically referring to the embodiment, where video-on-demand (VOD) service is supplied to users. It should, however, be noted here that other applications, such as teleshopping, games and other types of information exchange, are equally possible. Such services can be referred to as information-on-demand services in general.

In the interactive communication system shown in Fig. 1 video signals and/or audio signals are stored in SMU's 20. Several embodiments of a SMU 20 will be described below in detail.

In Fig. 1 end devices 40 are set top boxes, each of which can communicate with the navigation devices 30, the system manager 60 and can decode video data (preferably compressed according to the MPEG-2 standard) and/or audio data from a SMU 20, and supply decoded video signal and/or audio signal to a monitor 43 and/or a speaker system 42. Each set top box or end device 40 has an input device 44, for example a keyboard or remote control, connected thereto. Preferably a set top box is provided with a graphical processor unit 49 for generating graphical data to monitor

43 to facilitate interaction with the user. Preferably the data for the graphical processing unit is supplied by the system manager through the ATM packets. A viewer can input instructions through the keyboard 44 or other suitable input device through the set top box 40. An embodiment of a set top box 40 will be described below in detail.

Navigation devices 30 can provide information on available video programs to any one of the set top boxes 40. Such information can be represented on the monitor 43 of the set top box 40 in a graphical way or by text, or by a combination thereof. Available video programs are video programs which can be selected by a viewer. Such requestable information will hereinafter be referred to as service items. An embodiment of a navigation device 30 is described below in more detail.

The system manager 60 manages operation of the interactive communication system by managing the operation of the ATM switch 1. An embodiment of the system manager 60 will be described below in more detail.

A major feature of an interactive communication system according to this preferred embodiment of the present invention is, that there are no restrictions on the hardware used or the operating system installed. Each set of communication operations is preceded by transmission of a control software program dedicated to such set of operations to a receiving and/or transmitting component, so that the receiving and/or transmitting component can optimally handle the incoming and/or outgoing communication following this down-load of said control software program.

In the embodiment of Fig. 1, at least one of the SMU's 20 is an archive SMU. In this embodiment the other SMU's 20 are delivery SMU's. The archive SMU stores many kinds of control software programs, video data and/or audio data. An archive SMU may comprise as memory means a tape or MO disc, while a delivery SMU preferably comprises an agile hard disc or MO disc as memory means. A MO disc is less agile than a hard disc but more agile than a tape. Each of the delivery SMU's stores separate parts of the data of the

archive SMU. While the archive SMU may also be used as a SMU for delivery purposes, the delivery SMU's are used for VOD service. The system manager 60 downloads control software program to the archive SMU and the delivery SMU for a copy operation from the archive SMU to one of the delivery SMU's at the beginning of or in advance of a video on demand service. The installation of a delivery SMU by the archive SMU is shown in more detail in fig. 18. The delivery SMU stores necessary video data from the archive SMU according to a command for the copy operation from the system manager 60, and in particular from the storage medium manager 62.

When the system manager 60 receives the demand data from an end device 40, the system manager 60 outputs to the ATM switch 1 distribution control data including information of virtual channels for the selected video data produced from the received demand data and an address of the end device 40. Next, the delivery SMU outputs the selected video data with the routing information for this end device 40. A software program for write-in operation is down-loaded from the system manager 60 to the RAM 24 of the SMU 20 before copy operation of the video data is performed. The CPU 22 of the SMU 20 controls write-in operation of the physical storage medium, 21 according to the software program for write-in operation stored in the RAM 24. Then the software program for write-in operation in the RAM 24 is replaced with a software program for read-out operation by down-load from the system manager 60 before video service starts. The CPU 22 controls read-out operation of the physical storage medium 21 according to the software program for read-out operation in video service.

The interactive communication system preferably comprises a plurality of (delivery) SMU's. In the system, the necessary video and/or audio data of a particular video and/or audio program is only copied from the archive SMU to one of the delivery SMU's, if the number of end devices 40 with the possibility to select the particular video and/or audio program is smaller than a predetermined number. On the other hand, the necessary video and/or audio data is also

copied from the archive SMU or from the above delivery SMU to one or more of the other delivery SMU's, if more than the predetermined number of end devices have the possibility to select the particular video or audio program. The predetermined number can be determined based on certain statistics or real time monitoring of the number of end devices 40 requesting the particular video and/or audio program at a specific point in time.

The preferred embodiment of the present invention provides for the possibility that the number of end users is monitored in run time and that the configuration will dynamically change to prevent the system from overloading. When the number of end users increases, a new delivery SMU can be loaded from the archive SMU or another delivery SMU.

The system manager 60 preferably outputs backup control data, for the situation that one of the delivery SMU's malfunctions. Selected video and/or audio data is then output by another delivery SMU, which is not malfunctioning and is selected according to said backup control data. The conversion table of virtual channels in the ATM switch 1 is updated by the system manager 60 so that the input virtual channel of a possibly malfunctioning delivery SMU is changed to the virtual channel of another delivery SMU to provide the same video and/or audio data from the second SMU.

A user selects the desired navigation service and connects the end device 40 to a navigation device 30 providing the desired navigation service. Navigation data including a software program for displaying a menu of service items and identification data corresponding to each service item is downloaded preferably beforehand from at least one navigation device 30 selected by the end device 40. The monitor 43 of end device 40 displays such a menu of the available service items and, if necessary, corresponding identification data thereof. A menu from navigation device 30 may comprise video and/or audio information and control data, either in graphical form, textual format or a combination thereof, to facilitate the choice for the end user.

If a user selects a video and/or audio program through the input device 44 from the menu by pointing the desired video program with a pointer in the monitor 43 or by entering the identification data corresponding to the desired program, if displayed on the monitor 43, the identification data is supplied to the system manager 60 by the end device 40 via ATM switch 1. Such identification data may be a public address in case that the system manager 60 is connected to public ATM network. The navigation data may further include video data obtained from SMU 20 or navigation device 30. The navigation data down-loaded from a navigation device 30 can also contain information on other selectable navigation devices 30.

In a not shown embodiment an end device 40 can be connected to a navigation device through a public ATM switch, in which case such a navigation device can be selected through a public address. Through such a public navigation device it would also be possible to choose other navigation devices via the first publication navigation device.

The system manager 60 down-loads a VOD-software program for end devices 40 corresponding to a selected video program to the end device 40, after the system manager 60 receives identification data from the set top box 40. The system manager 60 also downloads a VOD-software program for the SMU's 20 corresponding to the selected video program to the SMU 20 via the ATM switch 1, before VOD service starts. The system manager 60 selects the SMU 20 and the most appropriate service items according to data representing video program allocation, for example in the form of a table, in the SMU's 20 and provides distribution control data including the information of the channel and the routing information corresponding to the selected video program to the selected SMU 20 so that the SMU 20 operates to reproduce the selected video program.

A controller 26 in the SMU 20 controls the physical storage medium 21, so that the physical storage medium 21 reproduces selected video data in a play mode

selected by the end device 40 as described below in more detail. The reproduced video and/or audio data is supplied to ATM interface 29.

As explained earlier the physical storage medium may comprise a hard disc, a MO disc or tape on which a video movie is recorded.

An ATM interface 29 combines the reproduced video and/or audio data preferably divided into cells each containing 48 bytes with the routing information stored in the memory of the SMU 20 in the form of ATM packets and outputs the same to the ATM switch 1.

Control data from the controller 26 such as control information for the end device 40 is supplied to the end device via the ATM interface 29 and the ATM switch 1. Control data from the end device 40 such as a required play mode is received through the ATM switch 1 and the ATM interface 29.

The ATM switch 1 routes the ATM packets between the end devices 40, the SMU's 20 and the system manager 60 according to the routing information attached to the ATM packets. The conversion table of the private ATM switch 1 is updated by the system manager 60.

In the not shown embodiment wherein a public ATM switch is used in combination with the private ATM switch, the virtual channel connection of the public ATM switch is established by using a public address at the start of the service.

In VOD operation, an end device 40 outputs control data requesting a play mode, such as normal play, fast forward play, reversed play, fast reversed play, still picture mode or more vague mode, to the ATM switch 1 through an ATM interface 41 according to the mode selection on the input device 44 by the user. The ATM switch 1 then routes the control data to the system manager 60. The system manager 60 outputs control data requesting the selected play mode to the ATM switch 1 through the ATM interface. SMU 20 reproduces the selected video data in the selected play mode. As a variation, the control data requesting a play

mode can be routed from the end device 40 directly to the SMU 20.

In case of VCR options, the physical storage medium is preferably a hard disc, as such hard disc is more agile than the other mentioned physical storage mediums. As an alternative an MO-disk can be used , on which information is recorded in a staggered fashion, which will be described hereinafter.

The system manager 60 functionally comprises one or more storage medium managers 62, a storage medium group 63 including one or more service item groups 64 and one or more service item providers 65, a service routing manager 66 and a program manager 67. Each storage medium manager 62 may contain static data and/or dynamic data with respect to each SMU 20 under its control. The static data may comprise for example type, costs or recording capacity of each storing medium unit 20. The dynamic data may for example include status information such as whether or not the SMU is occupied by video and/or audio data and whether or not it is being in use, or whether or not it is malfunctioning.

The storage medium group 63 outputs a request for assignment of a SMU 20 to the storage medium manager 62 on basis of the requirements from the end devices 40. Such requirement can be specified by the statistical information, such as potential number of the end devices 40 that can request service in a certain time frame or length of video program. Other possible requirements may be whether or not any end device 40 has a possibility to select the more complex play mode such as mentioned above and including fast forward, fast reverse etc. The storage medium manager 62 proposes a suitable SMU 20 or suitable storage medium in the SMU 20 to a storage medium group 63 for the video service to the end device 40, according to static data and/or dynamic data with respect to each SMU 20 contained therein, e.g. table means, and the request from the storage medium group 63. Further, storage medium group 63 controls down-load operation of software programs to one of the end devices 40 in response to a request from this end device 40.

In case of a plurality of storage medium managers 62, each storage medium manager 62 may propose a suitable SMU 20 belonging to each storage medium manager 62 for the video service to the storage medium group 63. A storage medium manager 62 will ask another storage medium manager 62 to propose a suitable SMU 20, requested by the storage medium group 63, if said storage medium manager 62 can not satisfy the request of the storage medium group 63. More specifically, the service item providers 65 request assignment of one of the SMU 20 to the storage medium manager 62 via the service item group 65. The service item group 65 also control the down-load operation of control software programs originally provided from the program manager 67, which manages all control software programs to be used in the system and delivers each devices updated, suitable, and effective programs.

The service item group 65 can down-load a suitable down-loadable software program to the set top box according to the table therein representing relationship between service item identification and service item provider. When the request is provided from the service item provider, the service item group 65 can decide which down-loadable software is suitable for subsequent operation of the set top box according to the table in the service item group.

Even if the storage medium manager 62 is malfunctioning, the malfunctioning storage medium manager 62 may be restored while the SMU 20 outputs video and/or audio data, as reproduced video and/or audio data is directly output to the ATM switch 1 without routing by the storage medium manager 62.

Next, full VCR functions, for example fast forward, reverse, fast reverse and still play mode will be explained. In the full VCR function, an agile storage medium, for example a hard disc, is used. The agile storage medium is installed in one or more of the SMU's. At the beginning of the video on demand service, the video and/or audio data of the selected video program or video program with possibilities of VCR functions from end device 40, is

copied from the archive SMU or a delivery SMU to this agile storage medium. The agile storage medium outputs video and/or audio data in the play mode required by a set top box 40 under control of the system manager 60. The system manager 60 provides for changing the virtual channel, if the full VCR function is requested by the end user, so that such end user is connected to an SMU with a hard disc enabling the full VCR function through the virtual channel. In the case, where an end device 40 is supplied with information from an MO-disc on which this information is recorded in a staggered fashion, and the end device for example request a fast forward or fast reverse play mode, a separate SMU containing an agile hard disc can be employed. This may be advantageous, when time will lapse between the request and the moment another virtual channel delivering this play mode becomes available. When the agile disc is employed intermediately, this agile hard disc can be engaged at a time pointer, corresponding to the time pointer of the virtual channel in use at the time of the request, can be speeded up or slowed down, and can consequently be disengaged, when the time pointer and speed of the agile disc correspond to that of another virtual channel delivering information in the selected play mode from an MO-disc containing information recorded in a forward or reverse staggered fashion.

When a set top box 40 requires simple VCR functions such as stepwise fast forward mode or stepwise fast reverse mode, these simple VCR functions can be performed by another delivery SMU 20. In this case, the delivery SMU which does not include an agile storage medium, for example outputs video and/or audio data recorded in a certain format which will be described hereinafter in a number of virtual channels through the ATM interface with respective time delays between the virtual channels. ATM switch 1 then provides the video and/or audio data in the required play mode to the set top box 40 by changing the relationship between input virtual channels and output virtual channels under control by the system manager 60.

Some examples of communications established between the end devices 40, the system manager 60 and the SMU's 20 by using the table data shown in Fig. 11 will be explained hereafter. If the end device 40 (STB-2) requests a selected movie by calling the identification number 678901 corresponding to the movie and provided from one of the navigation devices 30 at time 0:09, one of the service item providers 64 (SIP-1) is designated by the identification number.

The service item provider 64 (SIP-1) then checks the present time and obtains from the table therein the next available time point 0:10 as the starting time of the movie, distribution control data including the number "2" designating the SMU 20 storing the video and/or audio data if the movie and the number "2" designating one of the service item streams (SIS) from the SMU 20 making the movie available from the beginning at the time point 0:10, and the virtual channel number "21" for this stream, and supplies the SMU 20 designated by the end number "2" with the SIS number "2", virtual channel number "21" and the end device number "STB-2".

The service item provider 64 (SIP-1) up-dates the conversion table in the ATM switch 1 according to another table data available in the service item provider 64 (SIP-1) so that the relationship between input virtual channel number "21", for the service item stream (SIS) and the output virtual channel number "21" for the end device 40 (STB-2) is established. Therefore, the data stream of the requested movie is provided to the end device 40 (STB-2) from the beginning at time 0:10.

If the end device 40 (STB-2) requests one of the service item providers 64 (SIP-1) for full VCR function, the service item provider 64 (SIP-1) obtains from the table therein distribution control data including the number "4" designating the SMU 20 having full VCR function capability and the number "1" designating one of the service item streams (SIS) from the SMU 20 designated by the number "4"

with the SIS number "1", virtual channel number "28" and the end device number "STB-1".

The service item provider 64 (SIP-1) up-dates the conversion table in the ATM switch 1 according to another table data available in the service item provider 64 (SIP-1) so that the relationship between input virtual channel number "28" for the service item stream (SIS) and the output virtual channel "7" for the end device 40 (STB-1) is established. Therefore, the data stream of the requested movie is provided to the end device 40 (STB-1) with full VCR function.

Such an interactive communication system as outlined above is suitable to be used as a platform for a plurality of server-owners, navigation device owners, system manager owners and users simultaneously, where one party can for example exploit one or several SMU's 20, as well as a system manager 60 and/or one or several navigation devices 30.

In Fig. 1 the entire system is configured around a single ATM switch 1. Application of more than one private ATM switch and/or public ATM network is equally possible. Furthermore, another type of transmission network can be used. The network with one or more ATM switches, however, is considered to be the most suitable network configuration for the applications envisaged.

Next, details of each device will be explained.

Fig. 2 shows a configuration of a SMU 20. Each SMU 20 contains a physical storage medium 21, for example an Magneto Optical (MO) disc and a corresponding driver or one or more hard discs and the corresponding drivers thereof, an ATM interface 29 as part of the SMU 20 or located outside such unit 20, a memory 25, for example for storing a table, and a controller 26 formed by a CPU 22, a RAM 24, a ROM 23, and a bus 27.

CPU 22 of controller 26 controls the storage medium 21 and other operations of the SMU 20 according to software programs stored in ROM 23 and an additional control

software program downloaded into RAM 24 and table data stored in this memory of the SMU 20.

The physical storage medium 21 primary contains service items, but can also contain control software program to be down-loaded to the end device 40 or one or more of the SMU's 20 when required.

ROM 23 of the SMU 20 preferably contains a microkernel operating system and a storage medium interface resident software such as an ATM drive, an MO disc driver. The microkernel operating system functions as a basic set of instructions, capable only of the most elementary of communication operations, e.g. down-load of control software specifically tailored for subsequent communications to be performed by the SMU 20. The ATM driver is used for establishing communications through the ATM interface 29. The MO disc driver is responsible for the mode in which the physical storage medium 21 functions which will be described hereinafter. The controller 26 also contains a table 25, in which relationships between virtual channels and end devices 40 are established.

The ATM interface 29 may communicate with the ATM switch 1 in a full duplex mode, where the ATM interface 29 can simultaneously handle incoming and outgoing ATM packets 28. In Fig. 2 such an ATM packet 20 is shown to contain a header portion A, usually comprising five bytes, and an information field portion B, usually comprising forty-eight bytes.

RAM 24 contains executable code in ROM 23, a down-loadable module for optimum functionality as a server, and a buffer.

Fig. 3 shows a SMU 20, where bus 27 is divided into a separate control bus and a separate data bus to provide a high throughput.

Fig. 4 shows a schematic representation of control and data flow in the SMU 20 shown in Fig. 3. Here distinction is made between incoming and outgoing video and/or audio data and incoming and outgoing control data and incoming control software program to be down-loaded.

Respective packets of video and/or audio data, control data and software program, even if these packets are transferred to same SMU 20 or same end device 40, should have different routing information in the header to be distinguishable from each other.

Fig. 5 shows a third embodiment of the SMU 20, where an ATM switch 1 and the ATM interface 29 of the SMU 20 are incorporated. As a result connections can be established from the SMU 20 directly through ATM interfaces 41 to the end devices 40. In this case, the system manager 60 may be connected to the ATM switch 1 or the controller 26 may replace the function of the system manager 60.

Fig. 6 shows a SMU 20 corresponding to the embodiment of Fig. 2, where the method for reading and outputting data segments from a physical storage medium, e.g. a disc is shown. As an example data groups are output via three virtual channels, which channels could also be formed by separate physical channels. In this figure the principle of reproducing staggered recording data, which will be further described hereinafter, is shown. The SMU 20 shown here contains a buffer 210 and a timer 211, where the buffer 210 is preferably a part of the ATM interface 29. The video data is divided in a predetermined number T of sentences, where T corresponds to the number of channels and equals three in case of Fig. 6. Each sentence is divided in a predetermined number N of data groups and N equals four in case of Fig. 6. The video data are recorded in the storage medium 21 after the order of the data groups is changed in such a way that n-th (where n = 1, 2, 3, 4...N) data group of the first sentence is followed by n-th data group of the Tth, T-1th,....., and T-(T-2)th sentences sequentially, as n is sequentially increased, as shown in the upper left side of Fig. 6.

The video data recorded in the above manner is sequentially and cyclically reproduced from the storage medium 21. The n-th data groups of the respective T sentences are sequentially stored in the buffer 210 and output to respective different virtual channels through the

ATM interface 29. After respective N data groups of T sentences are output, the virtual channels are switched over in the next and following cycles as shown in Fig. 7, so that N x T data groups are continuously reproduced via each virtual channel with a time difference of one sentence from each other as shown in the right hand side of Fig. 6.

Fig. 8 shows a configuration of a navigation device 30. Navigation device 30 preferably comprises: a controller 36, formed by a CPU 32, a ROM 33, a RAM 34 also for navigation software programs to be down-loaded to the end devices 40 and a bus 37; a table 35 for available video programs and identification data, for example a public address of available video programs, and also an ATM interface 31. The controller 36 controls operation of the navigation device 30 according to programs stored in ROM 33 and RAM 34. The navigation device 30 down-loads navigation software programs to the set top box 40, when the set top box 40 requires a navigation operation to the navigation device 30. The navigation device 30 then provides information relating to available video programs and identification data thereof to the set top box 40. Public addresses can be used when a public network is used in the interactive communication system. Many kinds and versions of the navigation menu can be provided, if the interactive communication system has a plurality of navigation devices 30, which handle for example a Japanese version, an English version, three dimensional graphical version etc.

Fig. 9 shows the configuration of an end device, here a set top box 40. The set top box 40 may comprise a CPU 45, a RAM 46, a ROM 47 and an MPEG decoder 48. CPU 45 controls operation of the set top box 40 according to programs stored in ROM 47 and RAM 46. Said programs may be down-loaded from the system manager 60, a SMU 20 or a navigation device 30. The MPEG decoder 48 decodes compressed video data and/or audio data, supplied via the ATM switch 1 and supplies video data, if necessary combined with data from a graphic processor 49 through a video RAM memory 50 to the monitor 43 and supplies audio data via an amplifier 51

to the speaker system 42. The CPU 45 produces demand data according to instruction data input through the keyboard 44 or a similar device by the user. Such demand data is output via the ATM interface 41.

Fig. 10 shows a configuration of the system manager 60. The system manager 60 contains a CPU 68, a ROM 69, a RAM 70, and here a memory for various VOD software programs to be down-loaded to the set top boxes 40 and/or the SMU's 20, an ATM interface 61 and memory 71, e.g. in the form of table means. The CPU 68 controls operation of the system manager 60. The system manager 60 provides operation software to SMU's 20 and set top boxes 40 and updates tables for data representing a relationship between input virtual channels and output virtual channels in the ATM switch 1. Such a system manager 60 can perform all functions described above relating to the storage medium manager 62, the program manager 67, the service item providers 64, the service item group 65 and the server routing manager 66.

Fig. 11 shows a sequence of scenes, where said sequence can be accomplished by displaying video data on various transmission channels. In this example twelve (virtual) transmission channels are employed as T = 12, though from channels 4 to 12 are omitted from the drawing for simplification. Data groups are reproduced from a physical storage medium 21 containing the staggered recording data and output via these virtual channels in a similar manner to Fig. 6 and 7. As shown in Fig. 11, the sequence of scenes can be altered by switching from channel to channel for input of video data comprising such a scene so that a simple VCR function can be realized. For example, by switching from channel 1 to channel 2 while the scene '2' is displayed, the scene '4' can be displayed, thereby skipping scene '3' as fast forward mode. Similarly, by switching from channel 3 to channel 1 while the scene '6' is displayed, the scene '5' will next be displayed thereby creating a reverse mode. Such switching between virtual channels can be done by updating the conversion table of the ATM switch 1 under control of the system manager 60

according to the control data from the end device 40. When switching between channels is not performed, the natural sequence of scenes will be followed, as this is the sequence in which video data occurs on a single channel.

Scene 5 appeared after scene 6 by switching from channel 3 to channel 1. Thus reverse skip play is performed.

Fig. 12 shows an example of a mosaic function to be performed by an end device 40, whereby selected scenes taken from a sequence are displayed on monitor 43. A user can in this way select a starting point, other than the beginning of a film, by issuing a corresponding demand through the input device 44. Such a mosaic function can of course also be used for visualizing a menu of service items selectable through one or several navigation devices 3, e.g. title frames of several selectable video programs, where such selected scenes for mosaic function can be displayed by switching the virtual channels on a real time basis and storing these into the video RAM 50 simultaneously or by reproducing the video data previously stored in the SMU 20 as mosaic video data. Next, recording formats of video data on a physical storage medium 21 will be explained, referring to figs. 13-15.

In Fig. 13 a physical storage medium 21 is shown, where a head 90 is attached to an arm 91, movable to and from the center of the physical storage medium 21. Here, the physical storage medium 21 is formed by a MO disc. Data tracks of the MO disc 21 contain data groups in the staggered recording sequence 92 shown in this Fig. 13 above the physical storage medium 21. The arrows above and beneath this representation of sequence 92 denote the order, in which head 90 reads the data groups from the physical storage medium 21. As shown here, reproducing head 90 skips data groups on the outbound pass over the physical storage medium 21, where the skipped data groups are read during the inbound pass over the physical storage medium 21. In this way no time loss occurs between the end and start of a sequence of data groups, to be sent to the controller 26 of the SMU 20 (see Fig. 6) and a continuous flow of data groups

in the order, required by the controller 26 of the SMU 20 is ensured. Because of the continuous flow of data groups a buffer memory of only a small size is required.

Video data, which is to be recorded in a storage medium with a format described above, is reproduced from said storage medium 21, and output from the SMU 20 to the ATM switch 1 through the ATM interface 29 as three virtual channels.

In Fig. 14 first and second video data with the same content but opposite time lines are recorded on the disc. In this case the data groups of the first video data and the data groups of the second video data are interleaved. The first video data is used, when the set top box requires normal forward, fast forward, or stepwise fast forward play mode. On the other hand, second video data is used when the set top box requires reverse play mode. Furthermore it is possible for the data groups of the first video data to be recorded on every other track of the disc. The data groups of the second video data are stored in remaining tracks of the disc. Then the recorded first video data is reproduced from every other track of the disc by moving a reproducing head in a first direction. Recorded second video data is reproduced from the remaining tracks of the disc by moving the reproducing head in this first direction. It is also possible to reproduce the second video data in the reverse if the first direction after the first video data are reproduced so that similar effects to the recording format shown in Fig. 13 is obtained.

In the first and second video data are encoded in accordance with MPEG standard, the second video data should be encoded in the reverse manner of the first video data. In such a case, it may not be possible to reproduce the second video data in the reverse direction as explained above. In the example of Fig. 14A also the distance of head movement is minimized, both for forward and reverse play, as the forward data groups (1F, 2F, 3F, 4F etc.) are recorded in every fourth track in a similar manner to Fig. 13, while the reverse data groups (12R, 11R, 10R, 9R, etc.) are recorded

before 2F, 3F, 4F etc. respectively, also in every fourth track. Also the distance of the head movement is minimized at the edges of the disc as will become clear from the sequences of 6F, 7F and 8F and 7R, 6R and 5R at the inside edge, and 12F, 1F and 2F, and 1R, 12R and 11R, respectively.

Fig. 15 shows a diagram of a sequence of video data displayed on a monitor, where the sequence is obtained by using the recording format and reading sequence shown in Fig. 14, and by receiving from and sending to different virtual channels, respectively in order to obtain forward and/or reverse play modes, for which purpose data are recorded in the staggered fashion, described referring to Fig. 13, 14 and 14A as examples.

Multi-cast functions will be explained, referring to Fig. 16. In the multi-cast function the system manager 60 as shown in Fig. 1 also manages distribution of video data. If the system manager 60 receives a demand data from one or more of the end devices 40, even in the course of service, asking to provide a same video and/or audio data as transmitted from one of SMU 20 to or requested from other end devices 40, the system manager 60 outputs to the ATM switch 1 distribution control data including information of the input virtual channel of the selected video data from the SMU 20 and the output virtual channel of the end device 40 requesting the video and/or audio data which are generated in response to the received demand data. For example, if an end device STB-3 requests same video data "video 1", "video 2", and "video3" as requested by and transmitted to another end device STB-1 from the SMU 20 through an input virtual channel "vc 1" and an output virtual channel "vc7", the system manager 60 outputs the updated conversion table to the ATM switch 1, so that the header of the ATM packets transmitting "video 1", "video 2" and "video 3" are replaced in the ATM switch 1 with not only the header corresponding to an output virtual channel "vc7" but also the header corresponding an output virtual channel "vc8" designated by the end device STB-3. Therefore, the ATM packets containing "video 1", "video 2" and "video 3" are

supplied to both of the end devices 40 STB-1 and STB-3 simultaneously.

The sequence of communication, shown in Fig. 17, represents a method in which flow of video data from a SMU 20 to a set top box 40 is established. First, in step 1, a user informs a set top box 40, denoted by STB, through his input device 44, that he wishes to gain access to the system. The set top box 40 replies by asking the user in step 2 what kind of service, like video-on-demand, games or just television, the user wishes to select. Such selectable options may be stored in memory of the set top box 40. Next, in step 3, the user enters his choice through his input device 44 to the set top box 40, which then involves the navigation device 30, in this figure denoted by Navi. Description below will relate to the case, where the user has selected a video-on-demand service menu, for which one or several navigation devices 30 are suitable. Nevertheless, only one navigation device 30 is represented in this figure for clarity.

In step 5 navigation device 30 provides set top box 40 with a menu of selectable video services, to which the navigation device 30 can gain access. In said menu options can also be included, referring the set top box 40 to another navigation device 30, which can gain access to other video services. In the next step 6 set top box 40 passes the menu on to the user by display thereof on monitor 43. In step 7 the user enters his choice through his input device 44, which in this case is a request for a further menu. This request is relayed to navigation device 30 in step 8, whereupon navigation device 30 supplies a new menu of selections to set top box 40 in step 9. Steps 7-10 can be repeated a number of times, until, as is the case in step 10, a menu displayed on monitor 43 by set top box 40 contains an option for a video program the user wishes to select, which is represented by step 11. Set top box 40 in step 12 requests service item provider 64, denoted by SIP, to provide for a video stream to a top set box with a given public address, corresponding to the address of the service

item provider 64. In step 13 service item provider 64 first request service item group 65, denoted by SIG, to provide set top box 40 with control data necessary for optimum handling by the set top box 40 of the video stream to be established, which control software is down-loaded into the set top box 40 in step 14. Now, set top box 40 is capable of issuing commands relating to VCR functions, where in step 15 the first play command is issued to the service item provider 64. In step 16 service item provider 64 locates the first available video stream for the request, which in this case originates from storage medium unit 40, denoted here by SMU1, and sets ATM switch 1, denoted by ATM SW to connect said storage medium unit 20 and set top box 40 by re-writing the virtual channel table in the ATM switch 1. In steps 17 and 18 the requested video stream is routed through ATM switch 1 to set top box 40, where the requested video program can now be displayed on monitor 43.

In Fig. 18 dynamic reconfiguration of the system is clarified. In this timing chart on line 13 the service items group (SIG) creates a new instance of a SMU installer and provides the number of the source SMU, of the destination SMU and other parameters. In line 14 the SMU installer executes a download operation to SMU1 as destination and leaves SMU1 waiting for data. In line 15 the SMU installer requests SMU2 as source to start providing data to SMU1 as destination. In line 16 the requested data is transferred from SMU2 to SMU1. In line 17 SMU2 reports to the SMU installer that the data transfer is completed. In line 18 the SMU installer informs the SIG that SMU1 is ready to serve data, whereafter the SMU installer disappears. In line b19 the SIG requests SMU1 to start serving data to a certain virtual channel, so that such data can be served to end users.

In the foregoing description a number of characteristics and details have been described with reference to preferred embodiments. It should however be understood that the present invention is not limited to the

above description of such preferred embodiment. The requested rights are defined by the following claims.

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CLAIMS

1. A storage medium unit for recording of storing data, wherein the data are divided in a predetermined number of data groups, wherein the first portion of the data groups are memorized discretely on a recording medium and the remaining portions of the data groups are memorized on remaining parts of the recording medium.

2. A storage medium unit according to claim 1, wherein said predetermined number of data are recorded in a sequence different from the original sequence.

3. A storage medium unit according to claim 1 or 2, wherein said data are video and/or audio data.

4. A storage medium unit according to claim 1, 2 or 3, wherein said data consists of first and second video and/or audio data, said first and second video and/or audio data having the same content, wherein the first and second video and/or audio data are encoded in a mutually different direction, wherein the data groups of the first video and/or audio data are memorized on every other N (N=1,2,3...) track of the recording medium, and wherein the data groups of the second video and/or audio data are memorized on the remaining tracks of the recording medium.

5. A storage medium unit according to claim 4, wherein said first video an/or audio data are output as forward video and/or audio data in a reproducing mode and second video and/or audio data are output as reverse video data in a reproducing mode.

6. A storage medium unit according to any one of claims 1-5, wherein said data are divided in T (T=2,3,4,...) sentences, T depending on the number of channels, wherein the sequence of the data groups is changed so that the N(th) (N=1,2,3,...) data group of the last sentences of the data appears after the N(th) data group the first sentence.

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7. A storage medium unit according to any one of claims 1-6, wherein the first portion of the data group are reproduced from every other N(th) (N=1,2,3,..) track of the recording medium by moving ahead in the first direction and wherein said remaining portion of the data groups are reproduced from the remaining tracks of the recording medium by moving the head in a second direction opposite to the first direction.

8. A storage medium unit according to any one of claims 1-7, wherein said data are vide and/or audio data, wherein said data groups reproduced from the recording medium are supplied to an ATM switch for delivering a continuous video and/or audio data stream to a plurality of end devices by switching virtual channels.

9. A storage medium unit according to any one of claims 1-8, wherein said recording medium comprises an agile disc.

10. A storage medium according to any one of claims 4-9, wherein the first and second video and/or audio data have the same content but opposite time relationship to one another so that the data groups of the first and second video and/or audio data are recorded on the recording medium in an interleaved way relative to one another.

11. A storage medium unit according to claim 10, wherein said first and second video and/or audio data are recorded on the recording medium after changing the sequence of the data group of the first and second video and/or audio data respectively.

12. A storage medium unit according to claim 7 and 10, wherein the first video and/or audio data and the second video and/or audio data are reproduced as forward video and/or audio data and reverse video and/or data respectively.

13. A video service system, comprising:

- a storage medium unit for recording video data, wherein said video data are divided in a predetermined number of data groups, wherein the predetermined number of

data groups are recorded in a sequence different from the original sequence; and

at least one ATM switch supplied with the data group from the storage medium unit for delivering a continuous video data stream to a plurality of end devices by switching virtual channels.

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