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(54) VIDEO DISTRIBUTION SYSTEM

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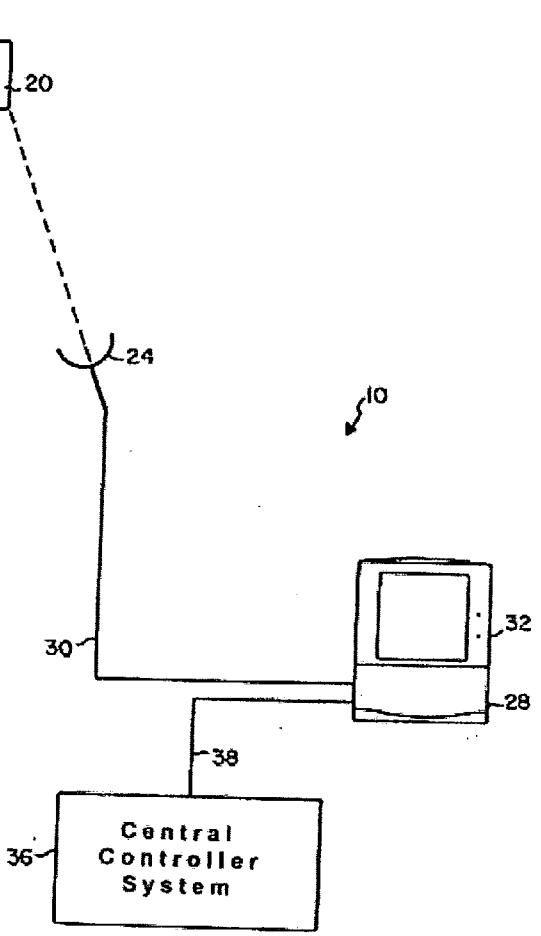
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(52) **U.S. Cl.** **709/217**

(57) **ABSTRACT**

The invention relates to video distribution systems and, more particularly, to a system that blanket transmits video/audio content such as movies (for example, via satellite downlink transmission) to each customer's recording, storage and playback system. Customers may preselect from a list of available movies or other content in advance using an interactive screen selector, and pay for the video/audio content that is actually viewed.



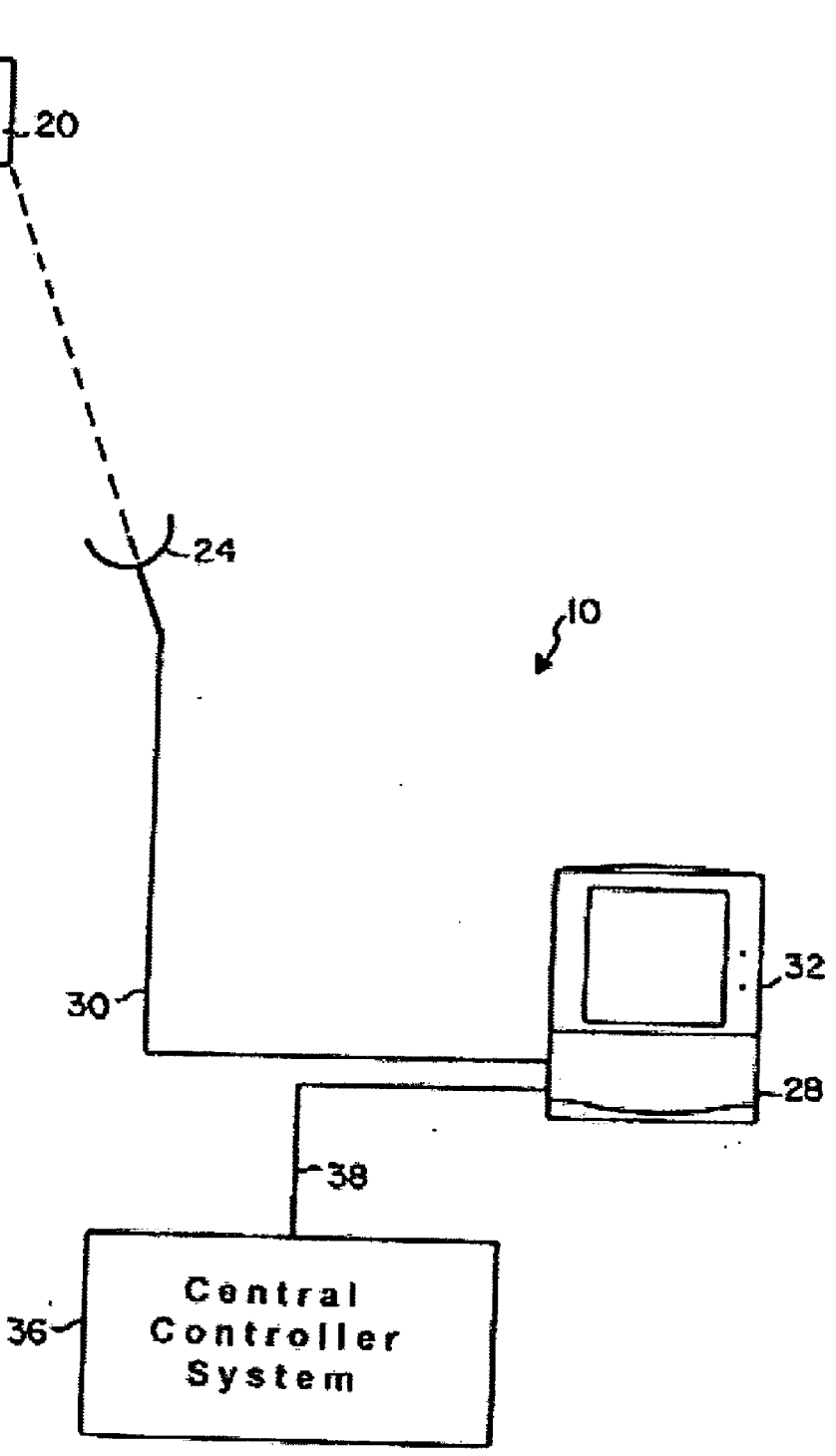


FIG. 1

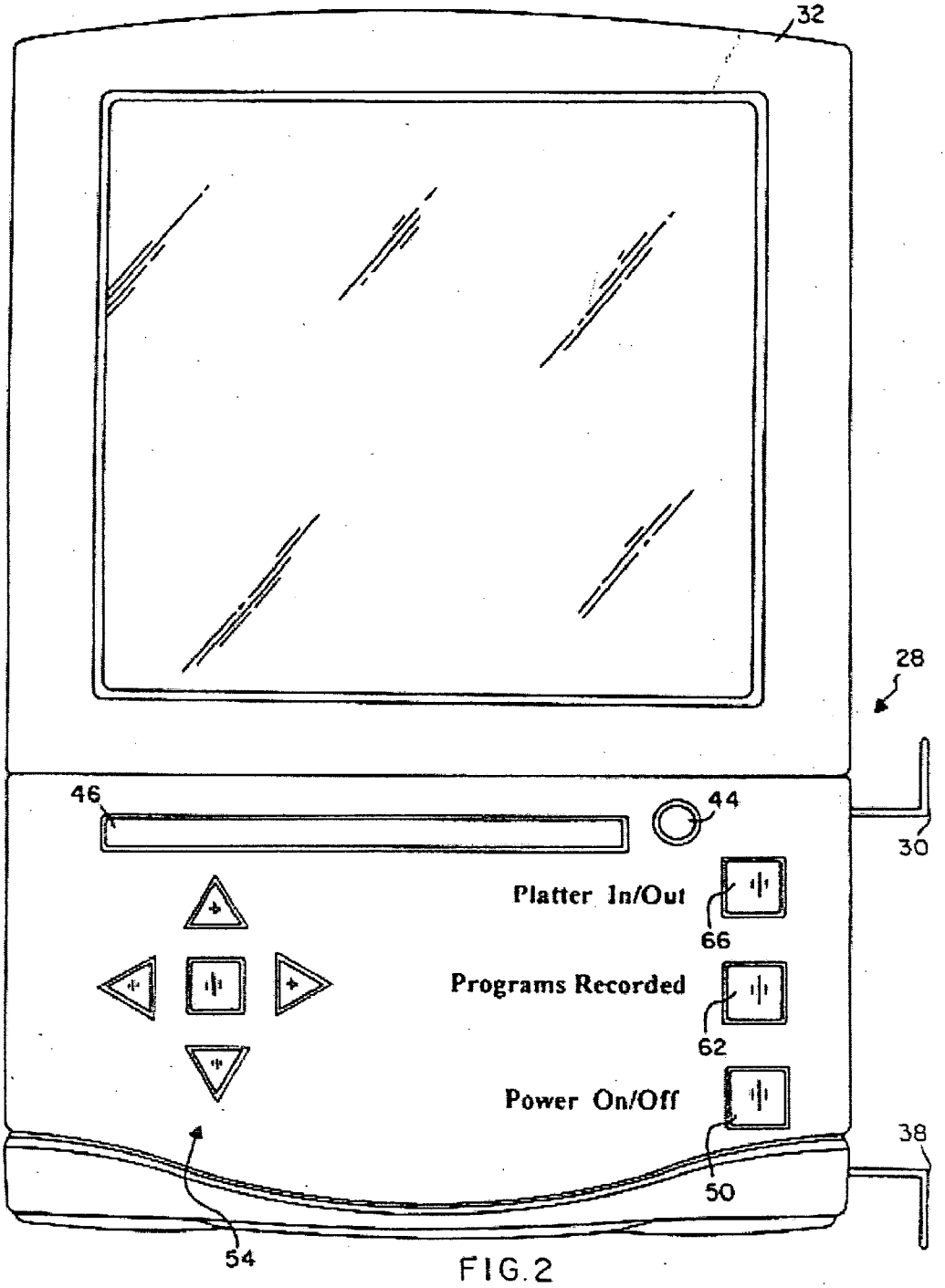

32
28
46
44
30
Platter In/Out
66
Programs Recorded
62
Power On/Off
38
50
54

FIG. 2

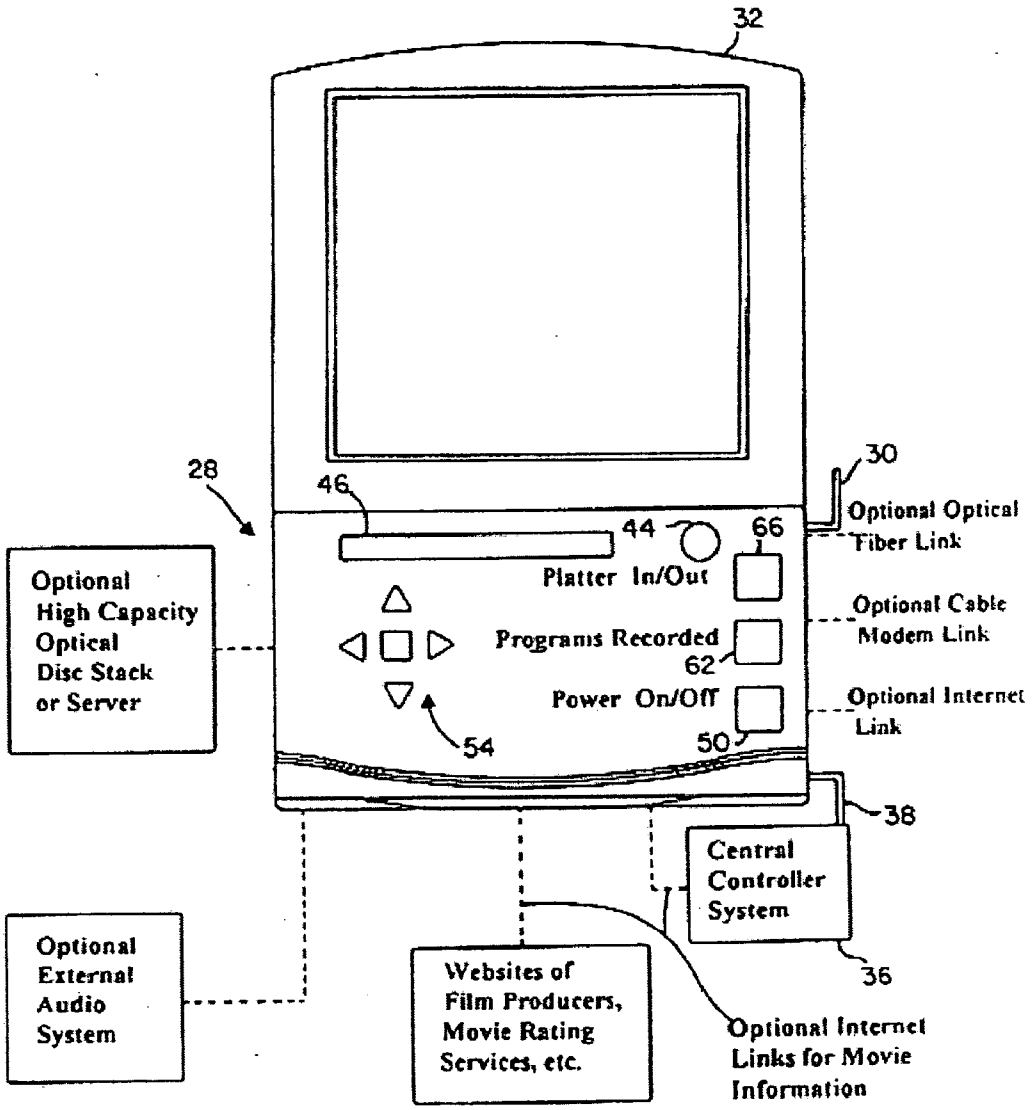

32
28
46
44
66
30
Optional Optical Fiber Link
Platter In/Out
Optional Cable Modem Link
Programs Recorded
62
Power On/Off
Optional Internet Link
54
50
38
Optional High Capacity Optical Disc Stack or Server
Central Controller System
36
Optional External Audio System
Websites of Film Producers, Movie Rating Services, etc.
Optional Internet Links for Movie Information

FIG. 2A

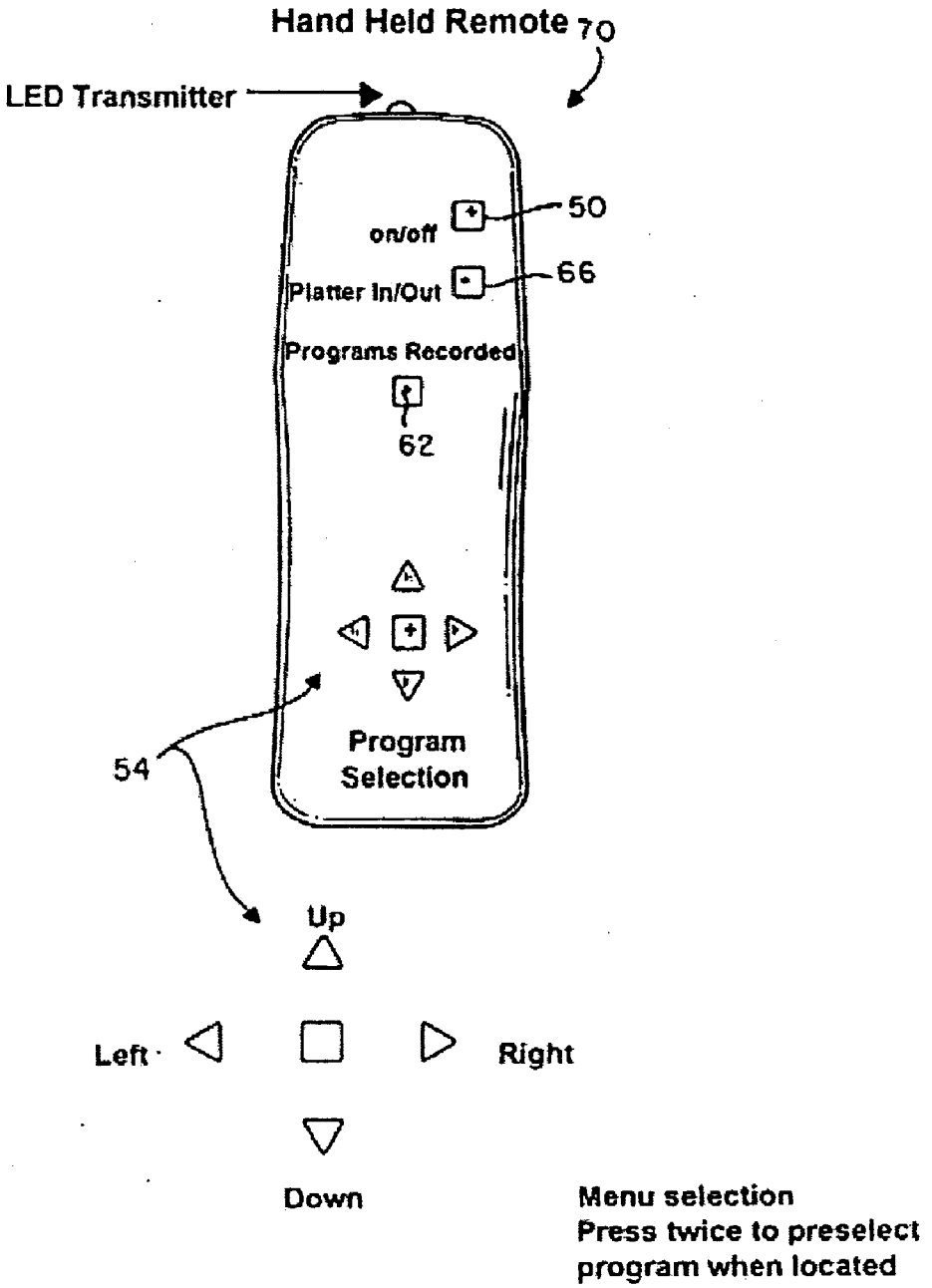

Hand Held Remote 70
LED Transmitter
on/off
50
Platter In/Out
66
Programs Recorded
62
54
Program Selection
Up
Left
Right
Down
Menu selection
Press twice to preselect program when located

FIG. 3

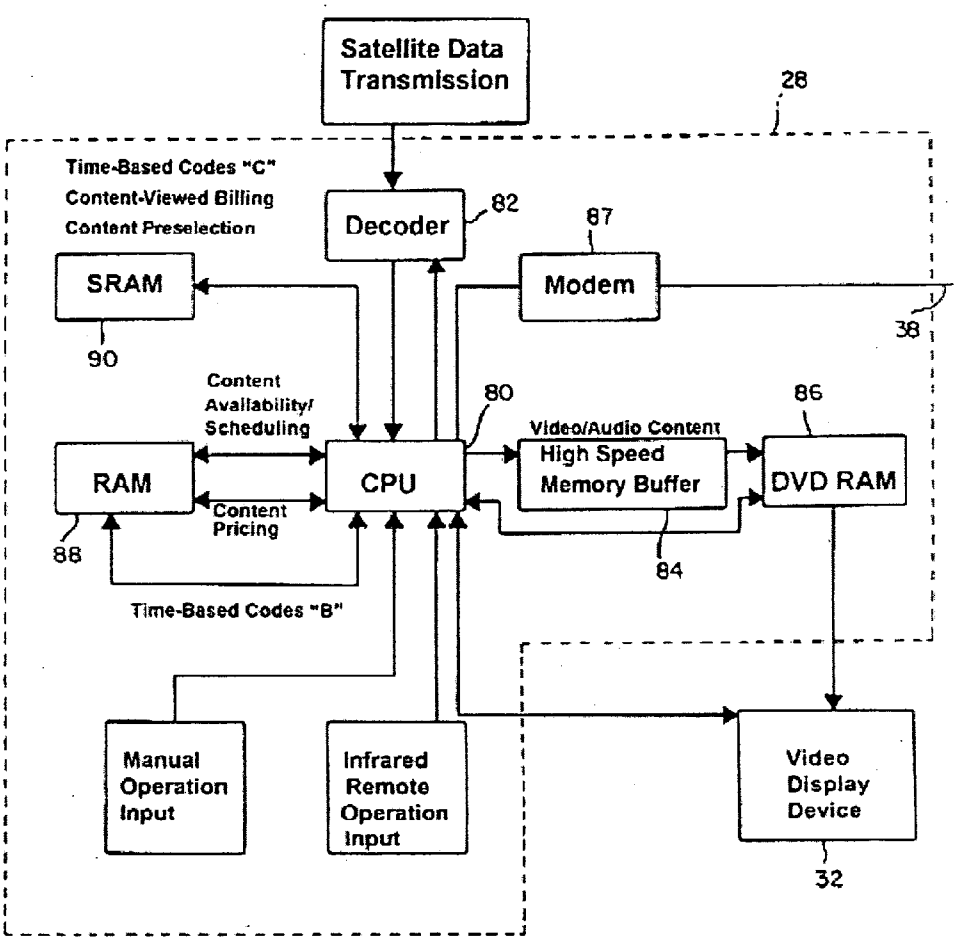

Satellite Data Transmission
28
Time-Based Codes "C"
Content-Viewed Billing
Content Preselection
Decoder
82
87
SRAM
Modem
38
90
Content Availability/ Scheduling
80
86
Video/Audio Content
RAM
CPU
High Speed Memory Buffer
DVD RAM
Content Pricing
88
84
Time-Based Codes "B"
Manual Operation Input
Infrared Remote Operation Input
Video Display Device
32

FIG. 4

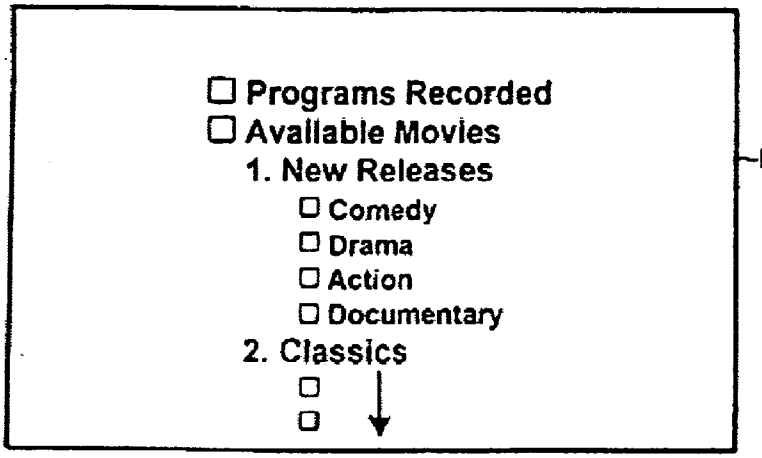


FIG. 5

SLOT	PROGRAM
1	Blank Disc
2	"Return of the Jedi"
3	No Disc
4	"To Sir with Love"
5	Blank Disc
6	"Sleepless in Seattle"
7	"Dave"
8	Blank Disc
9	No Disc
10	"True Grit"

110

FIG. 6

New Releases/Comedy (20 Titles)			
1	Title #1	120 mins.	PG
2	Title #2	98 mins.	R
3	Title #3	102 mins.	PG-13
4	Title #4	108 mins.	PG
5			
6			
7			
8			

120

FIG. 7

LEVEL I TIME-BASED SECURITY CODES

A	B	C
One 32 bit code in each movie header X 12 months X 100 years = 1200 32 bit codes.	One 32 bit code for each month chosen at the beginning of each month and transmitted by DBS.	One 32 bit code delivered each month by phone/ modem with billing query from central controller system. C provided only when customer is in good standing.

FIG. 8

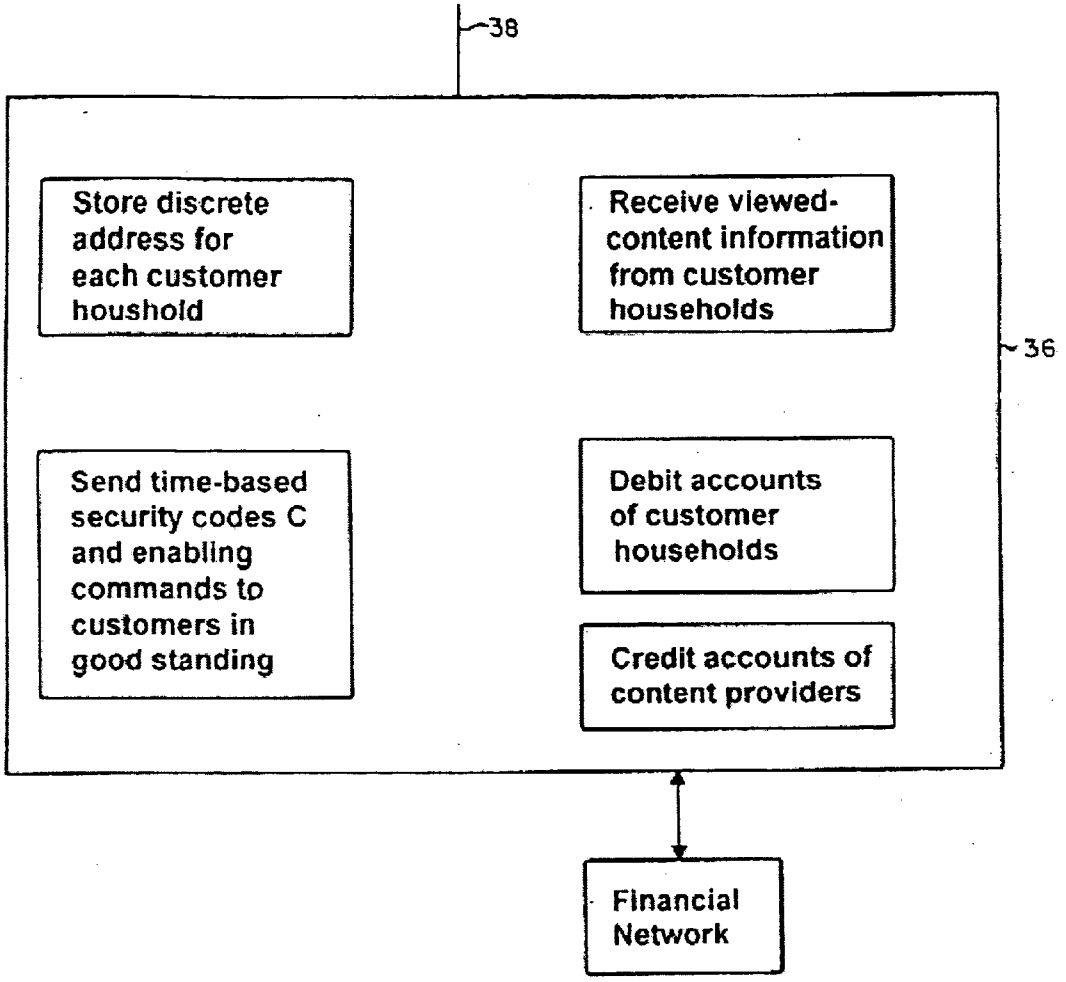

38
Store discrete address for each customer houshold
Receive viewed-content information from customer households
36
Send time-based security codes C and enabling commands to customers in good standing
Debit accounts of customer households
Credit accounts of content providers
Financial Network

FIG. 9

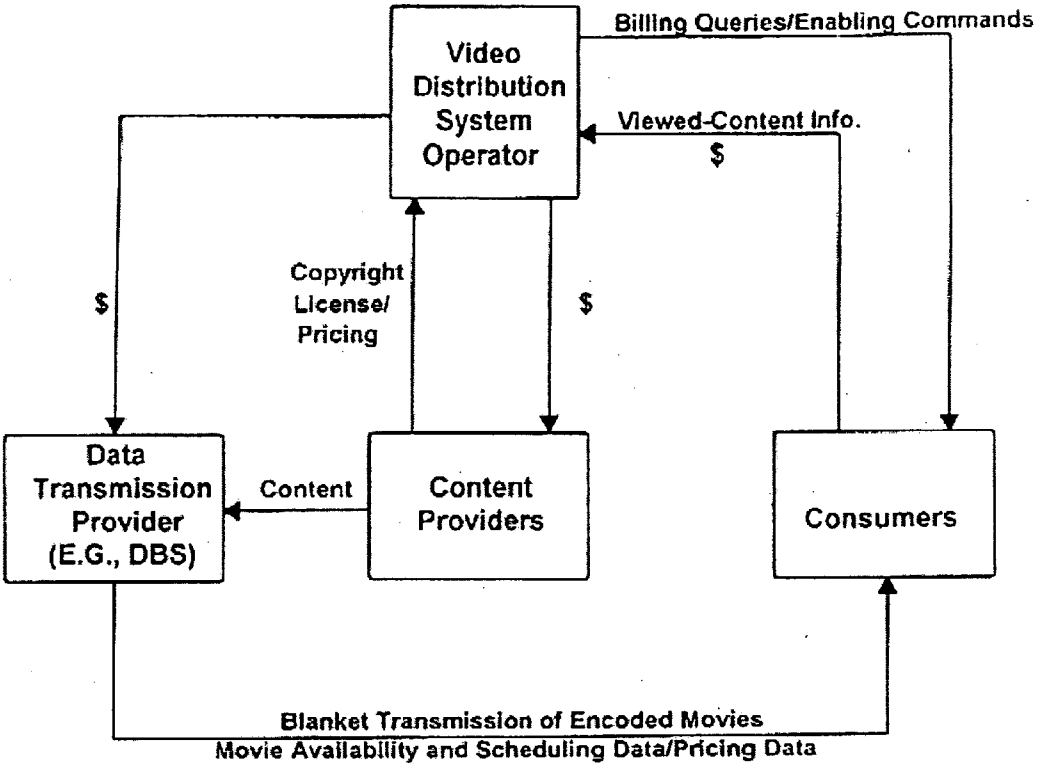

Video Distribution System Operator
Billing Queries/Enabling Commands
Viewed-Content Info.
$
$
Copyright License/ Pricing
$
Data Transmission Provider (E.G., DBS)
Content
Content Providers
Consumers
Blanket Transmission of Encoded Movies
Movie Availability and Scheduling Data/Pricing Data

FIG. 10

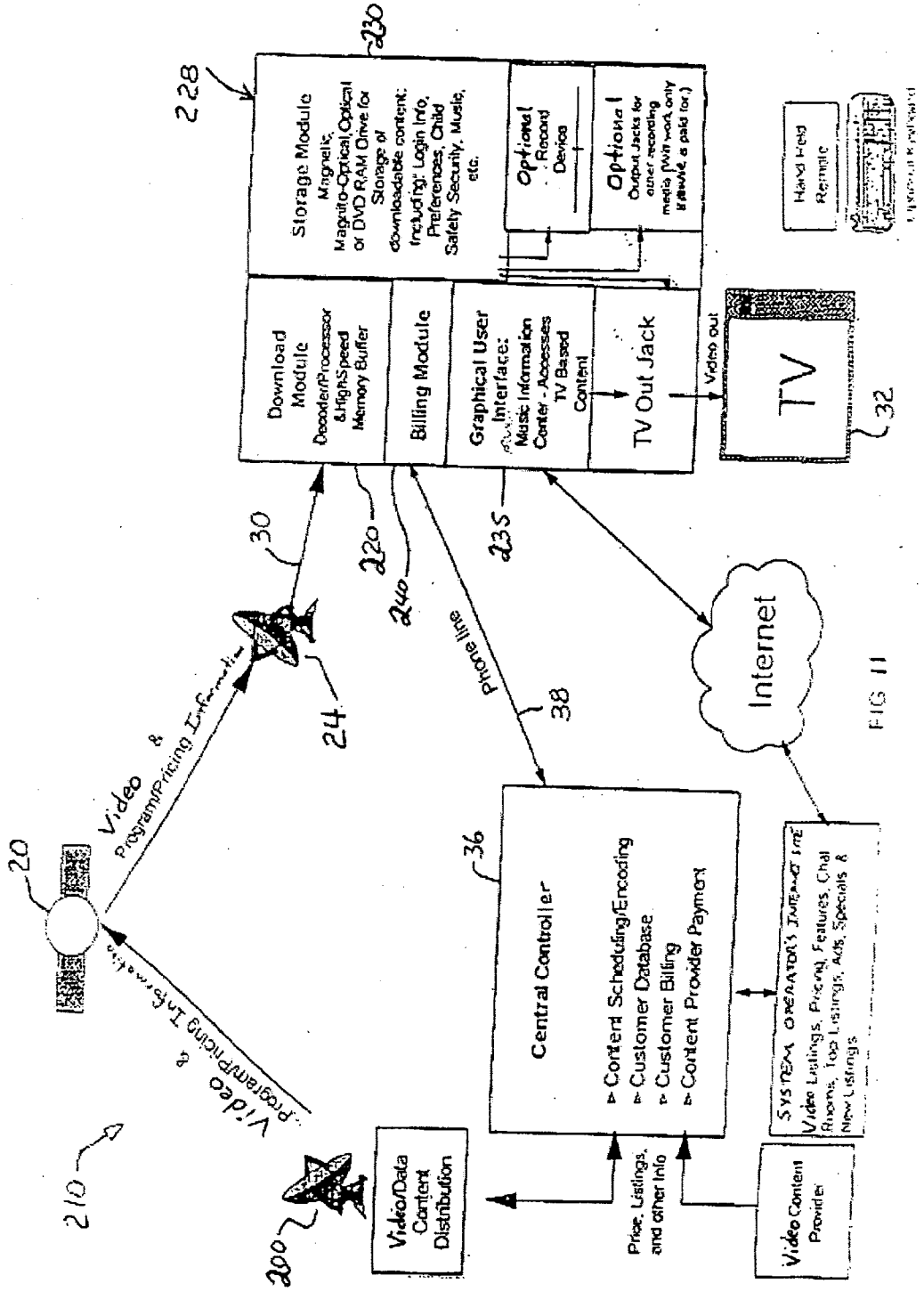

Storage Module
Magnetic, Magneto-Optical, Optical or DVD RAM Drive for Storage of downloadable content: Including: Login Info, Preferences, Child Safety Security, Music, etc.
Optional Record Device
Optional Output Jacks for other recording media (Will work only if WWE is paid for.)
Download Module Decoder/Processor & High Speed Memory Buffer
Billing Module
Graphical User Interface: Music Information Center - Accesses TV Based Content
TV Out Jack
Video out
TV
Hand Held Remote
Video & Program/Pricing Information
Program/Pricing Information
Phone line
Internet
Central Controller
Content Scheduling/Encoding
Customer Database
Customer Billing
Content Provider Payment
System Operator's Interface
Video Listings, Pricing, Features, Chat Rooms, Top Listings, Ads, Specials & New Listings
Price, Listings, and other Info
Video Content Provider
Video/Data Content Distribution
228
230
30
220
240
235
24
38
36
20
210
200
32

FIG 11

Step	Mode Name	Description	Hardware Involved
	Account Setup	Happens when customer buys and hooks up The user station.	
1	Selection	Customer looks at recently updated "catalog' of available movie selections on his TV using the graphical user interface. Use remote to page through information.	User station, remote, customer TV, stored catalog
2	Ordering	Customer uses user station, remote and TV screen to order	User station, remote, customer TV
3	Downloading	Movies are downloaded during transmission hours as encrypted, compressed files through customer's satellite dish to hard disk in user station.	User station, satellite receiver
4	Viewing	Customer plays movie directly from hard drive with decryption/decompressing in real time.	User station,customer TV and speakers
5	Billing	Customer's account billed later by modem or Internet communication with central controller.	User station
6	Optional "Library" Movie Delivery	Full-quality movie on selected medium (e.g. DVD) that can be played on any DVD player is burned with watermark.	User station, DVD burner

Fig. 12

SELECT MOVIE TYPE PREFERENCES	
Action	Documentaries
Romantic Comedy	Foreign Language
Science Fiction	Musicals
Combat	Westerns
Animated	Political
Family (G)	Suspense

Fig. 13

SECOND LEVEL MOVIE PREFERENCES			
Favorite Movie Stars (Male)	Favorite Movie Stars (Female)	Favorite Directors	Preferred Rating(s)
Mel Gibson Tom Hanks	Julia Roberts Meg Ryan	George Lucas John Doe	G PG PG-13 R X

Fig. 14

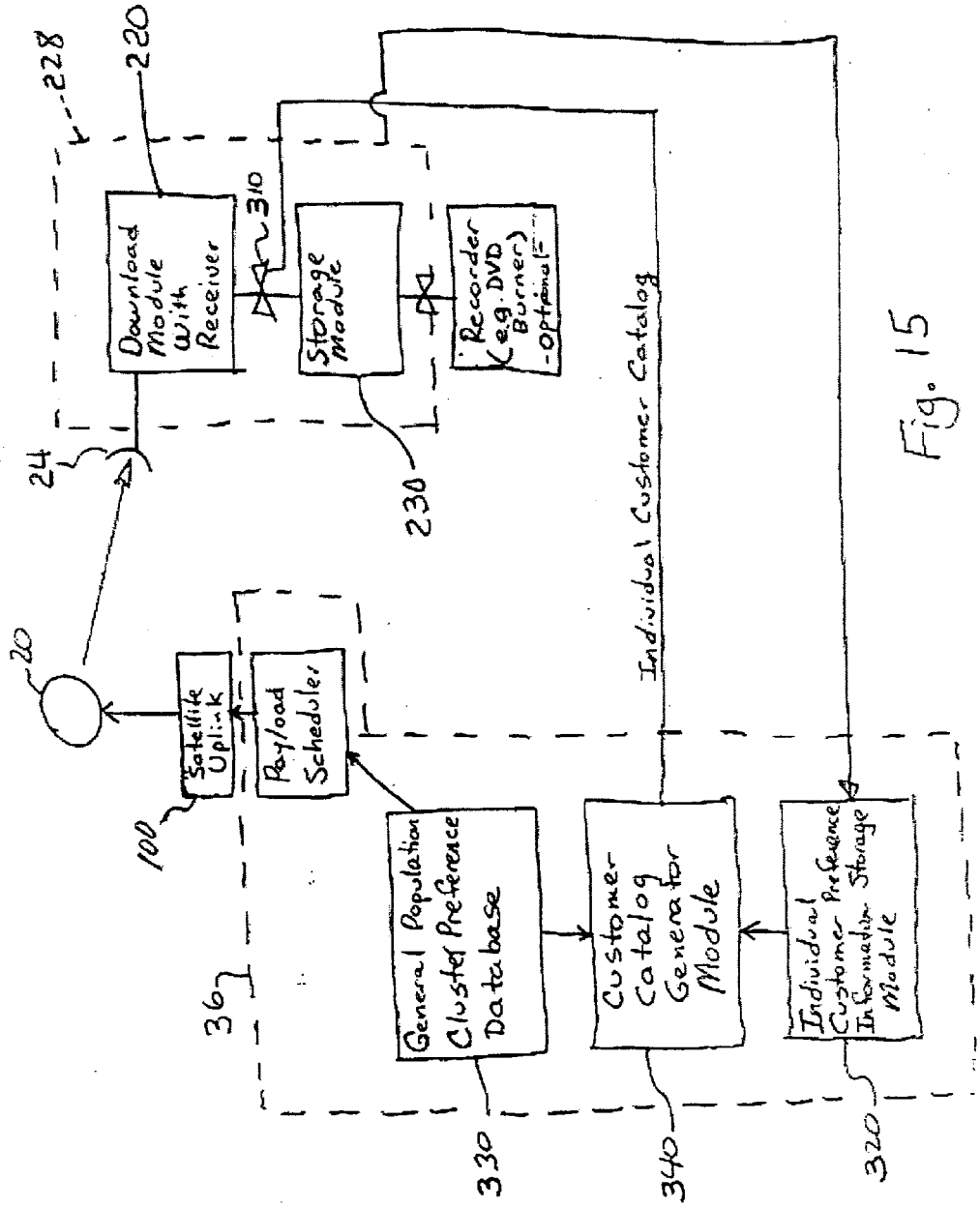

228
220
Download Module With Receiver
310
Storage Module
Recorder (e.g. DVD Burner) -optional-
24
230
Individual Customer Catalog
20
Satellite Uplink
Pay/load Scheduler
100
General Population Cluster Preference Database
Customer Catalog Generator Module
Individual Customer Preference Information Storage Module
360
330
340
320

Fig. 15

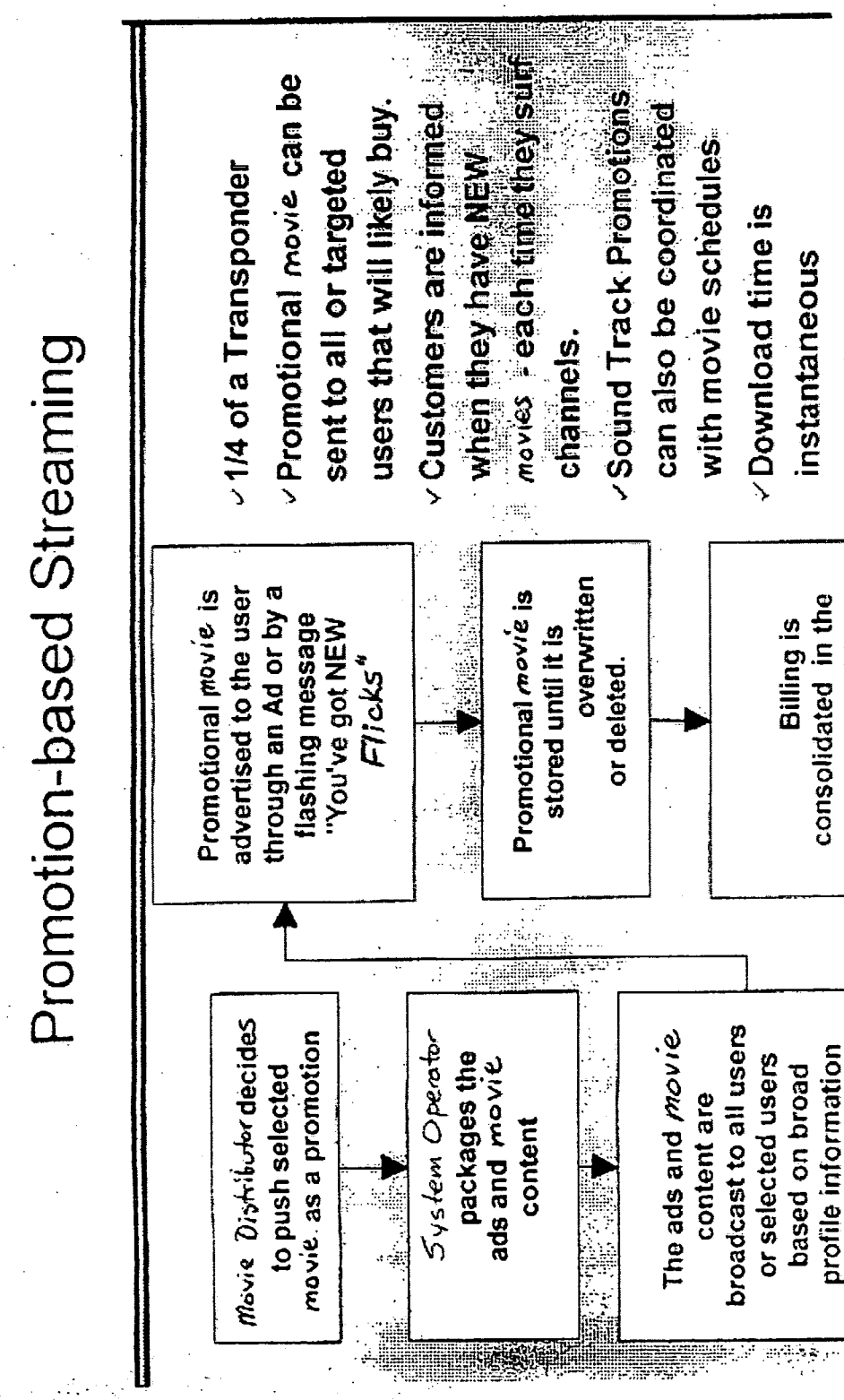

Promotion-based Streaming
Movie Distributor decides to push selected movie as a promotion
System Operator packages the ads and movie content
The ads and movie content are broadcast to all users or selected users based on broad profile information
Promotional movie is advertised to the user through an Ad or by a flashing message "You've got NEW Flicks"
Promotional movie is stored until it is overwritten or deleted.
Billing is consolidated in the users monthly statement
✓1/4 of a Transponder
✓Promotional movie can be sent to all or targeted users that will likely buy.
✓Customers are informed when they have NEW movies - each time they surf channels.
✓Sound Track Promotions can also be coordinated with movie schedules
✓Download time is instantaneous

Fig 16

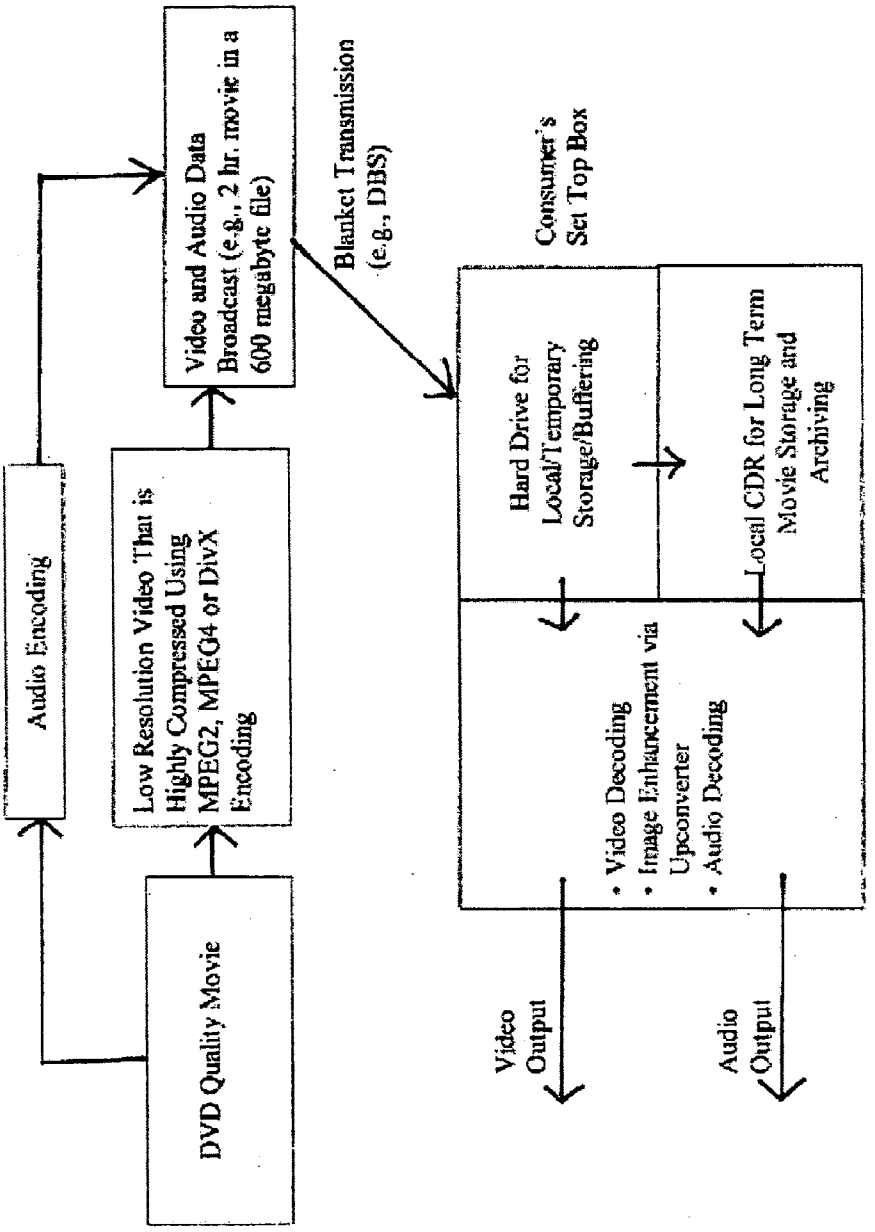

DVD Quality Movie
Audio Encoding
Low Resolution Video That is Highly Compressed Using MPEG2, MPEG4 or DivX Encoding
Video and Audio Data Broadcast (e.g., 2 hr. movie in a 600 megabyte file)
Blanket Transmission (e.g., DBS)
Consumer's Set Top Box
Hard Drive for Local/Temporary Storage/Buffering
Local CDR for Long Term Movie Storage and Archiving
• Video Decoding
• Image Enhancement via Upconverter
• Audio Decoding
Video Output
Audio Output

Figure 17

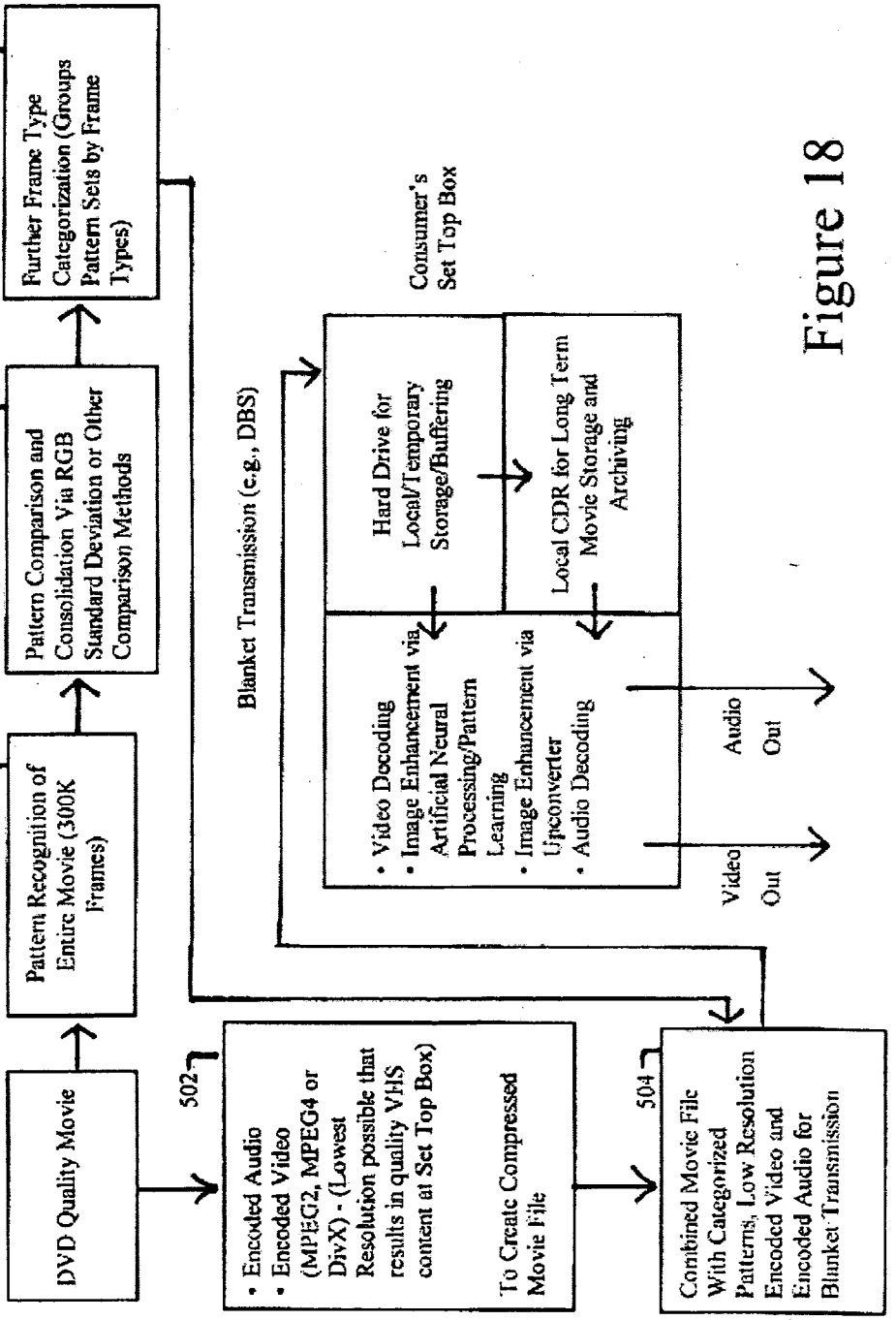

DVD Quality Movie
502
• Encoded Audio
• Encoded Video (MPEG2, MPEG4 or DivX) - (Lowest Resolution possible that results in quality VHS content at Set Top Box)
To Create Compressed Movie File
504
Combined Movie File With Categorized Patterns, Low Resolution Encoded Video and Encoded Audio for Blanket Transmission
Blanket Transmission (e.g., DBS)
Consumer's Set Top Box
Hard Drive for Local/Temporary Storage/Buffering
Local CDR for Long Term Movie Storage and Archiving
• Video Decoding
• Image Enhancement via Artificial Neural Processing/Pattern Learning
• Image Enhancement via Upconverter
• Audio Decoding
Video Out
Audio Out
510
Pattern Recognition of Entire Movie (300K Frames)
512
Pattern Comparison and Consolidation Via RGB Standard Deviation or Other Comparison Methods
514
Further Frame Type Categorization (Groups Pattern Sets by Frame Types)

Figure 18

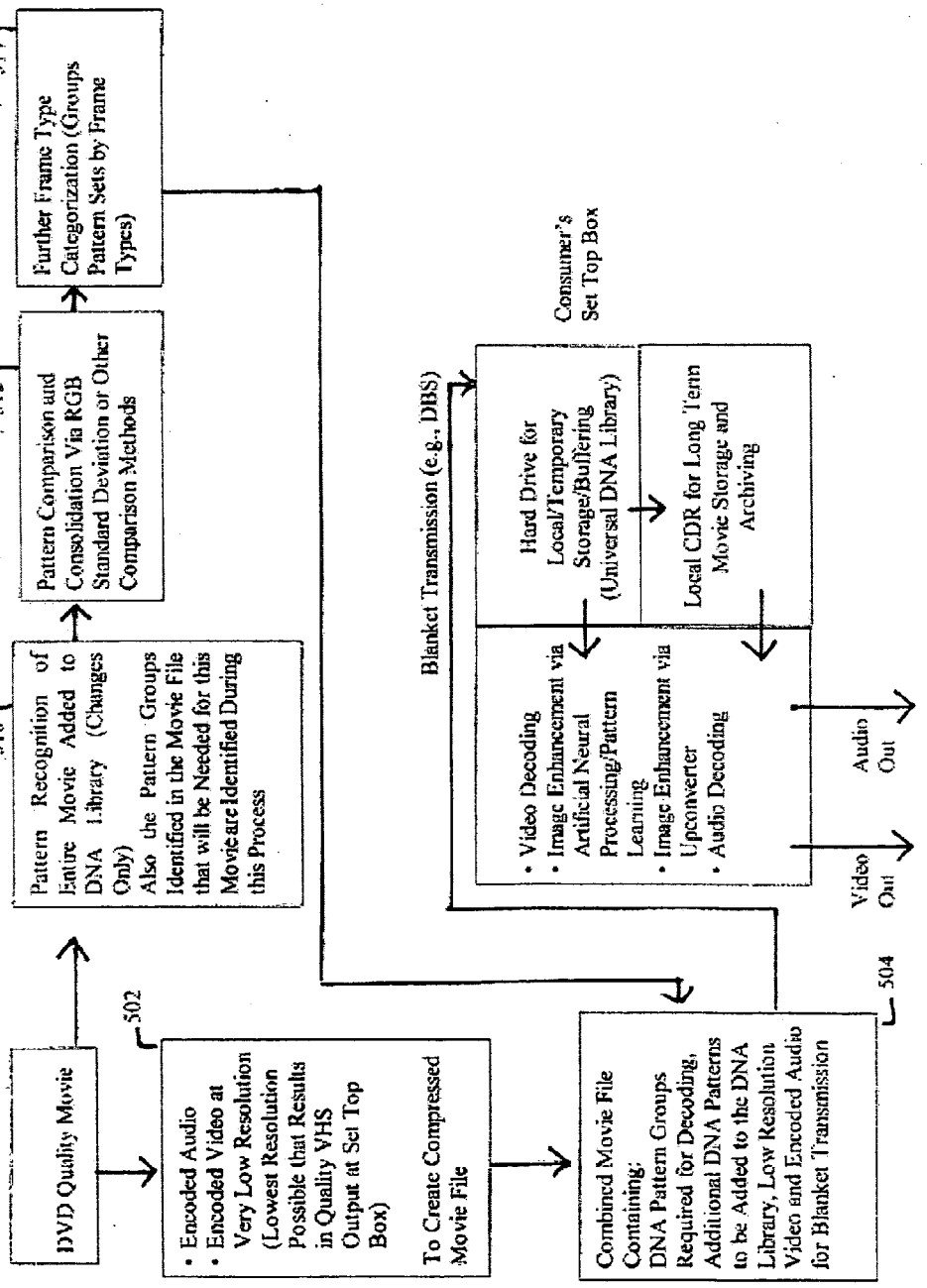

DVD Quality Movie
502
• Encoded Audio
• Encoded Video at Very Low Resolution (Lowest Resolution Possible that Results in Quality VHS Output at Set Top Box)
To Create Compressed Movie File
510
Pattern Recognition of Entire Movie Added to DNA Library (Changes Only)
Also the Pattern Groups Identified in the Movie File that will be Needed for this Movie are Identified During this Process
512
Pattern Comparison and Consolidation Via RGB Standard Deviation or Other Comparison Methods
514
Further Frame Type Categorization (Groups Pattern Sets by Frame Types)
Blanket Transmission (e.g., DBS)
Consumer's Set Top Box
Hard Drive for Local/Temporary Storage/Buffering (Universal DNA Library)
Local CDR for Long Term Movie Storage and Archiving
• Video Decoding
• Image Enhancement via Artificial Neural Processing/Pattern Learning
• Image Enhancement via Upconverter
• Audio Decoding
Video Out
Audio Out
Combined Movie File Containing:
DNA Pattern Groups Required for Decoding,
Additional DNA Patterns to be Added to the DNA Library, Low Resolution Video and Encoded Audio for Blanket Transmission
504

Figure 19

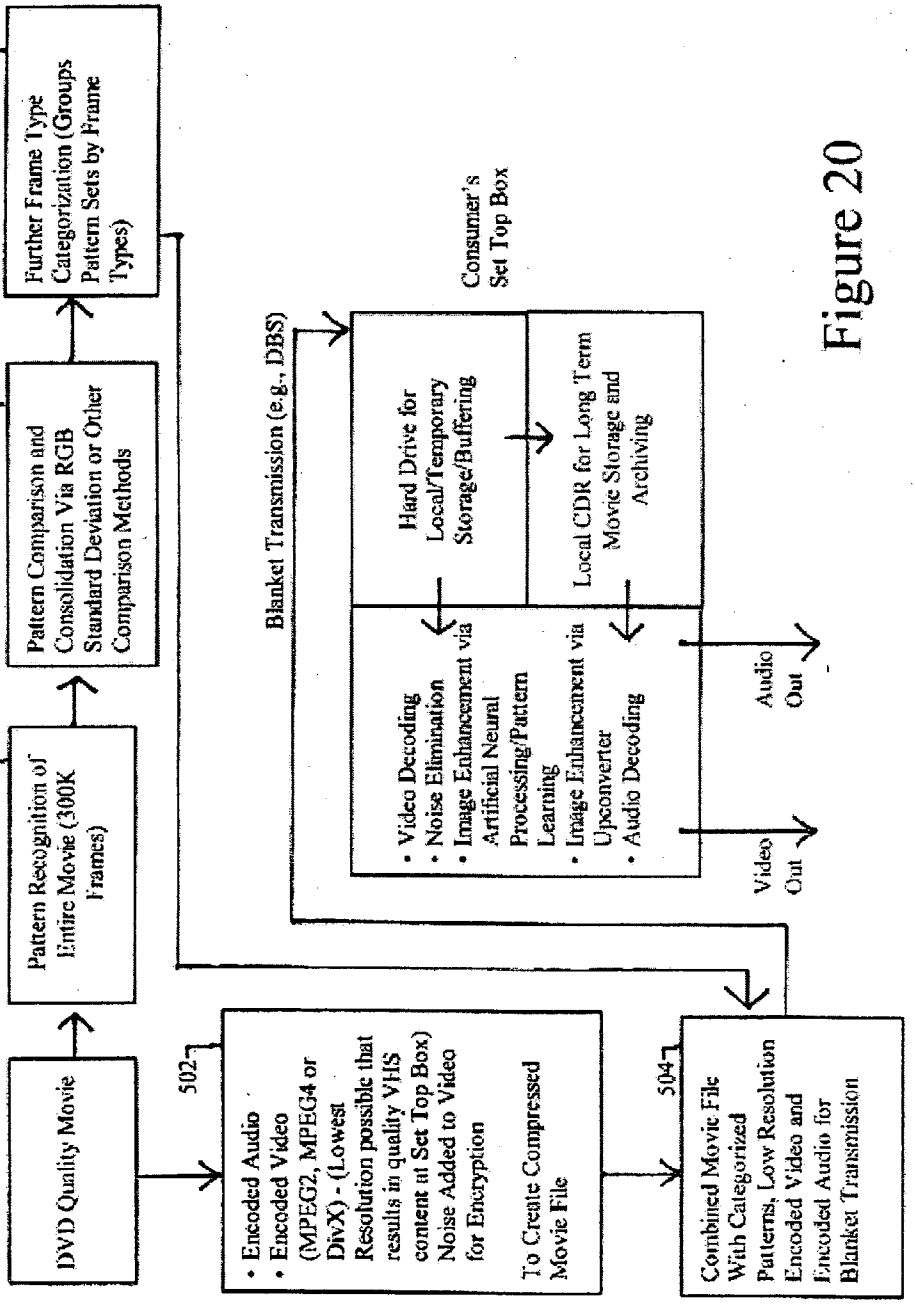

DVD Quality Movie
502
• Encoded Audio
• Encoded Video (MPEG2, MPEG4 or DivX) - (Lowest Resolution possible that results in quality VHS content at Set Top Box) Noise Added to Video for Encryption
To Create Compressed Movie File
504
Combined Movie File With Categorized Patterns, Low Resolution Encoded Video and Encoded Audio for Blanket Transmission
510
Pattern Recognition of Entire Movie (300K Frames)
512
Pattern Comparison and Consolidation Via RGB Standard Deviation or Other Comparison Methods
514
Further Frame Type Categorization (Groups Pattern Sets by Frame Types)
Blanket Transmission (e.g., DBS)
Consumer's Set Top Box
Hard Drive for Local/Temporary Storage/Buffering
Local CDR for Long Term Movie Storage and Archiving
• Video Decoding
• Noise Elimination
• Image Enhancement via Artificial Neural Processing/Pattern Learning
• Image Enhancement via Upconverter
• Audio Decoding
Video Out
Audio Out

Figure 20

DNA Pattern Library

Frame Group 1	Frame Group 2	Frame Group 3	.....	Frame Group n
Pattern 1	Pattern 1	Pattern 1		Pattern 1
Pattern 2	Pattern 2	Pattern 2		Pattern 2
Pattern 3	Pattern 3	Pattern 3		Pattern 3
•	•	•		•
•	•	•		•
•	•	•		•
Pattern N	Pattern N	Pattern N		Pattern N

Figure 21

Video Content File

- Required Frame Groups: 1, 4, 7, 9, ... n
- Additional Patterns to be Added to DNA Library Groups
- Highly Compressed/Noise Added Video File

Figure 22

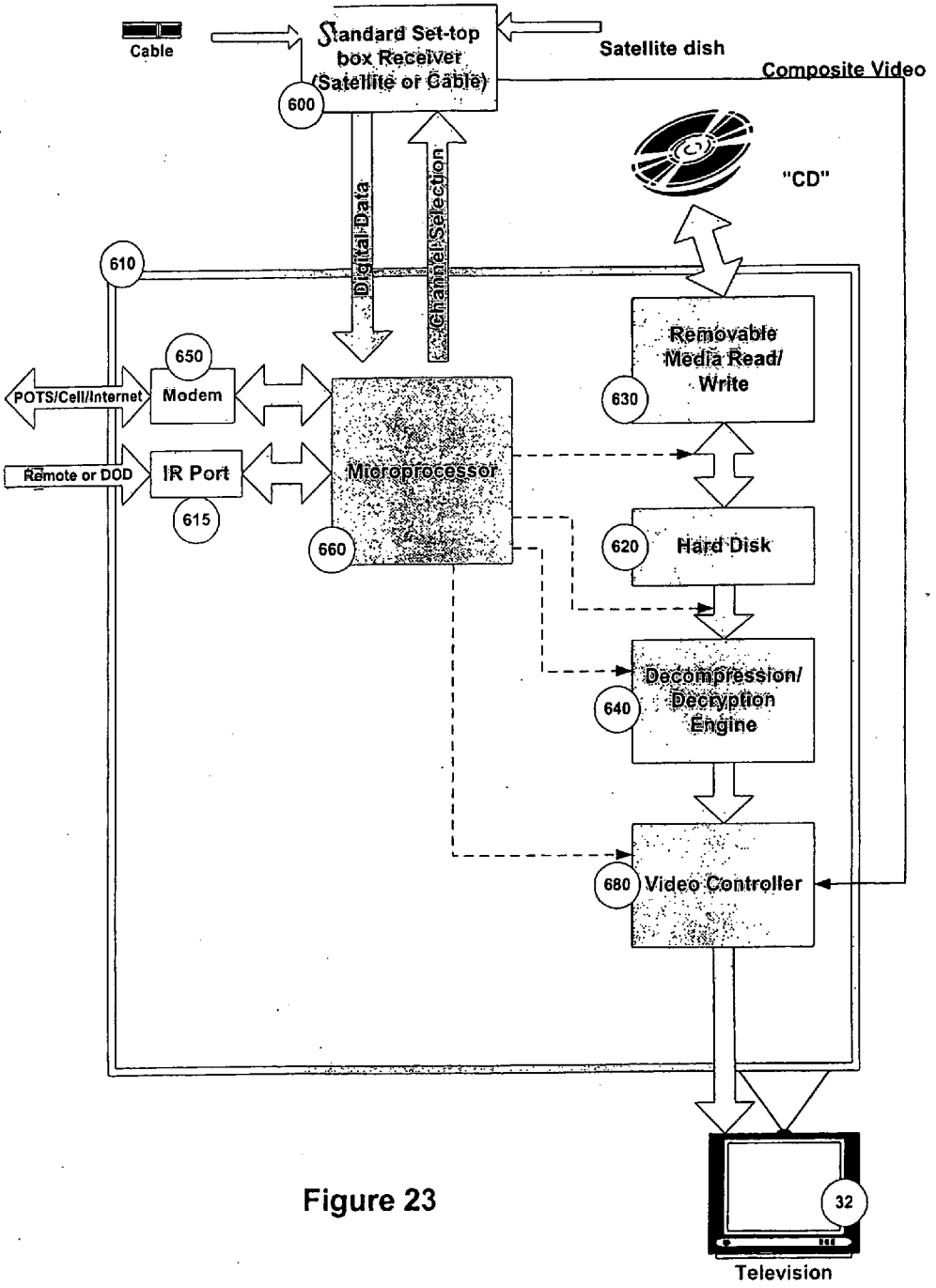

Cable
Standard Set-top box Receiver (Satellite or Cable)
600
Satellite dish
Composite Video
"CD"
Digital Data
Channel Selection
610
650
Modem
POTS/Cell/Internet
Remote or DOD
IR Port
615
Microprocessor
660
Removable Media Read/ Write
630
620
Hard Disk
Decompression/ Decryption Engine
640
680
Video Controller
32
Television

Figure 23

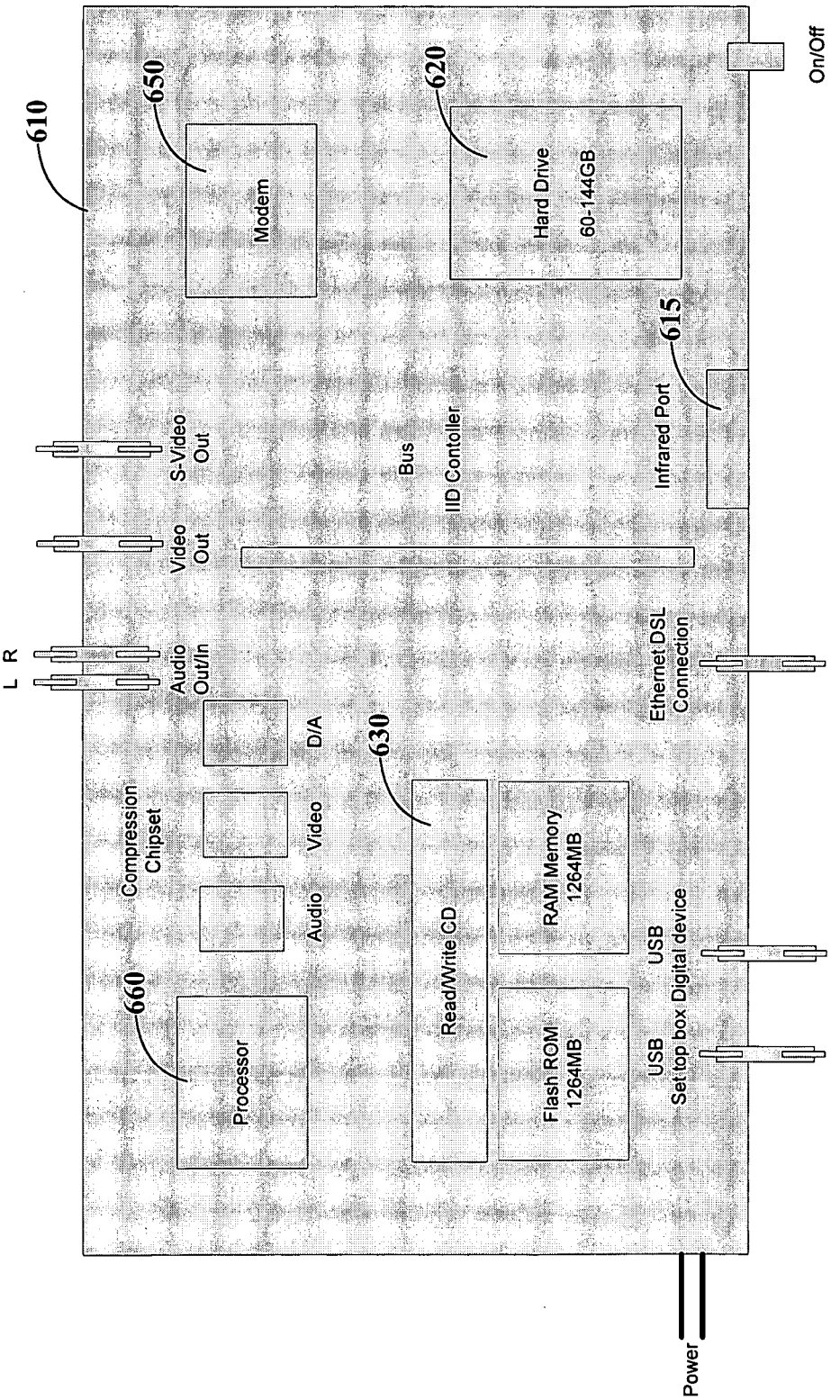

610
650
Modem
620
Hard Drive
60-144GB
On/Off
615
Infrared Port
IID Contoller
Bus
S-Video Out
Video Out
L R
Audio Out/In
D/A
Video
Audio
Compression Chipset
630
Read/Write CD
RAM Memory 1264MB
Ethernet DSL Connection
660
Processor
Flash ROM 1264MB
USB
Set top box
USB
Digital device
Power

Figure 24

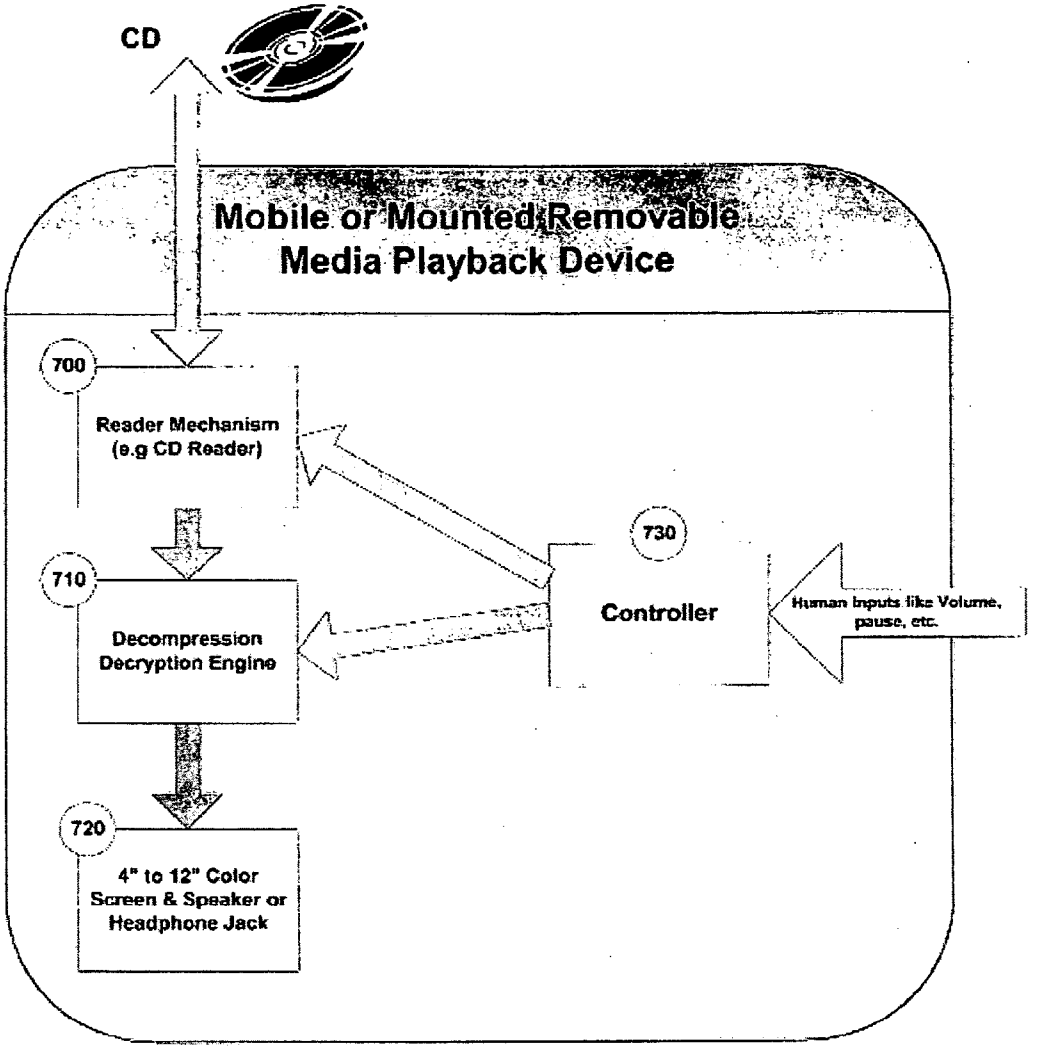
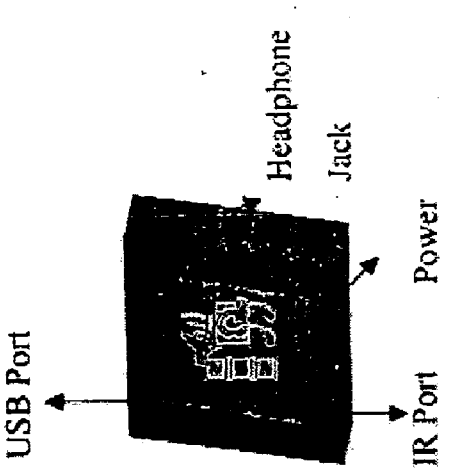
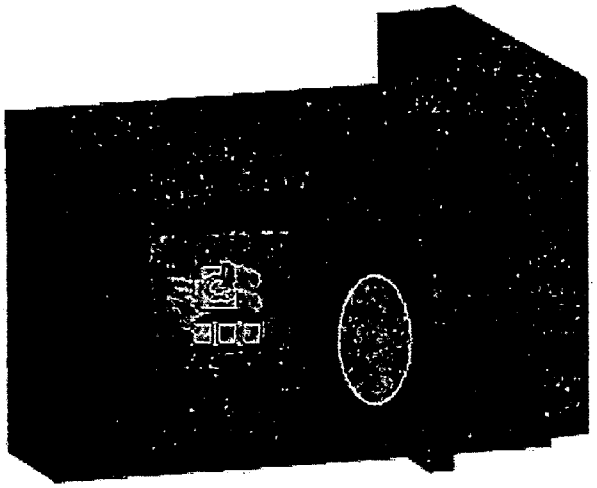

CD
Mobile or Mounted Removable Media Playback Device
700
Reader Mechanism (e.g CD Reader)
730
710
Controller
Human Inputs like Volume, pause, etc.
Decompression Decryption Engine
720
4" to 12" Color Screen & Speaker or Headphone Jack

Figure 25



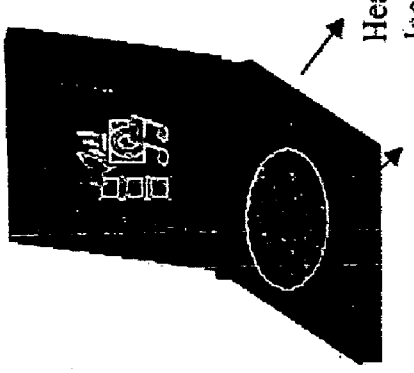
Hard Drive
Player

Fig. 28



Mounted Player

Fig. 27



Mobile Player

Fig. 26

VIDEO DISTRIBUTION SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional of U.S. patent application Ser. No. 09/675,025, filed Sep. 28, 2000, which is a continuation in part of Ser. No. 09/385,671, filed Aug. 27, 1999; Ser. No. 09/436,281, filed Nov. 8, 1999; Ser. No. 09/476,078, filed Dec. 30, 1999; Ser. No. 09/502,069, filed Feb. 10, 2000; Ser. No. 09/553,524, filed Apr. 20, 2000 and Ser. No. 09/645,087, filed Aug. 24, 2000. The disclosures of these applications are hereby expressly incorporated by reference.

FIELD OF THE INVENTION

[0002] The invention relates to video distribution systems and, more particularly, to a system that blanket transmits video/audio content such as movies (for example, via satellite downlink transmission) to each customer's recording, storage and playback system. Customers may preselect from a list of available movies or other content in advance using an interactive screen selector, and pay for the video/audio content that is actually viewed.

DESCRIPTION OF THE PRIOR ART

[0003] Widespread home television viewing began in approximately 1950 with broadcast networks transmitting shows on specific, prepublished schedules. This model remained the primary model for television viewing for over thirty years.

[0004] Cable, and later direct broadcast satellite, increased the number of channels. But viewers were still subject to programming schedules.

[0005] Video cassette recorders offered the prospect of shifting viewing times, provided the end user was one of the thirty percent or less of VCR owners who learned to program their VCR's. Even among those who learned to program their VCR, time shifting via VCR remains subject to properly setting up the timer, assuring the power is in the correct state, assuring that a correct tape is in the VCR, that the tape is not full, that the tape is properly rewound, etc. Thus, for the majority of TV viewers, even at the turn of the century, the TV viewing model has scarcely changed from the mode of 1950.

[0006] Video rental stores have provided a sort of "video on demand", subject, of course, to the high cost of video cassette purchases by the rental stores, as well as the high capital outlay for real estate (land and building) and the cost of labor at the stores. Even when a title becomes available through video release, the viewer's ability to watch the show at his chosen time is subject to availability of the video at the store, round-trip transportation to the store and the inevitable problems with late returns, damaged videos, lost videos, etc.

[0007] True video-on-demand has been envisioned whereby massive video servers would be positioned in every geographic location to transfer high speed video data streams to the houses of individual viewers at any time a viewer wished to access a particular movie or other content. However, this type of video demand system, after years and billions of dollars of investment, has proven to be too complex and expensive and, therefore, has not been implemented.

[0008] A compromise on the video-on-demand concept has been proposed by Replay Networks, Inc. (USA) whereby viewers create their own "replay channels" containing content categorized by, for example, show titles, actor, movie type, etc., with such programming being recorded on hard disks at a local facility and later available for on-demand access by individual viewers. Another type of on-demand video distribution system is described in U.S. Pat. No. 5,832,287, whereby video-on-demand and network programming is provided from master file and network program databases through multiple community systems, each of which may serve up to approximately one hundred homes.

[0009] Both the Replay Networks, Inc. and the X287 systems have severe limitations in terms of storage capability and customer options.

[0010] An interactive viewing system that automatically records selected programs is disclosed in U.S. Pat. No. 5,805,763. However, the '763 system simply provides another mechanism for recording television programs. This system attempts to simplify the VCR recording function, but because of its complex nature and limited benefits it has not been implemented.

[0011] There is an acute need in the video distribution industry for a system that will provide each individual viewer with ready access to thousands of movies titles, as well as educational programming, network programming, audio programming and the like, in a convenient low-cost manner that fully satisfies user demand, while enhancing the economic incentives of content providers to create and distribute an ever expanding offering of movies and other video/audio content.

SUMMARY OF THE INVENTION

[0012] The present invention provides a video distribution system that is beneficial to all involved parties, namely consumers, content providers and data transmission providers. In certain embodiments, consumers are able to preselect movies for viewing from as many as thousands of movies that are transmitted daily and as many as sixty thousand movies transmitted monthly. Customers of the video distribution system utilize a menu driven, graphical user interface with simplified controls that provide movie selection by title, type, or category (e.g., comedy new releases from major studios). In preferred embodiments, video/audio content is blanket transmitted via direct broadcast satellite (DBS) in an encoded, compressed form for playback at VHS resolution (or other desired resolution). The transmission is directly to each customer's receiving dish or antenna which is linked to the customer's user station where selected movies are stored on DVD RAM discs or CD's in a multiple disc platter, or on a hard drive having a storage capacity of, for example, 20 gigabytes or more. The movies may then be played immediately or at any time desired by the consumer, with the consumer paying only for those movies that are actually viewed. Preferably, the movies are encoded to prevent conversion and duplication for play on existing DVD, CD or other systems. The encoding technology also prevents playback on user stations of the video distribution system in homes that are not current on payments for previous purchases. In certain embodiments, the encoding system includes a novel time-based encoding technology, and movies may be watermarked so that copies are traceable to the customer site.

[0013] The video distribution system of the present invention offers numerous advantages to consumers. For example, consumers have access to new movie releases at those times dictated by market conditions to be most favorable by the content providers and the distributors, often before the movies would be available at video rental stores. In preferred embodiments, consumers will pay for a movie only after it has been viewed, not when recorded. Thus, consumers are free to record categories or classes of movies (e.g., new releases) and later make a decision as to which movies to actually view—paying only for those that are viewed. In certain embodiments, consumers have access to movies that are automatically recorded, such as popular new release movies and movies that are being promoted by the content provider and/or system operator. Consumers may view the videos at any time without restraints related to broadcasting schedules and with no need to visit a video rental store for selection of the movie or returning the movie. There are no late fees. New movie releases will never be "sold out", as they frequently are in existing video rental stores. Another advantage to consumers is the ultimate lower cost occasioned by the system's elimination of the real estate and labor costs associated with existing video rental stores. Because literally thousands of movies are available on a daily/weekly/monthly basis, the video distribution system of the invention provides a much greater selection than any existing video rental store. The invention also provides full access to content for those who live in geographically remote and/or sparsely populated areas that may presently have little or no access to video rental stores. The invention also allows access to videos for families with young children, elderly persons and handicapped persons where theater viewing and round trips to video rental stores are inconvenient, prohibitive or expensive. Each user station utilizes high capacity storage such as DVD platters or hard drives for its read/write functions in addition to an operating system that provides greatly simplified on-screen programming. The present invention also provides the ability to update movie pricing at any time, for example on a daily, weekly or monthly basis, so that consumers can choose to view movies at times when content providers offer pricing specials or incentives. When a movie is recorded on a removable storage medium, it can be labeled and stored for future play or, depending upon the storage medium, recorded over (similar to a blank VCR tape). As new movies are recorded and shelved, blank or previously recorded media can be inserted into the platter for future recording. Video quality is improved over existing video rentals where, in most cases, available tapes have been degraded by previous play.

[0014] Content providers (e.g., major studio producers) recognize a very significant benefit in that they receive income every time a movie is played, thereby creating significant residual value for their investments. Importantly, new release movies are always available (i.e., not "sold out") during initial peak demand when pricing power is the highest. The mentioned residual value translates into increased income for the content providers because a significant portion of existing content is available for sale every day—since thousands of movies are transmitted on a daily/weekly/monthly basis. The invention also allows content providers to change pricing at any time, e.g., daily/weekly/monthly, to optimize price vs. consumer demand. In this regard, content providers are allowed to meet consumer demand for a significant portion of the existing content inventory value every day. This provides an extremely high benefit by effectively allowing the market to clear (i.e., real demand matches supply), something that the current video distribution model (TV, movie channels, pay-per-view and video rental) do not provide. Additionally, content providers may provide preview material for download that is specific to user profiles.

[0015] According to the invention, content providers may be confident that they can distribute their movies with extremely high security through the use of appropriate encoding technology. The encoding may include time-based encoding technology, with new code keys for every distributed movie transmitted via phone/modem with billing queries every month. Time-based coding, in combination with a single standard operating system, allows the video distribution system operator to achieve the level of security demanded by content providers. Watermarks coded to each site may be placed in any playback signal to assure that movie copies, even those made by recording at the input to the TV or monitor can be traced to a specific site or purchase.

[0016] Transmission providers (DBS satellite system providers, in preferred embodiments) realize the advantage of a significantly increased income base for supporting their services and the utilization of lower cost, off-peak time for transmission of a significant portion of the movies, as well as opportunities to market other products and services to specific customer profiles.

[0017] In one aspect, the video distribution system of the present invention includes a data transmission system which blanket transmits a plurality of encoded movies to customer households. A user station is provided at each customer household, the user station including means permitting the customer household to preselect desired transmitted movies for recording. A receiver and associated recording device at each customer household is provided for recording movies. The recorder may be an internal or external hard drive, DVD or CD recording device or other appropriate device. A playback device permits each customer to play back those recorded movies that the customer desires to view. The video distribution system also includes a central controller system having a database for storing therein an address corresponding to each customer household, a communications link between each customer household and the central controller system to verify to the controller unit that a recorded movie has been played back for viewing and a billing system linked to the central controller system to bill customer households for only those recorded movies that are played back for viewing.

[0018] In another aspect, the invention may be defined as a method of distributing movies to customer households comprising the steps of blanket transmitting a plurality of movies to customer households, permitting each customer household to preselect and record desired movies, permitting each customer household to playback for viewing any recorded movie, communicating movie playback information from each customer household to a central controller, and billing customer households for only those recorded movies that are played back for viewing.

[0019] Other embodiments allow downloading and storage of marketing material, information, transmission schedules, or even several movies that are currently in high demand.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Some of the features of the invention having been stated, other features will appear as the description proceeds, when taken in connection with the accompanying drawings, in which

[0021] **FIG. 1** is a schematic representation of a video distribution system consistent with the present invention utilizing global satellite downlink data transmission.

[0022] **FIG. 2** illustrates further details of a user station shown in **FIG. 1**.

[0023] **FIG. 2A** is a view of the user station of **FIG. 2** showing several optional features.

[0024] **FIG. 3** shows a hand held infrared remote control for use in association with the user station.

[0025] **FIG. 4** is a block diagram showing components of a representative user station of the invention.

[0026] **FIGS. 5,6**, and **7** show several screens that appear on the **10** display when a customer reviews available movies, preselects movies for viewing and performs other associated functions using the interactive program guide.

[0027] **FIG. 8** illustrates a Level I time-based coding format that provides enhanced security for the transmitted programming.

[0028] **FIG. 9** is a block diagram showing functions of the central controller system.

[0029] **FIG. 10** is a block diagram of one simplified embodiment of a business model for commercializing a video distribution system consistent with the invention.

[0030] **FIG. 11** is schematic representation of another satellite-based video distribution system that utilizes a relatively large hard drive as the primary data storage medium.

[0031] **FIG. 12** shows the operational sequence for use of the video distribution system of **FIG. 11**.

[0032] **FIG. 13** shows a screen containing one example of a simple graphical user interface used by a customer to enter customer movie preference information by movie type.

[0033] **FIG. 14** shows a screen containing another example of a graphical user interface for entering more complex, multilevel **30** customer preference information.

[0034] **FIG. 15** is a block diagram showing how customer preference information entered by customers and general population clustered preference data compiled and analyzed by the system operator are used to create customized preference-based **35** downloading choices at the customer user stations.

[0035] **FIG. 16** is a flow sheet showing the procedure for promotion-based streaming of movies, for example where a movie distribution company decides to push a selected movie as a promotion.

[0036] **FIG. 17** is a schematic representation of an embodiment consistent with the invention wherein the video portion of a movie is highly compressed prior to being blanket transmitted at low resolution. The video is enhanced by an upconverter at the customer's user station (set top box), thereby **45** permitting transmission and storage of the video as a smaller file while still permitting the customer to enjoy a picture with the desired resolution, for example, VHS resolution.

[0037] **FIG. 18** is a schematic representation of another embodiment consistent with the invention wherein a hardware **50** implementation of artificial neural networks is used to sample the video portion of a movie frame by frame to create a library of neural patterns. The library of patterns for the movie is blanket transmitted along with very low resolution, highly compressed encoded video, with the transmitted video file undergoing pattern recognition image enhancement at the set top box and, optionally, up-conversion as well.

[0038] **FIG. 19** is a schematic representation of an embodiment that is similar to that of **FIG. 18** except that the set top box contains in memory a universal library of neural patterns for image enhancement of the transmitted video so that a complete, unique pattern library for each transmitted movie does not have to be transmitted along with the movie.

[0039] **FIG. 20** is a schematic representation of another embodiment similar to that of **FIG. 18** with the additional feature that the video portion of the movie is transmitted with a uniform pattern of added noise that is used as copy protection encryption. The noise is removed by the processor in the set top box, as the processor is also enhancing the image.

[0040] **FIG. 21** is a representation of how neural patterns can be grouped in the library by frame type.

[0041] **FIG. 22** is a representation showing how, as a video file is being scanned, the specific frame types of **FIG. 21** are noted and stored in the pattern library.

[0042] **FIG. 23** is a block diagram of a companion set-top box that connects to an existing satellite or cable TV receiver box for use with a system consistent with the present invention.

[0043] **FIG. 24** is a partly schematic representation of the companion box of **FIG. 23**.

[0044] **FIG. 25** is a block diagram of the principal components of a mobile or mounted playback device for viewing movies recorded by a system customer on a removable media such as CD or DVD.

[0045] **FIG. 26** is a pictorial view of a mobile playback device incorporating the features illustrated in **FIG. 25**.

[0046] **FIG. 27** is a pictorial view of a playback device that is mounted, for example, on the seat back of an airplane, train or automobile.

[0047] **FIG. 28** is a pictorial view of another form of mobile playback device that incorporates a hard drive.

DETAILED DESCRIPTION OF THE INVENTION

[0048] While the present invention will be described more fully hereinafter with reference to the accompanying drawings, in which aspects of the preferred manner of practicing the present invention are shown, it is to be understood at the outset of the description which follows that persons of skill in the appropriate arts may modify the invention herein described while still achieving the favorable results of this

invention. Accordingly, the description which follows is to be understood as being a broad, teaching disclosure directed to persons of skill in the appropriate arts, and not as limiting upon the present invention.

The Overall Video Distribution System. Generally

[0049] Referring to **FIG. 1**, there is shown a simple schematic of one embodiment of a video distribution system **10** consistent with the invention. System **10** utilizes direct broadcast satellite (DBS) transmission via satellite **20** from a video distribution system operator as the means for blanket transmitting encoded programming data, either in real time or in time compressed format (discussed below) to a large number of customer households. The program data is received at each customer household by a receiving antenna or dish **24**. Dish **24** is linked to a dedicated user station **28** by a satellite receiver link **30**. User station **28** is an interactive device permitting customers to preselect desired transmitted movies, record the preselected movies and play back the recorded movies on a video display device (e.g., television **32**) anytime the customer wishes to view them. Each station **28** communicates at appropriate times with a central controller system **36** via a phone/modem connection **38** (land, Internet or cellular). Central controller system **36** stores a discrete address (e.g., telephone number, credit card number or billing address) for each customer household and receives information via connection **38** to verify that a preselected, recorded movie has been played back for viewing. Central controller system **36** utilizes the movie playback information to bill customer households and also to credit the accounts of content providers. The satellite link (or alternatively the central controller system **36**) periodically communicates with each customer household to provide information on available movies and when they will be transmitted, along with pricing information for the playback of specific movies or categories of movies. In preferred embodiments, the satellite link and phone/modem connection **38** transmit time-based code keys for the transmitted movies that form part of the security system for the video distribution system.

[0050] **FIG. 2** illustrates the front panel of one embodiment of user station **28**. Station **28** includes a port for the satellite receiver link **30**, a phone/modem connection **38**, a remote infrared sensor **44** and a DVD platter **46** (e.g., a 10-disc platter) which is utilized as the write/read mechanism for recording and playback of movies or other content. User station **28** also includes a user interface comprising a power on/off switch **50**, a five key program selector **54**, a "Programs Recorded" key **62** and a platter out/in key **66**, all of which preferably are duplicated on an infrared handheld remote **70** (**FIG. 3**). A more detailed discussion of the use of user station **28** to review movie availability, to preselect, record and playback movies will be set forth below in the description of the viewer interface and interactive program guide.

The Satellite(s)

[0051] According to preferred embodiments consistent with the present invention, data transmission is achieved utilizing geostationary satellites operating in the KU band that are downlinked to conventional receiving antennae or dishes located at the customer households, which are in turn linked to TV Receive Only (TVRO) units included in customer user stations **28**.

[0052] Following the recent acquisition of PrimeStar's assets by Hughes, there are now two digital broadcast satellite providers in the United States, Hughes (DSS) and EchoStar (DISH Network). EchoStar's DISH network launched an additional satellite in September 1999 (its fifth satellite) that, in combination with its previous satellites, provides continuous transmission of greater than five hundred channels to substantially the entire continental United States. EchoStar now has satellites located in the 119, 110, 61.5 and 148 degree positions within the Clark Belt.

[0053] With the above satellite orientations, EchoStar's new "DISH 500" system utilizes an elliptical twenty inch antenna or dish containing two LMBS heads that can receive information from two different satellites simultaneously. As mentioned above, this system permits greater than five hundred channels to be directly broadcast to each customer household.

[0054] Currently preferred embodiments consistent with the present invention utilize the EchoStar system, most preferably the DISH 500 system, for programming data transmission at either real time or time-compressed transmission rates, discussed below. In alternative embodiments, the invention may be implemented utilizing the Hughes (DSS) system, or a combination of both the Hughes and EchoStar systems (resulting in a relatively smaller portion of each system's total capacity being devoted to the invention's video distribution).

Data Transmission Parameters

[0055] EchoStar's DISH 500 system has 480×704 resolution, providing a very high band width of approximately 4 megabits/sec for each channel, for a total transmission capacity of approximately 2000 megabits/sec for five hundred channels.

[0056] As mentioned above, in accordance with certain preferred embodiments consistent with the invention, the video content (e.g., movies) may be broadcast at standard VHS resolution (240×352) which translates into a requirement of approximately 1.3 megabits/sec per channel with MPEG II compression. Thus, the full (greater than 2000 megabits/sec) capability of the DISH 500 system translates into the capability to broadcast approximately 1,530 movies simultaneously in real time (i.e., not time compressed). At 110 minutes per movie, the full twenty-four hour capacity is approximately 20,000 movies per day, far greater than total requirements for the video distribution system of the invention.

[0057] Thus, according to this aspect of the invention, a portion of the total transmission capability of the DISH 500 system may be utilized to blanket transmit thousands of movies for preselection and recording by customers. In this regard, and as discussed in more detail in the Examples below, new release movies (e.g., the 100 most popular new release movies from major studios) may be transmitted several times per day with concentration before and during prime evening viewing periods, with a second tier of popular movies transmitted less often, but still at least daily, and third and fourth tiers of movies transmitted weekly/monthly—all in accordance with content listings and transmission schedules available to customers through their periodically updated electronic program guide.

[0058] It will be appreciated that instead of using more typical 120 watt DBS transponders, implementation of the

present invention may be carried out with higher power transponders (e.g., 240 watt transponders) to increase the effective transponder capacity (e.g., from 23 megabits/sec to 30 megabits/sec) by reducing much of the capacity allotted for forward error correction and system management inherent in lower power transponders. Also, along with the use of higher power transponders, the invention may be carried out with quantemary (QPSK) polarization to double the effective bit transfer rate for each transponder over that which may be obtained by using current orthogonal polarization—with a sacrifice in bit error rate that is acceptable for those applications of the invention where lower video and audio resolution is not an important consideration to the customer. Thus, the use of high power transponders (e.g., 240 watts or higher) in conjunction with higher level polarization (e.g., quantemary) permits video distribution systems of the invention to be implemented utilizing less of the DBS system's total transmission capacity, permits the transmission of a greater number of movies or other content, permits more frequent transmission of high demand (e.g., Tier **1**) movies and permits greater time compression of movies, or a combination of the above, all to the benefit of consumers.

User Station Details

[**0059**] **FIG. 4** is a block diagram showing components of a representative user station **28** consistent with the invention. The primary controller for station **28** is a central processing unit (CPU) **80** that includes a microprocessor, a non-volatile high speed memory device containing an operating system, a graphics generator, and additional peripheral devices, such as a clock, that are common in CPU devices.

[**0060**] Encoded programming data as a datastream via satellite downlink through antenna **24** is transmitted to a decoder **82**.

[**0061**] Decoder **82** looks for headers in the datastream indicating movies or other content that have been preselected for recording. The programming data includes video/audio content data, content availability/scheduling data and content pricing data. Decoded preselected movie data is transmitted via CPU **80** to a high speed memory buffer **84** (with or without high capacity storage capability) and then written to a high density record/playback drive **86**, such as a DVD drive associated with the DVD platter **46**. In certain embodiments, the high speed memory buffer **84** may utilize a magnetic drive, a magneto-optical drive, an optical drive, or other suitable drive. Buffer **84** may utilize DRAM, flash memory, SRAM or other suitable memory media such as digital tape.

[**0062**] As will be appreciated by those skilled in the art, in alternative embodiments the transmitted data may bypass CPU **80**.

[**0063**] An internal or external modem **87** connects to a phone line that provides communication to the central controller system **36**.

[**0064**] The content availability/scheduling data, content pricing data and time-based security codes B (discussed below) are transmitted at periodic intervals (e.g., every ten minutes, every hour or every day, as deemed most desirable by the video distribution system operator) and are routed from CPU **80** to RAM **88** where the information is stored and available.

[**0065**] Viewed-content information used for billing purposes, content preselection information entered by the user and time-based security key codes C (discussed below) are stored and available in SRAM **90**.

[**0066**] CPU **80** directly receives manual and infrared remote operation input data. Video display device **32** receives input from recorder **86** for playback of movies and receives graphics data from CPU **80** for display of an interactive program guide.

[**0067**] It is understood that important aspects of this invention may be provided by different electronics configurations such as a central server to support, and in certain cases to replace, functions carried out by the RAM, SRAM and DVD drive shown in **FIG. 4**. In addition, SRAM or a suitable high speed memory drive could be used to fulfill the function provided by RAM **88** (shown in **FIG. 4**). Other embodiments may include an additional disc drive in support of the system data storage and retrieval functions.

Viewer Interface/Interactive Program Guide

[**0068**] The viewer interface and interactive program guide will now be described in connection with how they permit a customer to review available movies, preselect movies for recording, playback movies for viewing and perform other associated functions.

[**0069**] Referring to **FIG. 5**, there is shown a representative screen **100** that is displayed on video display device **32** when a user initiates use of the system via on/off key **50**. By utilizing the four (up/down, left/right) keys of program selector **54** and by clicking on "Programs Recorded", the user may choose to first determine the status of the multiple (e.g., ten) disc positions in the DVD platter **46**, i.e., what movies are currently recorded and stored in the DVD platter **46** at which disc positions (or "slots"), which disc positions contain blank discs and which disc positions have no discs. **FIG. 6** shows a representative screen **110** indicating the status of each disc position. Once this information is displayed, the user may elect to playback a movie that is already on the platter, remove disc(s) for storage, etc.

[**0070**] After, or instead of, using the "Programs Recorded" function, the user may use the "Available Movies" function to scroll down through a listing of movies in the interactive program guide that, as shown in **FIG. 5**, may be based on various categories of available movies. For example, the first category of movies is new releases, which may be subdivided into, for example, comedy, action, drama, documentary, etc. After a particular category of movies is chosen (e.g., new releases/comedy), another screen **120** (**FIG. 7**) is displayed showing the titles (in this case, twenty titles) in this category. In order to preselect a title for recording, the viewer moves the cursor to the chosen title and presses the middle key of program selector **54**, the first press showing the current playback price and changing the background color of the display (indicating "selection mode") and the second press completing the selection.

[**0071**] It will be appreciated that the interactive program guide may include links to a short summary of a movie being considered, critical review(s) of the movie or a brief "clip" or preview of the movie. This information may be stored in internal memory, obtained through a link to the website of the video distribution system operator or obtained by direct Internet access to the websites of film producers, movie

rating services, etc. (See **FIG. 2A**.) Other suitable means for providing movie information may also be employed.

Program Security Utilizing Encoding Technology

[**0072**] As mentioned above, in certain embodiments consistent with the invention, programming security is best achieved by time-based coding, in combination with the utilization of security codes that are interlaced into the video frames.

[**0073**] The operating system of user station **28** utilizes standard interlaced encoding data that, as known in the art, prevents movies recorded by a customer at a user station from being played on other nonconforming playback devices (for example, standard DVD playback devices). In addition, recognizing the possibility of pirates utilizing data conversion technology to defeat this security technique so that bootleg copies could be run on other systems, and recognizing the prospect of recorded movies being played on user stations that are not current on payment or are otherwise unauthorized, the invention incorporates a time-based code key to assure that playback of recorded content can only occur on currently authorized user stations.

[**0074**] **FIG. 8** describes one preferred Level I time-based coding format wherein a first code key A comprises a 32-bit monthly code at the beginning of each transmitted movie. With one such code key provided for each month over an extended period of time, say 100 years, there is a total of 12×100=1200 32-bit code keys A per movie.

[**0075**] A second code key B comprises a 32-bit code for each month chosen by the video distribution system operator at the beginning of each month. Code keys B for all available movies are blanket transmitted to customer households each month by the data transmission means, preferably, satellite.

[**0076**] A third code key C comprises another 32-bit code for each available movie. Code keys C are delivered to each customer household by phone/modem on a monthly basis, preferably at the time of monthly billing queries from central controller system **36** to the household. The third code keys C are provided only when the customer household is current in payments and otherwise is in good standing.

[**0077**] The time-based coding of **FIG. 8** assures that a movie will playback at a specific user station only when all three code keys A (transmitted with the movie), B (chosen and blanket transmitted monthly) and C (delivered monthly by phone modem) are present, with the user station software simply verifying that C is the correct value when a predetermined mathematical function is applied to A and B.

[**0078**] Level II security coding comprises a 128-bit code interlaced through every third frame of the movie. This code, in conjunction with the decoding software of the unit's operating system, is used to assure that recorded movies can be played only on stations provided to consumers by the video distribution system operator. (The players incorporated into the user stations of the video distribution system simply read and ignore Level II code.)

[**0079**] Thus, recorded movies may not be played back on standard DVD players. However, even if a determined pirate were to defeat the Level II code to produce a disc playable on a standard DVD player, a pirated copy would be useful only until the end of the month, due to Level I time-based coding protection, discussed above.

[**0080**] Optional Level III coding may be utilized to relate Level I and Level II coding in a specific location in each movie over multiple frames where the Level II code is a more complex (e.g., 1024K) program requiring completion from the time-based coding of Level I.

[**0081**] In addition to the security means discussed above, preferably each user station **28** must be in an enabled state. In this regard, an enabling command from central controller system **36** (via phone/modem) may be sent monthly to each customer household that is in good standing.

[**0082**] To deter production of copies of movies recorded at input terminals of TV **32**, a digital watermark identifying the purchasing customer may be placed in the movie signal. The watermark would be unnoticable to a viewer but would allow copies of the movie to be traced to the original purchase site.

[**0083**] As an alternative to monthly billing queries by central controller system **36** to each customer household, monthly provision of code keys C and monthly provision of an enabling command to customer households in good standing, as described above, these functions may be carried out each time a movie is played back for viewing via a two-way communication between central controller system **36** and the customer household. To this end, when a customer initiates playback of a movie through the interactive controls, the playback information (the identity of the movie and the identity of the customer household) is communicated to central controller system **36** by phone/modem, at which time central controller system **36** verifies good standing status for the customer household and sends back a single code key C for the specific movie and an enabling code for the user station. Utilization of this form of communication between a user station and central controller system **36** at the time of every playback offers the advantage of the video distribution system operator not having to send thousands of key codes C (for all available movies) on a monthly basis to each customer household (where the key codes C must be stored in memory) and the further advantage of assuring good standing of the customer household's account prior to each movie playback. A further advantage is that customers' accounts may be billed more currently, at the time of each playback instead of monthly.

Central Controller System

[**0084**] Referring to **FIG. 9**, central controller system **36** will now be discussed in more detail. As discussed above, in one preferred embodiment, central controller system **36** provides the following functions:

[**0085**] 1. Stores a discrete address for each customer household.

[**0086**] 2. Transmits monthly billing query to each customer household to determine which preselected, recorded movies were viewed.

[**0087**] 3. Sends monthly transmission of time-based security codes "C" and an enabling command to each customer household that is current in its payments and otherwise is in good standing.

[**0088**] 4. Credits accounts of content providers for the use of their content through linkage to a financial network.

[**0089**] 5. Debits accounts of customers for movies viewed.

Alternative Data Transmission Technologies

[0090] Referring to **FIG. 2A**, several alternative data transmission technologies may be utilized in place of or in addition to direct broadcast satellite (DBS) which is discussed above.

[0091] A first option is data transmission by optical fiber employing suitable technology, preferably an optical fiber technology providing high transmission rates, for example OC3. A single OC3 optical cable transmits data at approximately 128 megabits/sec so that, at VHS resolution, it can transmit approximately sixty movies simultaneously at real speed, or transmit one movie every two minutes at a time-compressed speed.

[0092] Other options include cable/modem transmission, Internet connection, other suitable phone connections, or the use of higher or lower frequencies than KU if licensed for satellite-based content transmission, or a combination of any of the transmission means discussed herein.

[0093] It will be appreciated that video/audio content transmitted by any of the above means, whether transmitted at real time or at a time-compressed speed, may run in series for simultaneous recording on multiple stations at a consumer household.

Business Models

[0094] The present invention provides significant flexibility with respect to the business model to be used to commercialize the invention. In one simplified embodiment, shown in block diagram form in **FIG. 10**, the video distribution system operator interfaces with three parties: a data transmission provider, content providers, and consumers. The content providers provide content (e.g., music and movies) to the data transmission provider which, in turn, blanket transmits the content to the consumers, preferably by direct broadcast satellite. The satellite transmission also includes content availability/scheduling data and content pricing data, updated periodically. The content providers also provide copyright license and pricing requirements to the video distribution system operator. Both the data transmission provider and the content providers receive payments directly from the video distribution system operator. Lastly, the video distribution system operator periodically receives viewed-content information for billing, while also sending enabling commands to the consumers.

[0095] Other business models may utilize time-based security coding as discussed above. Also, the Internet may be used to provide centrally posted content availability information and permit preselection of movies for recording at the customer's household.

EXAMPLE I

[0096] The video distribution system of the present invention is implemented using the business model of **FIG. 10**, the DISH 500 DBS system, and the other hardware and software systems described above and illustrated in the drawing figures.

[0097] The video/audio content provided by the video distribution system is transmitted in real time (i.e., not time-compressed—average movie 110 minutes). The movies are blanket broadcast utilizing approximately 49% of the total capacity of the DISH 500 system, with transmission times heavily weighted for Tier **2**, **3** and **4** movies to off-peak broadcast hours (e.g., 1:00 am-8:00 am).

Movie "Hierarchy"

[0098] Tier **1**: The current 100 new release movies from major studios.

[0099] Tier **2**: The 6000 movies that are at the second level of consumer demand after the Tier **1** new release movies.

[0100] Tier **3**: The 8000 movies at the third level of consumer demand.

[0101] Tier **4**: 60,000 additional movies.

Transmission Schedule

[0102] Tier **1**: Each new release movie is transmitted every day on the hour from 4:30 pm to 8:30 pm, and at several other times daily.

[0103] Tier **2**: Each Tier **2** movie is transmitted once per day.

[0104] Tier **3**: Each Tier **3** movie is transmitted once per week.

[0105] Tier **4**: Each Tier **4** movie is transmitted once per month.

[0106] A consumer who wishes to plan ahead can easily record all new releases in the "comedy" category, for example, and have them available for viewing at his pleasure, with payment obligations arising only for those movies he actually views, when he views them. The same consumer or another consumer wishing to view a new release on the evening at which the viewing decision is made, simply preselects the movie for recording any time during the day so that it will be available during the evening viewing hours. An Internet phone/modem connection (not shown) may be provided so that consumers may access their user stations from remote locations (e.g., from their business offices) to preselect movies for viewing that evening.

[0107] The term "movies" as used in connection with the Examples, and as used at other times herein, encompasses more than the term traditionally implies. The term "movies" may encompass not only motion pictures and similar content, but also certain content that appears in the lower tiers, especially Tier **4**, such as classic sporting events (e.g., all Super Bowls) and popular TV series (e.g., all episodes of Star Trek or Sienfeld or J Love Lucy). In this regard, a customer who wishes to do so may record all episodes of I Love Lucy (transmitted monthly in Tier **4**) on DVD platter **46**, store the discs and play back selected episodes any time he desires, paying only when he views an episode or episodes.

EXAMPLE II

[0108] The video distribution system of Example II is implemented with the same tiers of movies as Example I with, the difference being that the Tier **1** movies are transmitted in compressed time format to high speed memory buffer **84** contained in user station **28** which, in turn, writes to recorder **86** at its maximum write speed. This compressed time transmission (e.g., 8 to 10 minutes per movie) permits consumers to have movies, particularly Tier **1** movies, available on short notice, often in a time less than or on the order of that time required for a round trip to a video rental

store. To further facilitate this enhanced availability of movies on short notice, according to Example II Tier **1** new release movies are transmitted every 30 minutes from 5:30 pm to 8:30 pm, and at several other times daily.

EXAMPLE III

[**0109**] Same as Example II except that all movies are transmitted in compressed time format.

EXAMPLE IV

[**0110**] The video distribution system of this Example IV is implemented with the same tiers of movies as Examples I-III. According to Example IV, drive **86** of user station **28** comprises a magneto-optical disc recording and playback device that has the capacity to write to a magneto-optical disc at write speeds on the order of 12 megabits/sec or greater, a write speed that is approximately 6 to 10 times the data stream speed for conventional VHS resolution video/audio transmission and playback (with conventional MPEG II compression). Utilizing an approximately 12 megabit/sec write speed, and a corresponding data transmission speed via DBS or other suitable transmission means, a movie may be transmitted in time-compressed format and recorded at 8 to 10 times real time, so that a 110 minute movie may be transmitted and recorded in approximately 11 to 14 minutes or less.

[**0111**] In order to provide ready consumer access to new-release movies, each of the 100 Tier **1** movies is broadcast from 6:00 p.m. to 9:00 p.m., at 15 minute intervals. Thus, during these prime time hours, a consumer may select any Tier **1**, movie and have it available for viewing within 15 to 30 minutes. (With faster transmission and write speeds the Tier **1** movie availability time period may be reduced accordingly.) As with Example II, the Tier **1** movies are also transmitted at several other times daily, for example, hourly.

[**0112**] According to Example IV, Tier **2**, **3** and **4** movies are also transmitted and written to discs in compressed time, for example, at approximately 12 megabits/sec or greater.

EXAMPLE V

[**0113**] The distribution systems described in Examples I-IV have the capability to transmit audio in compact disc (CD) quality or another form to a suitable storage medium such as read/write CD's, write only CD's, DVD, magneto-optical disc, digital tape or a central server. In this Example V, the consumer may choose any music selection from up to as many as 80,000 or more titles in a tiered transmission structure similar to Examples I-IV and use less than 10% of the existing DBS transmission capacity.

[**0114**] With music distribution under this Example V, the system allows the user to listen to the recording (e.g., CD) several times for free before the consumer is required to permanently select the CD. Once permanently selected, the CD receives a permanent enabling code and the consumer pays a one time fee—similar to the current one-time fee structure which is standard in the existing music distribution business model. The player then plays the CD through TV speakers or provides an audio output to an optional external audio system (**FIG. 2A**). This music distribution model eliminates a significant portion of the labor, real estate and transportation costs inherent in the current distribution models for music, much as the novel movie distribution model described herein eliminates costs in the distribution of movies as compared to current models. The music distribution model of this Example V may utilize DBS or the alternative data transmission means described above, either alone or in combination.

EXAMPLE VI

[**0115**] The distribution system of Example IV is augmented with CD quality music transmission capability where 10,000 titles per day are transmitted at a time-compressed speed of, for example, 12 megabits/sec or greater. The music transmission of this Example VI may be carried out by utilizing additional DBS capacity, by reducing the number of Tier **2** movies transmitted daily, by reducing movie transmission in other tiers, or by a combination of the above. As described above in connection with Example V, the customer may listen to the recording several times for free after the encoded transmission is stored (with or without the use of memory buffer **84**), before the purchase selection. Once the purchase selection is made, the recording preferably is written to a conventional CD so that it may be played back on conventional home or auto playback devices. To this end, user station **28** may include positions for holding and writing to conventional CD's—in addition to the ability to write to another medium such as DVD or magneto-optical discs used for storage of movies. In the alternative, once the recording is selected, it may be routed to the external audio system (**FIG. 2A**) which has its own CD read/write or write only device that will permanently write the selected recording to a CD that can be held in a single, stack or platter system.

One Alternative User Station Configuration

[**0116**] **FIG. 11** illustrates an alternative user station configuration that is substantially similar to user station **28** of **FIG. 1**, **2**, **2A** and **4**, with a primary difference being the use of a high capacity hard disk drive as the primary memory component. The encoded video content is scheduled and transmitted to the direct broadcast satellite up-link facility **200** by the video system distribution operator through system controller **36**. In addition, periodic digital program/pricing information is transmitted to up-link facility **200**, for example, every ten minutes. The digital video content and program/pricing information, once received by the appropriate satellite **20**, are then transmitted down to broad geographic coverage areas (i.e. "blanket transmitted") for user stations **228** to receive the downlink transmissions via the home user's satellite dish **24**. Data is then transmitted to a download module **220** contained in user station **228** where it is stored digitally in storage module **230**, preferably in a large hard disk drive having a storage capacity of 20 gigabytes, or more. The use of a hard disk drive of suitable size permits the storage of six to twenty or more movies at one time in storage module **230**. Thus, a video distribution system may be operated with customers storing and playing back movies solely by using the hard disk drive of storage module **230**. Additionally, for those customers desiring to build a library of movies, user station **228** may include an optional recording/playback device that records movies onto, for example, a DVD, and plays back these movies through user station **228** at any desired time, with customers paying only when they view the movies. While it is preferred that the movies in such a library remain fully encoded and

encrypted for playback only on a user station in the system operator's network, user station **228** may include a CPU or CODEC capable of real-time decryption and decompression as the movie is recorded to a storage medium such as a DVD, so that such movies may be played on a standard DVD player. The decryption/decompression process preferably processes digital watermarks in these recorded movies so that a unique customer or transaction number is hidden in the movie, thereby allowing a copy of the movie to be traced to its source. Suitable watermarking technologies are available to those skilled in the art.

[**0117**] The transmission of movies in compressed time format has been discussed above. This mode is particularly appropriate when larger hard disk drives are installed in the user station **228**. A typical VHS movie requires about 10 gigabits of storage (about 1.3 gigabytes), and an HD movie requires about 12 gigabytes of storage. Thus a 20 gigabyte hard drive could hold a dozen VHS movies or one HD movie. Typical receivers can receive a maximum of 27 megabits per second per transponder and current units can only receive one transponder at a time allowing downloading a typical 110 minute VHS movie in about eight minutes or an HD movie in about 55 minutes. Other receivers may contain multiple tuners allowing simultaneous downloading of several movies, or a movie and a CD, or several CD's while watching a live baseball game.

[**0118**] The sequence of operation for a customer of the system using user station **228** is summarized in **FIG. 12**, which is large self-explanatory. The illustrated modes of operation, following account set up, are identified as:

[**0119**] **1**. Selection

[**0120**] **2**. Ordering

[**0121**] **3**. Downloading

[**0122**] **4**. Viewing

[**0123**] **5**. Billing

[**0124**] **6**. Optional "Library" Copy Delivery.

"On-Demand" Movies

[**0125**] As discussed above, storage module **230** of user station **228** includes a storage medium (e.g., a hard disk drive) that stores each movie that the customer selects until such time as the customer either deletes the recording from memory, or the recording is written over when the storage medium's capacity is reached (e.g., on a "first in, first out" basis). When the user station is provided with a storage module **230** having a substantial data storage capacity, it is possible for many movies to be immediately available to the customer for viewing. For example, a user station in the form of a DBS (or cable) system "set top box" may have a hard disk drive with a storage capacity on the order of 20 Gigabytes or more, with most of the storage devoted to the movie storage function of storage module **230**. This storage medium permits the storage of approximately six to twenty, or more, compressed movies at all times in each customer's user station. The customer, therefore, at all times has immediate on-demand access to the movies in his storage module for viewing or permanent recording on his recorder (e.g., DVD writer). Movies on the hard disk drive preferably are stored in encrypted format to prevent piracy.

[**0126**] Thus, one advantage of a large storage capacity at storage module **230** is that a customer may maintain a significant number of movies in storage for a considerable period of time before having to make a decision on whether to view (and pay for) a particular movie. However, this large storage capacity opens up other possibilities, as well. For example, according to one manner of carrying out the invention, the system operator may automatically (i.e., without requiring customer preselection) download certain very popular movies (usually very popular new releases) to every customer storage module on a periodic basis, such as one featured movie every day. At one automatically downloaded movie per day to each customer, a fifteen movie storage capacity and a "first in, first out" write-over protocol would permit each automatically downloaded movie to remain in storage module **230** and available for on-demand viewing for approximately two weeks, with the exact time depending upon how many customer-selected movies are downloaded during that period. Thus, over any two week period, the system operator may automatically make available (at one automatic download per day) 14 popular movies for all customers, without the customers having to preselect anything. Of course, the preselection option for all catalog movies remains available at all times. It will be appreciated that the automatic downloading of movies to all customer user stations can be readily achieved by the system operator simply communicating (e.g., daily) to all user stations the ID header information for that day's automatically downloaded movie or movies. The user station downloads movies to the intermediate storage in storage module **230** just as if the recording had been preselected by the customer. The graphical user interface alerts the customer that the recordings are available by a cue such as "YOU'VE GOT FLICKS".

Using Customer Preference Information

[**0127**] In a more customer-specific manner of carrying out the invention, different sets of movies are automatically downloaded at customer user stations according to the movie preferences of the customer. For example, each customer may use the graphical user interface (see **FIG. 13**) to select those movie types (e.g., romantic comedy, documentary, action) they most prefer. The system operator uses this information to tailor the automatic downloads to that customer's user station accordingly. In a simple application, the system operator may create, for example, five to ten standard customer profiles so that each customer receives automatic downloads for the one of those profiles which he most closely matches. The objective is for the storage module **230** to have available for on-demand viewing a large percentage of the movies that any particular customer may be interested in at any given time—or at least have those movies available to the customer over a period of time as new entries into storage overwrite older entries, recognizing that at all times the customer is free to order any movie from the catalog.

[**0128**] As described above, the system operator may create, for example, five to ten typical customer profiles and assign each customer to one of these typical profiles according to movie preference information entered by the customer. Thereafter, the customer receives (e.g., daily) the automatically downloaded movies for his particular profile. However, in other embodiments of the invention, customer preference information may also be used in a more sophisticated fashion to a more detailed profile reflecting the

individual tastes of a customer or the tastes of the customer household family members. To this end, the customer may use the graphical user interface (**FIG. 14**) to enter movie preferences at a desired level of detail. As shown in **FIG. 14**, a first level of detail is the selection of one or several types of movies (similar to the selection made in connection with **FIG. 13**). In addition, the customer may go to a second step where each selected type of movie may be further subdivided by, for example, favorite movie star(s), top ten movies this month, etc. Other means for subdividing interest areas under a particular type of movie may be used (e.g., World War II,). However the expression of movie preferences is made, this information may be used alone, or in conjunction with other information, to permit the customer's user station to download to memory (e.g., fifteen movie capacity) an ongoing, rolling selection of movies that will most likely match the preferences of the customer.

[**0129**] Referring to **FIG. 15**, there is shown a block diagram that illustrates in schematic form the generation and use of customer preference information. **FIG. 15** shows portions of user station **228**, namely, the download module **220** with receiver and the storage module **230** for movie storage. The optional recorder for permanently recording nlibrary" movies (e.g., DVD burner) is also shown. As schematically shown between user station **228** and storage module **230**, apparatus **310** serves to read the ID headers on all of the broadcast movies and select for downloading to module **230** only those that are indicated as being desirable to the customer by the processed movie preference information.

[**0130**] **FIG. 15** also shows portions of central controller **36** that store and analyze customer preference information and customer order information, and generate from that information the individualized customer catalog" that determines which movies will be automatically downloaded at that customer's user station. To this end, controller **36** includes an individual customer preference information storage module **320**, a general population cluster preference database **330** and a customer catalog generator module **340**. Each customer's preference information is entered in the manner described above via the graphical user interface and is communicated to module **220** by phone/modem. In addition, the preference information of the entire customer population (or some subset thereof), as well as order data, is stored in module **330**. Information from modules **320** and **330** is analyzed to create an individual wcustomer catalog" for each customer via module **340**. The individual customer catalog data is communicated to the user station in each customer household and serves to assure that those movies that best fit the preference customer profile are the ones that are downloaded to storage module **230**. While a first-in, first-out protocol may be used for overwriting onto the hard drive of module **230**, the customer catalog information may serve to establish a different protocol that will overwrite the less likely to be purchased movies ahead of those recordings which, by analysis at module **340**, show more promise of being viewed by the customer. Certain new release movies in high demand within the customer's primary areas of interest may be designated to remain in storage for a minimum period of time, say one week, regardless of the "traffic" through storage module **230**.

[**0131**] Along with movies, there is blanket transmission of catalogs and other advertising or customer interest information. The storage and display of this information may be based on customer profiles. For example, an advertisement for a new movie that is expected to appeal to young adults, Julia Robert fans, and customers living in a particular geographic area would have this information contained in its header, and the receiver would recognize if any of its users are in any of these categories and will appropriately store or not store this advertisement on the hard drive, and may determine to display or not display this ad on the user's TV catalog. Similarly, advertisements for other related merchandise, like "Star Wars" paraphernalia, might also be displayed. Text describing individual movie stars or related events might also be stored with the catalog.

Promotion-Based Streaming

[**0132**] **FIG. 16** shows the use of promotion-based streaming to download movies at user stations **28** and **228**. A content provider (e.g., movie distribution company) may decide to push a selected movie as a promotion. The system operator packages the advertisements and movie and then broadcasts them for automatic downloading by all customers or by a selected group of customers based on the broad profile information developed by the operator (**FIG. 15**). The promotional movie is advertised to the customers through an advertisement that appears at the top of screens generated by the system, or by a flashing message such as, "YOU'VE GOT NEW FLICKS". Promotional movies are stored in storage module **230** until they are overwritten or deleted. As with the other means of providing movies for viewing, once the customer views the movie, the billing is consolidated in the customer's monthly statement. Promotional-based streaming may be accomplished typically in a relatively short period of time using appropriate bandwidth (e.g., one quarter transponder).

[**0133**] In applications of the invention where both movies and music are made available to customers, promotions may include movie soundtracks for movies that are being broadcast by DBS or cable. In this situation, prior to broadcast of the movie, the soundtrack is broadcast and automatically downloaded to all user stations. When the movie is broadcast, viewers of the movie are informed that the soundtrack for the very movie they are viewing is on their hard drive and available for immediate on-demand purchase. Purchases may be made during the movie by appropriate means; for example, a translucent icon may appear on the screen and purchase made by simply clicking on the icon. Or, the purchase can simply be made at the conclusion of the movie where, preferably, viewers are reminded that the soundtrack is available on their hard drive for on-demand purchase.

Alternative Embodiments: User Station Including a "Companion Set-Top Box" That is Backwards Compatible With Standard Satellite and Cable TV Boxes (**FIGS. 23 and 24**)

[**0134**] User stations **28** and **228** described above are largely self-contained units, that, in combination with the blanket broadcasts and central controller **36** of the system operator, enable a system customer to enjoy the benefits of the present invention. However, in those situations where a household already has an appropriate satellite or cable TV receiver box **600**, it may be desirable to provide an add-on or "companion" set-top box **610** (**FIGS. 23 and 24**) that connects to a bidirectional digital port of the existing box **600**. In this situation, companion set-top box **610** augments the functions provided by the standard satellite or cable box

600 to allow downloading, recording, playback and billing for compressed and encrypted video and audio (movies and songs), as well as providing specific marketing and profiling functions. Companion box **610** receives encrypted content either directly from the existing satellite or cable box **600** as shown in **FIG. 23** or, using its own tuner (not shown), may directly connect to a satellite dish or cable in parallel with the customer's satellite or cable box **600**. The customer's television **32** is connected directly to companion box **610** and video and audio outputs from satellite or cable box **600** are merged in the companion box.

[**0135**] Companion box **610** interacts with the customer by displaying menus and choices to the customer on the screen of the connected TV **32** and responding to customer input via IR port **615** from a standard TV remote, allowing a customer to call up menus, scroll through them and select material to be recorded or shown in the manner described above in connection with other embodiments. Additionally, companion box **610** may provide interactive TV capabilities that permit it to respond to a remote control input or a direct ordering device (DOD) input (also via port **615**) that communicates a customer's identification and allows limited selection and ordering functions.

[**0136**] Internally companion box **610** contains a high capacity storage device, such as a hard disk drive **620**, a read-write module **630** for reading and writing to removable media (e.g., a CD reader/writer), a decompression/decryption engine **640**, a modem **650** to provide "slow" connection to the central system computer **36**, and a microprocessor **660** capable of transferring digital streams among the other components as well as generating menus, conducting billing and profiling functions, and generally controlling the functions of companion box **610**.

[**0137**] Hard disk drive **620** (preferably more than 10 gigabytes and most preferably in the range of 60-144 gigabytes, or more) has the capability to store multiple compressed movies and songs as well as billing, profiling and interactive advertising information. Although hard disk drive **620** may be large enough to act as a library of songs and movies, its main function is to store content from earlier broadcast downloads that have yet to be viewed directly from hard disk drive **620** or stored on removable media. This content includes songs and movies requested by the customer; songs, movies, information or advertising material that has been cached for later display to the customer; catalog information; and software upgrades for box **610**. A portion of hard disk drive **620** may be allocated for advertising/information content that is matched to a customer profile. As described above, profiles may be based upon prior customer selections and customer-indicated interests. Maintaining customer profile information in a specially allocated part of the hard disk drive **620** allows profiling to occur mainly at the level of box **610** rather than at the level of central controller system **36**, and also allows the profile information to remain invisible to the customer. Preferably, customer-selected profile information may be adjusted or supplemented by communications from central controller system **36**, such as by profiling, storing and integrating customer-specific advertisements into the video presentation.

[**0138**] A desirable feature of box **610** is the ability to store content on removable media, such as CD's and DVD's. As described above, removable media allows creation of customer libraries of movies and songs that can be replayed on the box **610** or on remote fixed or mobile players that may be owned by the customer, by an acquaintance or provided for use by the general public, such as a seat-back video player in an airplane. Content stored on the removable media preferably is compressed and encrypted so that content providers can be assured to receive proper payment for viewing or use of the content. In one embodiment, customers purchase a limited number of plays when they write a CD, and box **610** or other players register each playing of the content so that the number of plays can be limited to the purchased number of plays.

[**0139**] As described above, in order to efficiently use broadcast bandwidth and to fit an entire movie with good quality on the removable media, powerful compression of content is desirable. As with other embodiments previously discussed, compression is performed prior to blanket transmission of the content to efficiently use bandwidth, provide secure transmission of the content, and achieve highest quality of compression by using sophisticated compression algorithms, engines and human judgment, when necessary. Decryption and decompression will be accomplished in box **610** (as well as in any other players) by a specialized algorithm or chipset.

[**0140**] Box **610** has the capability to communicate with central controller system **36** to conduct billing transactions (or simple extension of "credit" to the box), to receive scheduling, catalog or profiling information that is not received in digital form from the blanket broadcast, and to communicate other information such as customer profiles or registration information to central controller system **36**. This communication may be accomplished through modem **650** that is connected to a standard POTS phone line, a DSL or ethernet port connected to a digital network or an internal cell phone. In the future, the communication may be possible by transmissions from box **610** to central controller system **36** via satellite. Similarly, where appropriate, box **610** may use the communication capabilities of the customer's satellite or cable box **600** to achieve connection with the central computer system.

[**0141**] Microprocessor **660** within box **610** conducts the data transfer and communication functions of the box. This includes directing or handling the content bit-streams in or out of hard disk drive **620**, read/write media, or decompression engine, as well as communications with satellite or cable box **600**, IR remotes or DOD's, and modem. Microprocessor **660** may also generate or direct the generation of the graphics required for customer selections or functions such as interactive advertisements. Directing both content and customer data in and out of hard disk drive **620** also is done by microprocessor **660**. Interactions with the satellite or cable box **600** is also done by microprocessor **660** (for example, requesting box **600** to tune to a certain channel to receive a particular song or movie). As mentioned, in certain embodiments, microprocessor **660** may control a tuner for direct communication of transponder data into box **610**.

[**0142**] A video controller **680** (**FIG. 23**) functions to take the digital output from decompression engine **640**, combine it with other video or graphics and convert the result into a conventional video signal. Video controller **680** also allows conventional video signals from satellite or cable box **600** to

go directly to TV **32** when video from box **600** is being viewed. Video controller **680** may also place interactive video, such as a window of choice, information or video, into the normal picture. A request for an interactive video overlay or window comes from the customer via port **615**.

[**0143**] As mentioned above, preferably box **610** also has software applications that allow interactive TV purchasing or information requests by system customers. A remote control or dedicated ordering device that identifies the customer through an internal identification number and/or a user-entered pin code allows ordering a variety of merchandise (other than transmitted movies and music) through box **610**'s IR port, processor and modem communication link. Such a device allows ordering a variety of merchandise (other than transmitted movies and music) both at the customer's own box **610** as well as at a remote box, for example ordering and paying for a pizza while watching a football game at a friend's house. The remote control and/or dedicated ordering device also allow calling up interactive ads played through box **610**.

[**0144**] As described above, removable media containing movie or music content, for example writeable CD's or DVD's, are created at box **610** for later playback on box **610**. Additionally, these CD's or DVD's may be played at remote locations using mobile or mounted playback devices as shown schematically in **FIG. 25** and pictorially in **FIGS. 26 and 27**. CD's or DVD's may also be commercially distributed, for example by stewardesses for playback on long airplane flights or by public libraries. The playback devices shown in **FIGS. 25-27** are simple music or video players that include a reader mechanism **700** for the removable media (e.g., CD) on which the movie is recorded, a decompression/decryption engine **710**, a color screen with speaker (or headphone jack) **720** and a controller **730**. These playback devices present the media recorded on box **610**, much like small, portable CD players are used to listen to music today. In this case the material presented is primarily video and can serve as entertainment for adults or children during travel, for example/individual players with relatively small (e.g., four-inch to twelve-inch) screens on planes or in the back seats of automobiles. These playback devices may also be used for educational purposes by allowing students to use inexpensive media to view lectures by professors. The playback devices differ from laptop computers since they are smaller and less expensive without keyboards, batteries, hard disks or RAM. Furthermore, the playback devices are packaged to allow easy viewing and may be provided with specialized mounts to hold them at convenient viewing heights. The playback devices are not necessarily owned by an individual, but may be made available for public use.

[**0145**] In preferred embodiments, the playback devices accommodate pay-per-play media, for example, a movie CD that has been purchased at a price that allows three plays, by either affecting media as it is viewed, for example, by a laser mark that signifies one play has occurred, or by reading or marking a token, like a magnetic card, that accepts billing or accounting associated with each playing. In some embodiments, the token may be integrated into the CD, for example as a magnetic strip that adheres to a surface of the CD. Similarly, a CD may be recorded with a limit date on playback. For example, a CD may be purchased and written with a 24 hour limit on playback. In that case, the playback device contains a clock to assure the media is still within its purchase-to-play time. Other movies may be purchased with no restrictions on numbers of playings. The security of the content on the removable media may be secured against unauthorized playback by a number of means. One means is encryption and a proprietary decompression algorithm such as ZISC (described below), requiring a specialized chip to accomplish real-time decoding. Another means is by using a specialized hardware reader incorporating a laser reader of a particular wavelength that is generally unavailable to the public. For example, a companion box **610** and associated playback device may use blue lasers to record and playback on conventional CD's with much higher densities than possible with conventional 780 nM lasers. In this case, and as described in more detail below, by utilizing mostly mature, volume-produced conventional CD components, and only a few specialized parts such as the blue laser and a controller chip, costs are kept low while maintaining content security against unauthorized copying or playback.

[**0146**] As an alternative to mobile players that use removable media, a mobile player (**FIG. 28**) may incorporate a small hard drive of perhaps 10 gigabyte capacity that can be loaded with movies and songs from companion set top box **610**. Songs and movies are stored on the hard drive in the same encrypted, compressed format that is used for the removable media. Because hard drives are becoming smaller, the entire system with a hard drive can be made smaller than a mobile player having a removable media reader, and issues such as damage, loss or carrying CD's can be avoided. Typical uses of the mobile player of **FIG. 28** include loading several movies and songs for a long airplane trip, or for the children for a car trip. A mobile player with a disk drive may or may not incorporate a removable media reader since loading the hard drive could be accomplished by an electrical connection such as through a USB port.

Alternative Embodiments: Transmission and Storage of Highly Compressed Video Files

[**0147**] As mentioned above, utilizing current technology, transmission of the video portion of a movie at standard VHS quality for MPEG 2 compression requires approximately 2.4 megabits/sec of bandwidth. A 100-minute movie stored at this compression requires a file size on the order of 1.3 to 1.8 gigabytes, typically about 1.6 gigabytes, which can be stored on various media discussed above, but which is too large for a onesided compact disc (approximately 600 megabytes storage capacity) or a two-sided CD (approximately 1200 megabytes storage capacity). Preserving desirable (e.g., VHS quality) video playback for the consumer, while reducing these bandwidth and data storage requirements, is desirable, particularly if the movie file can be stored on a two-sided CD or, even more preferably, on a single-sided CD. (Preferably, current audio encoding/decoding technologies, such as those from MPEG, Microsoft, Liquid Audio or Dolby, can continue to be used for the audio portion of the movie.)

[**0148**] Several embodiments of video encoding, compression and processing that achieve the above goals will now be described with reference to **FIGS. 17-22**.

Video Encoding Utilizing Existing Codecs and an Upconverter (**FIG. 17**)

[**0149**] IBM Corporation (France) has developed a digital video upconverter, **1**C that performs real time upconversion

of an incoming video stream and outputs a video pixel stream at up to 3 times the input rate, for the purpose of providing a high definition (HD) or near HD signal to an HD digital TV from a relatively low resolution input. As its primary advantage, this IBM upconverter permits broadcasters to provide HDTV-like services without using the precious bandwidth that would otherwise be required. The IBM upconverter uses a combination of functions to increase the number of lines, remove interlacing, enhance pixelization through spatial and temporal interpolation and increase the frame rate enabling users with high resolution television sets to view high definition video with low resolution input. The IBM upconverter **1**C is described at http://www.fr.ibm.com/france/cdlav/video.htm, included in the attached appendix. Other suitable upconverters may be used.

[**0150**] According to the present invention, upconversion technology is used in a new way for image enhancement of a low resolution, blanket transmitted video input stream (e.g., at 0.8 megabits/sec) so that it can be displayed at an apparently higher resolution (e.g., VMS) at the customer's television. Referring to **FIG. 17**, the video portion of a movie is highly compressed using, for example, MPEG 2, MPEG 4 or DivX encoding to the lowest possible resolution that can be upconverted at the set top box to permit VHS quality viewing. In certain embodiments, this might be accomplished by shrinking a normal VHS picture from fullscreen to quarter-screen size and then compressing the screen comprising a quarter-screen image with the rest of the screen black. The highly compressed, low resolution video is blanket transmitted to the consumer's set top box where conventional decoding hardware (MPEG 2, MPEG 4, DivX) decodes the signal and an upconverter, preferably one employing three-dimensional spatial/temporal interpolation such as the IBM upconverter **1**C referred to above, increases the pixelization rate to a point where the quarter-screen video may be viewed by the consumer as a full-screen image. The compressed movie (video and audio) may be stored via a local hard drive for local temporary storage. It may also be stored via a CDR on a single-sided or double-sided CD prior to decoding and upconversion provided, as is in preferred embodiments, the total broadcast data will fit on a CD. It will be appreciated that the above described techniques of **FIG. 17** not only permit blanket transmission of the movie file using less bandwidth and the ability to store an entire movie on a CD, but also protects the transmitted content by degrading it before transmission and then using specialized processing at the set top box—a type of processing that is poorly handled on a PC and requires a specialized chip.

Video Encoding Utilizing Zero Instruction Set Computer (ZISC) Pattern Recognition on a Video-By-Video Basis (**FIG. 18**)

[**0151**] Another development by IBM Corporation (France) is a zero instruction set computer (ZISC) that utilizes an hardware implementation of artificial neural networks for noise reduction and image enhancement of a gray scale digital still image. By way of summary, the ZISC chip set (e.g., IBM ZISC036) can recreate images from pattern recognition learning. The ZISC chip set can be taught the difference between original and a degraded image (degraded from high compression or additive noise) by processing samples of each (the higher number of samples, the better the processing ability and resulting images) and then recreate the original image from an extremely poor quality or degraded image. A discussion of the ZISC technology can be found in "Noise Reduction and Image Enhancement Using a Hardware Implementation of Artificial Neural Networks", published in VI-DYNN'98-Virtual Intelligence-Dynamic Neural Networks-Stockholm, Sweden, Jun. 22-26, 1998, and in U.S. Pat. Nos. 5,621,863; 5,701,397; 5,710,869; 5,717,832; 5,740,326 and 5,943,670, the contents of which are incorporated herein by reference.

[**0152**] In accordance with the invention, and with reference to **FIG. 18**, a highly compressed version of the video (e.g., the video portion of a DVD movie) is created at encoder **502** with a compression method such as MPEG 2, MPEG 4 or DivX at the lowest resolution possible that will result in VHS quality output at the consumer's set top box (STB). This highly compressed, low resolution video is stored in database **504**, along with audio that is encoded using standard encoding/decoding technology as identified above. In certain embodiments of the invention, a 100 to 120 minute movie may be compressed in this manner to a file on the order of 500 to 600 megabytes or less, a file that can be stored on a single-sided CD, or alternatively, to about 1100 megabytes for storage on a two-sided CD.

[**0153**] In parallel, utilizing the zero instruction set computer's pattern recognition capabilities, the video portion of the DVD movie is sampled frame by frame at **510**. Each sample takes the form of a recognizable pattern that may be, for example, an 8 pixel by 8 pixel pattern that can be stored in 64 bytes. The number of samples per frame is at or near the number to effectively recreate the frame at VHS quality, for example, sampling about 1000 to 2000 samples per frame. As each frame is sampled, optimal patterns are stored. Optimal patterns are those permitting maximal enhancement of the video images that will be degraded by resolution reduction or additive noise prior to transmission. A typical movie has less than 300,000 frames to sample. The resulting database will be substantially less than 600,000,000 samples because so many of the samples can be reused. All of the resulting samples are stored as a digital neural archive (DNA) pattern library. Preferably, the patterns undergo comparison and consolidation at **512** and frame type categorization (described below) at **514**.

[**0154**] Once the frame patterns have been created and stored in the DNA library, the library of patterns is packaged up at **504** with the highly compressed version of the video, and with the encoded audio. For transmission, the entire contents of database **504** is sent. The DNA library of patterns for the movie can be sent and buffered first, followed by the highly compressed video content. Once the patterns are received at the customer's set top box, they are cached in memory for image enhancement to the video. The video content can be streamed in or stored for later playing. When the video is played, it is first decoded using a standard video decoding method (MPEG 2, MPEG 4, DivX) and then sent to the ZISC processor for enhancement with the pattern database. Thereafter, optionally, but preferably, the resulting images are sent directly to an upconverter to increase the pixelization rate, as described above in connection with **FIG. 17**.

[**0155**] It will be appreciated that for archiving and storage, the system only needs to store the patterns, along with the highly compressed video file (and the encoded audio). In

certain preferred embodiments of the invention, the entire movie, video and audio, and DNA library can be stored on a single-sided CD. Thus, in accordance with this aspect of the invention, the set top box may include a hard drive or other suitable memory device for local temporary storage, as well as a CD recordable device

[0156] (CDR) for recording movies onto one-sided (or, less preferably, two-sided) CD's for long-term movie storage and archiving.

Video Encoding Utilizing ZISC Pattern Recognition for any Video Source (**FIG. 19**)

[0157] Once a substantial number of videos have been successfully learned through pattern recognition methods described above, eventually there will be enough patterns in the DNA library that the library may be used to enhance virtually any type of video. Once this is accomplished, the DNA library becomes a database that no longer needs to be attached to the video file, but can be stored on remote devices (for example, on disc or ROM) for movie enhancement purposes. Thus, as shown in **FIG. 19**, the customer's set top box can include a stored universal DNA library so that the transmitted movies need not be accompanied by their own pattern library information. In this regard, the universal library may include libraries for various video types, for example, broadcast sports, old black-and-white movies, animation movies, or other broad color palette video types.

[0158] Referring to **FIG. 21**, it will be appreciated that patterns can be grouped in the DNA pattern library by frame type. Grouping in this manner enables the library to be further categorized and to reduced access speed to the library by the ZISC processor.

[0159] Referring to **FIG. 22**, it will also be appreciated that as a video file is being scanned, the specific frame types may be noted and stored in the DNA pattern library. The library pattern groups are grouped by the most likely patterns to be used for a given frame type in the video. The goal is to reduce the number of patterns and to group them to the point that they can be stored and read as needed from the ZISC processor.

[0160] Thus, the ZISC-enabled compression technology described above relies on a DNA library of small image types (for example", 8 by 8 pixels) to decode. The library is valuable because:

[0161] 1. It provides extra security, especially if the library is communicated separate from the media and stored in the set top box.

[0162] 2. It may allow a higher level of compression of the media so the compressed video with or without its respective library information can be stored on a single CD.

[0163] 3. It may provide extra security by requiring a hardware chip whose functions cannot be run quickly on a PC type processor.

Video Encryption Utilizing ZISC Noise Reduction (**FIG. 20**)

[0164] The embodiment of **FIG. 18** can be further enhanced by adding noise to the transmitted video as a type of copy protection, with the noise being capable of removal by the ZISC processor. This noise is added based upon the premise that, at some point, the quality of the transmitted video content is so poor that it is not worth duplicating or copying the digital source. In preferred embodiments (**FIG. 20**), a uniform pattern of noise is added to each frame of the movie. To enable the best enhancement by the ZISC processor at the set top box, preferably care is taken to restrict the character and the location of the noise to specific areas of the video frames so that noise reduction and removal by the ZISC processor is optimized. (Obviously, noise will not be used to distort the transmitted DNA library.) Coordination between noise distribution and initial pattern recognition points assure that the associated category pixels of the degraded video are not changed by added noise. Another benefit to adding the noise in the form of uniform noise from frame to frame is the additional compression ratios that can be achieved due to identical pixels throughout the entire video.

Alternative Embodiments: Increasing "CD" Data Storage Capacity by Storing Video and Audio Files on CD's Read by Short Wavelength Lasers (i.e. 620 nM and below)

[0165] As discussed elsewhere herein, in certain applications of the invention it is desirable to place VHS-quality (or better) movies on robust, inexpensive, storage media that can be stored in a "video library" for playback on a set top box or on a simple, mobile video playback station, for example, a unit having a four-inch to twelve-inch color screen that can be used by children traveling in a car on a family vacation. In these embodiments, the storage media should be physically robust to survive vigorous handling, and inexpensive to encourage users to create a large library that is frequently used. Writable CD's that now cost on the order of $0.20 or less per CD provide the low-cost, ruggedness, and long life that meet library needs. Additionally, CD readers and writers are a mature technology and relatively inexpensive due to the use of CDs for both music and consumer computers.

[0166] Fitting an entire movie on a single CD using conventional compression algorithms requires accepting slightly sub-VHS video quality. A two-hour, VHS-quality video stream is about 35 gigabytes (320 by 240 pixels per frame, 60 frames per second, 7200 seconds) of information. Using a conventional MPEG-2 encoder/decoder running at 2 to 4 megabits per second, several 650 megabyte CD's are required to store a single movie. With an MPEG-4 compression codec, a 95 minute movie can be encoded in 850 Mbytes with slight reductions in video quality such as slightly reduced color depth, slight splotching of colors in large areas of uniform color, loss of details in some objects (like a face in a crowd of people), slight jerkiness in slow pans and occasional dropped frames in action scenes. Furthermore, with this sort of compression, even a fast computer like a a 900 MHz Pentium computer sometimes saturates and must drop frames during decoding. Similarly, a more advanced contemporary compression algorithm, tuned by experienced compression operators, allows a 95 minute movie (with audio) to be stored in 630 megabytes on a conventional CD, although the quality is noticeably below that of conventional VHS tape.

[0167] Multi-layer or two-sided CD's allow sufficient storage capacity for a two-hour movie using current compression techniques. However, the higher cost of the CD's and

writers of these low-volume technologies lessens their appropriateness to the present invention's low-cost library application.

[0168] As is known to those skilled in the art, the amount of information that can be stored on a single-sided, single-layer CD is limited by the size of the diffraction pattern of light from the laser and optics used to read the disk. Spot size is defined as the half-intensity diameter of the Airy diffraction pattern (see *Principles of Digital Audio.* 4th edition, by Ken Pohlmann, published by Howard W. Sams and Co., 1985) where spot diameter, d=(0.61)×(light wavelength/numerical aperture). In conventional CD players, the numerical aperture is 0.45. Larger values of numerical aperture require tighter positional tolerances including depth of focus, skew tolerance and disk thickness. Only small (less than 30%) increases in numerical aperture are technically feasible since tolerance requirements scale to the second through fourth power of numerical aperture. Increasing the numerical aperture from 0.45 to 0.60 result in higher costs of disks and readers and a less robust playback system.

[0169] On the other hand, the technology of blue and other short-wavelength lasers (i.e., below about 530 nM wavelength) is rapidly evolving using materials such as indium gallium nitride that have wider band gaps. Currently, 3 to 5 mW blue lasers are available, and 10 mW lasers below 530 nM are under development. According to the invention, these lasers are cost-effective for writing conventional CDs. By way of comparison, current CD readers for music and computers use 780 nanometer lasers and 0.45 numerical apertures for spot sizes of 1.06 micrometers (uM) resulting in pitland lengths of 0.83 micrometers and track pitches of 1.6 uM. By using short wavelength lasers, for example 410 nM, and optics with 0.45 numerical aperture the information capacity of a CD nearly quadruples as spot size becomes 0.56 uM allowing pit/land lengths of 0.43-uM and track pitches of 0.84 uM. Furthermore, because data may be conventionally stored as a single helical track with conventional feedback-based radial positioning and servo controlled disk rotation rate, the technology and mechanisms used to produce today's low-cost CD readers and writers easily adapt to the higher densities. Thus, a single-sided, single-layer CD may hold 2.3 gigabytes of data when read with a 410 nM laser and detector. This allows conventional inexpensive CD's to hold a two-hour movie with VHS quality playback using conventional compression algorithms and decoding chips that are currently available. A description of short wavelength laser diodes is contained in U.S. Pat. No. 5,912,477, incorporated herein by reference in its entirety.

[0170] As another approach, conventional CD's of the CR-RW type may be provided with higher capacity by forming smaller pits that are spaced closer together using 620 nM rather than 780 nM lasers. Using the same optics with this shorter wavelength light, hence the same numerical aperture, and the same track pitches, this allows approximately 26% more data to be stored on the CD. Manufacturing tolerances established for CD's, such as hole concentricity, make it less desirable to reduce the track pitch, however, improvements in the error correction coding scheme may allow still closer pit spacing and higher densities.

[0171] The use of this 620 nM read/write system permits storage of 880 Mbytes or more per CD in a proprietary format that is not conveniently readable by standard CD or DVD readers. Thus, this system, coupled with the video distribution system operator's control of broadcast and encoding/decoding parameters, provides the structure for security of transmitted content that is required by the content providers.

[0172] It will also be appreciated that the storage medium may be in the form of a multiple layer CD-like medium that is read and written to by multiple light sources of different wave lengths. In this embodiment, the medium may include a first data storage layer that is read and written to by a longer wavelength light source, for example 620 nM, overlaid by a second data storage layer that is read and written to by a shorter wavelength light source, for example, 410 nM, with a light filter in between that blocks light having wavelength less than about 620 nM. This system accomplishes the goal of providing an information storage capacity that is well above that of a conventional CD, and the ability to secure the transmitted content through a proprietary system.

[0173] Alternately, DVD or another read/write technology, when made sufficiently robust and inexpensive, can be used as the storage media for the invention's system of video distribution, library storage and playback when coupled with sufficient security measures.

Ensuring Flawless Movie Recordings Using Checksums and Multiple Downloads

[0174] Satellite receivers do not have perfect reception due to the tradeoff between electrical power and bandwidth of the satellite. Weather conditions, motion of atmosphere layers or obstructions between the dish and the satellite may interrupt the signal. A momentary loss of bits will cause a video image to freeze for a frame or two, while longer interruptions will cause reception to blank. Whereas a short loss in video is a couple of frozen frames, data loss in audio may leave a glaring blank. Therefore, a satellite system for transmission of movies and/or music preferably should include a method to detect and fix data losses at the receiver.

[0175] Patching data "potholes" requires a method for sensing potholes and another for placing "asphalt" to fill them. Typically, digital data is sent in packets of bits (perhaps one thousand bits at a time with each packet containing 1/40 second of music). Loss of bits within a packet can be detected by error codes or merely a "checksum" at the end of the packet which indicates the sum of all the sent bits. Each packet may have an identifying number so that loss of an entire packet is noticed. This is all conventional Internet technology.

[0176] Repairing data loss might be accomplished by replacing an occasional packet by the receiver asking for a copy of the packet via an Internet or modem phone connection. However, the frequency of data loss and amount of contiguous data might be lost (for instance, during a rainstorm), requires a wider bandwidth, like the satellite, to provide the material to repair data loss.

[0177] Therefore, in certain embodiments, the present invention provides the capability in the system to detect bit losses and receive a second copy of the selection and use all or part of that copy to patch the missing or corrupted bits or packets in the original download. This would require storing a requested download on the storage medium (e.g., hard

drive), checking for missing data, informing the customer that the download was imperfect, then receiving and storing all or part of a second (or rarely a third) transmission, and then selecting good packets of bits to make up the final copy.

[0178] In practice, a customer selects a movie or music selection via the TV-remote interface and the TV screen notes a download, say, 45 minutes later. As soon as the download is completed, the customer is informed of the quality of the download (A, B, C, D) and informed of the time of the next transmission of the material. The customer has the option of viewing the less-than-perfect movie, or even burn a CD if they wish. Or the customer can wait for a better version.

[0179] While the present invention has been described in connection with certain illustrated embodiments, it will be appreciated that modifications may be made without departing from the true spirit and scope of the invention. For example, the term "video display device" has been used herein in its broadest sense to refer to any suitable video imaging system, such as a television, computer monitor, plasma screen, LED display, liquid crystal display, 3D imaging system, or the like, understanding that an appropriate audio capability is provided. Also, while a DVD RAM platter system has been described as one preferred recording and playback device, both at real time and time-compressed transmission speeds and write speeds to the discs-, other systems may be used, alone or in combination, such as magneto-optical disc, digital tape, VHS tape, a central or auxiliary server (optical, magnetic or magneto-optical). The discrete storage media of any one of these alternative devices may be arranged in a platter or stack or other suitable format to provide the user access to multiple stored audio/video content stored thereon. These and other modifications are deemed to be within the true spirit and scope of the invention.

That which is claimed:

1. A method of distributing digital data content to a consumer comprising:

transmitting a plurality of the digital data content to the consumer; permitting the consumer to preselect desired digital data content from the plurality of digital data content received at a consumer location;

permitting the consumer to create a copy of any of the preselected digital data content to a removable storage medium; and

transmitting digital data content information from the consumer to a remote location to verify that a preselected digital data content has been copied to the removable storage medium and displayed therefrom, wherein the removable storage medium is a CD which is read with a laser having a wavelength shorter than about 530 nM.

2. The method of claim 1, wherein the removable storage medium is a CD which is read with a laser having a wavelength about 410 nM.

3. The method of claim 1, wherein the laser is formed using a wide band gap material.

4. A method of distributing digital data content to a consumer comprising:

transmitting a plurality of the digital data content to the consumer;

automatically selecting desired digital data content from the plurality of digital data content according to a predetermined criteria for storage on a removable storage medium;

permitting the consumer to create a copy of any of the selected digital data content to a removable storage medium; and

transmitting digital data content information from the consumer to a remote location to verify that a selected digital data-content has been copied to the removable storage medium and displayed therefrom, wherein the removable storage medium is a CD which is read with a laser having a wavelength shorter than about 530 nM.

5. A method of distributing digital data content to a consumer comprising:

transmitting a plurality of the digital data content to the consumer; automatically selecting desired digital data content from the plurality of digital data content according to a predetermined criteria for storage on a removable storage medium;

permitting the consumer to create a copy of any of the selected digital data content to a removable storage medium; and

transmitting digital data content information from the consumer to a remote location to verify that a selected digital data content has been copied to the removable storage medium and displayed therefrom, wherein the removable storage medium is a CD or DVD and wherein the removable storage medium is a CD which is read with a laser having a wavelength about 410 nM.

6. The method of claim 5, wherein the laser is formed using a wide band gap material.

7. A system for distributing digital data content to a consumer comprising:

first transmitter, configured to transmit a plurality of the digital data content to the consumer;

a receiver configured to receive the plurality of digital data content and permitting the consumer to preselect desired digital data content from the plurality of digital data content received at a consumer location;

a removable storage memory for storage of the preselected digital data content;

a playback device for permitting the consumer to display any of the preselected digital data content from the removable storage memory; and

second transmitter, configured to transmit digital data content displaying information from the consumer to a remote location to verify that a preselected digital data content has been copied to the removable storage medium and displayed therefrom, wherein the removable storage memory is a CD which is read with a laser having a wavelength shorter than about 530 nM.

8. The system of claim 7, wherein the removable storage memory is a CD which is read with a laser having a wavelength about 410 nM.

9. The system of claim 7, wherein the laser is formed using a wide band gap material.

10. A system for distributing digital data content to a consumer comprising:

a first transmitter, configured to transmit a plurality of the digital data content to the consumer;

a a receiver configured to receive the plurality of digital data content and automatically selecting desired digital data content from the plurality of digital data content according to a predetermined criteria;

a removable storage memory for storage of the selected digital data content;

a playback device for permitting the consumer to display any of the selected digital data content from the removable storage memory; and

a second transmitter, configured to transmit digital data content displaying information from the consumer to a remote location to verify that a selected digital data content has been copied to the removable storage medium and displayed therefrom, wherein the removable storage memory is a CD which is read with a laser having a wavelength shorter than about 530 nM.

11. The system of claim 10, wherein the removable storage memory is a CD which is read with a laser having a wavelength about 410 nM.

12. The system of claim 10, wherein the laser is formed using a wide band gap material.

13. A user station for displaying digital data content, the user station comprising:

a a receiver configured to receive a transmission of a plurality of digital data content;

a removable storage memory; and

a selection mechanism configured to inform the user of the plurality of digital data content received, for selecting from the plurality of digital data content for storage in the removable storage memory, and for selecting from the digital data content stored in the removable storage memory for display, wherein the removable storage memory is a CD which is read with a laser having a wavelength shorter than about 530 nM.

14. The user station of claim 13, wherein the removable storage memory is a CD which is read with a laser having a wavelength about 410 nM.

15. The user station of claim 13, wherein the laser is formed using a wide band gap material.

16. A user station for displaying digital data content, the user station comprising: a receiver for receiving a transmission of a plurality of digital data content;

a removable storage memory;

an automatic selection mechanism configured to automatically select from the plurality of digital data content for storage in the removable storage memory; and

a selection mechanism configured to inform-the user of the digital data content automatically selected and for selecting from the digital data content stored in the removable storage memory for display, wherein the removable storage memory is a CD which is read with a laser having a wavelength shorter than about 530 nM.

17. The user station of claim 16, wherein the removable storage memory is a CD which is read with a laser having a wavelength about 410 nM.

18. The user station of claim 16, wherein the laser is formed using a wide band gap material.

19. A storage medium having at least one track having data stored thereon in the form of pit and land lengths and a track pitch, the data having been stored by a process comprising writing the pits and land lengths with a laser having a wavelength shorter than about 530 nM.

20. The storage medium of claim 19, wherein laser has a wavelength about 410 nM.

21. The storage medium of claim 20, wherein the track pitch is about 0.84 uM.

22. A device for writing to a storage medium, the storage medium having at least one track having data stored thereon in the form of pit and land lengths and a track pitch, the device comprising a laser for writing the pits and land lengths having a wavelength shorter than about 530 nM.

23. A device for reading data from a storage medium, the storage medium having at least one track having data stored thereon in the form of pit and land lengths and a track pitch, the device comprising a laser for reading the pits and land lengths having a wavelength shorter than about 530 nM.

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