PTO/SB/81 (11-08)
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POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	90/009,329
Filing Date	November 10, 2008
First Named Inventor	James M. BARTON
Title	Multimedia Time Warping System
Art Unit	3992
Examiner Name	FERRIS, Fred
Attorney Docket Number	2513.002REX0

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: **26111**

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number: **26111**

OR

☐ Firm or Individual Name				
Address				
City		State		Zip
Country				
Telephone		Email		

I am the:

☐ Applicant/Inventor.

OR

☐ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____

SIGNATURE of Applicant or Assignee of Record

Signature		Date	2/10/09
Name	MATTHEW ZINN	Telephone	(408) 519-5100
Title and Company	SVP, GENERAL COUNSEL TIVO INC		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Electronic Acknowledgement Receipt

EFS ID:	4815377
Application Number:	90009329
International Application Number:	
Confirmation Number:	2859
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Customer Number:	29989
Filer:	Lori Ann Gordon/Maya Bennett
Filer Authorized By:	Lori Ann Gordon
Attorney Docket Number:	454032800200
Receipt Date:	18-FEB-2009
Filing Date:	10-NOV-2008
Time Stamp:	16:22:10
Application Type:	Reexam (Third Party)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2513002REX0POA.pdf	106465 a33e96c4f0ac14d37e75c85da036861e329b27c8	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Power of Attorney	2	2
Warnings:			
Information:			
	Total Files Size (in bytes):	106465	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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* Admitted only in Virginia
•Practice Limited to Federal Agencies

February 18, 2009

WRITER'S DIRECT NUMBER:
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Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Re: Reexamination of U.S. Patent No. 6,233,389
Reexam Control No. 90/009,329; Filed: November 10, 2008
For: **Multimedia Time Warping System**
Inventors: BARTON *et al.*
Our Ref: 2513.002REX0

Sir:

Transmitted herewith for appropriate action is the following document:

1. Certification of Service on Third Party Requestor of Power of Attorney or Revocation of Power of Attorney with a New Power of Attorney and Change of Correspondence Address.

The above-listed document is filed electronically through EFS-Web.

Fee payment is provided through online credit card payment. The U.S. Patent and Trademark Office is hereby authorized to charge any fee deficiency, or credit any overpayment, to our Deposit Account No. 19-0036.

Respectfully submitted,
STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Edward J. Kessler
Attorney for Patent Owner
Registration No. 25,688

EJK/LAG:mlb
Enclosures
942278_1.DOC

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Under Reexamination: 6,233,389
Reexamination Control No.: 90/009,329
Examiner: Ferris, Fred
Art Unit: 3992

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

CERTIFICATION OF SERVICE OF POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

In compliance with 37 C.F.R. § 1.550(f), the undersigned, on behalf of the patent owner, hereby certifies that a copy of this paper has been served on the third-party requester by first class mail on February 18, 2009. The name and address of the party served is as follows:

David L. Fehrman
Morrison & Foerster, LLP
555 W. Fifth Street, Suite 3500
Los Angeles, CA 90013

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Edward J. Kessler
Attorney for Applicant
Registration No. 25,688

Date: February 18, 2009

1100 New York Avenue, N.W.
Washington, D.C. 20005-3934
(202) 371-2600

942269_1.DOC

Electronic Acknowledgement Receipt

EFS ID:	4816283
Application Number:	90009329
International Application Number:	
Confirmation Number:	2859
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Customer Number:	29989
Filer:	Lori Ann Gordon/Maya Bennett
Filer Authorized By:	Lori Ann Gordon
Attorney Docket Number:	454032800200
Receipt Date:	18-FEB-2009
Filing Date:	10-NOV-2008
Time Stamp:	16:56:16
Application Type:	Reexam (Third Party)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2513002REX0certificationofservice.pdf	76286 a5e78209bc22220ab10b5dbd137801f285b74465	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Reexam Certificate of Service	2	2
Warnings:			
Information:			
	Total Files Size (in bytes):	76286	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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New International Application Filed with the USPTO as a Receiving Office
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UNITED STATES PATENT AND TRADEMARK OFFICE

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Bib Data Sheet

CONFIRMATION NO. 2859

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
90/009,329	11/10/2008 RULE-	386	3992	454032800200

APPLICANTS

6233389, Residence Not Provided;
TIVO, INC.(OWNER), SUNNYVALE, CA;
DISH NETWORK CORPORATION(3RD.PTY.REQ.), ENGLEWOOD, CO;
MORRISON & FOERSTER LLP, LOS ANGELES, CA

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

This application is a REX of 09/126,071 07/30/1998 PAT 6,233,389

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

Foreign Priority claimed	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☐ no			61	4
35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged Examiner's Signature Initials				

ADDRESS
26111

TITLE
MULTIMEDIA TIME WARPING SYSTEM

FILING FEE RECEIVED		
2520	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
90/009,329	11/10/2008	6233389	454032800200

CONFIRMATION NO. 2859

POA ACCEPTANCE LETTER

26111
STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.
1100 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

Date Mailed: 02/23/2009

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/18/2009.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/sdstevenson/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
90/009,329	11/10/2008	6233389	454032800200

CONFIRMATION NO. 2859

POWER OF ATTORNEY NOTICE

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2055 GATEWAY PLACE
SUITE 550
SAN JOSE, CA 95110

OC000000034671273

Date Mailed: 02/23/2009

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/18/2009.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/sdsteyenson/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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May 27, 2009

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Commissioner for Patents
PO Box 1450
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Re: Reexamination of U.S. Patent No. 6,233,389
Reexam Control No. 90/009,329; Filed: November 10, 2008
For: **Multimedia Time Warping System**
Inventors: BARTON *et al.*
Our Ref: 2513.002REX0

Sir:

Transmitted herewith for appropriate action is the following document:

1. Petition of Patent Owner Under 35 U.S.C. § 181, 182, and/or 37 C.F.R. 1.183 to Vacate the Order Granting Second Reexamination Request;

2. Certification of Service of Petition of Patent Owner Under 35 U.S.C. § 181, 182, and/or 37 C.F.R. 1.183 to Vacate the Order Granting Second Reexamination Request;

3. Petition of Patent Owner under 37 C.F.R. § 1.182 to Temporarily Suspend *Ex Parte* Reexamination Proceeding;

4. Certification of Service of Petition of Patent Owner under 37 C.F.R. § 1.182 to Temporarily Suspend *Ex Parte* Reexamination Proceeding; and

5. Online Credit Card Payment Authorization for $800.00 to cover two (2) petition fees.

The above-listed documents are filed electronically through EFS-Web.

Fee payment is provided through online credit card payment. The U.S. Patent and Trademark Office is hereby authorized to charge any fee deficiency, or credit any overpayment, to our Deposit Account No. 19-0036

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Edward J. Kessler
Attorney for Patent Owner
Registration No. 25,688

EJK/LAG:mlb
Enclosures
984185_1.DOC

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re reexam of: U.S. Patent 6,233,389 (Barton)	Confirmation No.: 2859
Reexam Control No.: 90/009,329	Art Unit: 3992
Filed: November 10, 2008	Examiner: Ferris, Fred
For: **Multimedia Time Warping System**	Atty. Docket No.: 2513.002REX0

PETITION OF PATENT OWNER
UNDER 35 U.S.C. § 181, 182, AND/OR 37 C.F.R. § 1.183 TO VACATE THE ORDER GRANTING SECOND REEXAMINATION REQUEST

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

TiVo Inc., ("TiVo") the owner of U.S. Patent 6,233,389 (the '389 patent) petitions the Director, under 37 C.F.R. §§ 1.181 and/or 1.182, to vacate the January 7, 2009 Order Granting the Second Request for *Ex Parte* Reexamination (the "Second Order") filed by Dish Network Corporation, formerly EchoStar Communications Corporation[1]. The reexamination statute allows for the grant of a reexamination only when the request establishes a ***substantial*** new question of patentability. 35 U.S.C. §§ 302-303. To establish a substantial new question of patentability, a reexamination request must demonstrate that the proposed question of patentability is different from and non-cumulative to questions raised in previous examinations. MPEP § 2216. Additionally, when the request relies on a previously considered reference, the request must include evidence that the previously considered reference is being presented in a "new light." That is, the request must present ***substantial evidence*** that the previous Examiner did not properly understand the reference or did not

[1] For ease of discussion, both Dish Network Corporation and EchoStar Communications Corporation are referred to herein as "EchoStar."

consider a portion of the reference in making the prior decision on patentability. H.R. Rep. 107-120, p. 3.

EchoStar's Second Request for reexamination was based solely on two references that were considered in the first reexamination. EchoStar, however, failed to meet its burden of showing how the question of patentability raised in the second request was different from and non-cumulative to those raised in the previous examination of the '389 patent. Additionally, EchoStar failed to meet is burden of providing substantial evidence that the Examiners in the previous examination proceedings did not properly understand the previously considered references presented in the second request. By granting the Second Request, which lacked a showing of a substantial new question of patentability, the United States Patent and Trademark Office ("the Office") took an action that negated the protections guaranteed to TiVo under 35 U.S.C. § 303. As such, the Order granting the Second Request for Reexamination was *ultra vires* and must be vacated.

The present petition goes to the jurisdiction of the Office to order reexamination of the '389 patent based on the November 10, 2008 request for reexamination. Because subject matter jurisdiction may be raised at any time, the provision of 37 C.F.R. § 1.181(f) limiting the time period for filing a petition in response to an action or notice from which relief is requested is not applicable to the present petition. *See Fanning et al v. West, Secretary of Veterans Affairs*, 160 F.3d 717, 720 (Fed. Cir. 1998)("A party, or the court sua sponte, may address a challenge to subject matter jurisdiction at any time, even on appeal."); *see also In re Swanson*, 540 F.3d 1368 (Fed. Cir. 2008) (existence of a substantial new question of patentability raised for the first time in response to the first Office Action.)

Although TiVo does not believe that a waiver of 37 C.F.R. § 1.181(f) is necessary for the Office to consider the present petition on its merits, it is respectfully requested that a

waiver of 37 C.F.R. § 1.181(f) under 37 C.F.R. § 183 be granted if the Office deems such to be necessary.

I. PERTINENT FACTS

PTO Proceedings	Litigation
1. U.S. Patent No. 6,233,389 ("the '389 patent"), entitled "Multimedia Time Warping System" was filed on July 30, 1998 and issued on May 15, 2001. The term of the '389 patent expires on July 30, 2018.	
	2. On January 5, 2004, TiVo filed suit against EchoStar Communications Corporation in the United States District Court for the Eastern District of Texas, Marshall Division, *TiVo Inc. v. EchoStar Communications Corporation, et al*, Civ. No. 2:2004CV-00001, for infringement of the '389 patent.
3. On October 17, 2005, EchoStar filed a request for *ex parte* reexamination of claims 1, 6, 20, 21, 23, 32, 37, 51 and 52 of the '389 patent.	
4. On December 15, 2005, the request for reexamination was granted and assigned Control No. 90/007,750. In the Order Granting Request for *Ex Parte* Reexamination ("First Order"), the Examiner *sua sponte* examined all claims, including claims 31 and 61, expressly stating that **"All claims will be reexamined."** (*See* First Order, p. 12.) The reexamination proceeding was conducted by Examiner Harvey and Examiner Escalante of the Central Reexamination Unit.	
	5. Following a trial on the merits, the jury awarded TiVo damages totaling nearly $74,000,000. The jury and the Court rejected EchoStar's invalidity defenses. The jury verdict was filed on April 13, 2006. On August 17, 2006, the District Court entered judgment on the merits and issued a permanent injunction against EchoStar. EchoStar appealed to the Court

of Appeals for the Federal Circuit.

6. On May 25, 2006, the Examiner issued a first, non-final Office action ("the First Office Action"). The first Office Action discussed, on the record, over two dozen prior art documents, including U.S. Patent Nos. 5,949,948 and 6,304,714 to Krause. Additionally, **the first Office Action stated with respect to claims 31 and 61, "[t]he prior art of record does not show or suggest an object-based method/apparatus that is recited in claims 31 and 61."**

7. On November 28, 2007, the Office issued a *Notice of Intent to Issue Ex Parte Reexamination Certificate* ("NIRC"). **In the NIRC, it was again stated that "[T]he prior art of record does not show or suggest an object-based method/apparatus that is recited in claims 31 and 61."**

8. In a decision dated January 31, 2008, the Federal Circuit upheld the decision of the District Court with respect to claims 31 and 61, the claims at issue in the Second Request. Among other things, the Federal Circuit rejected EchoStar's invalidity arguments. The Federal Circuit denied EchoStar's petition for a rehearing and for a rehearing en banc on April 11, 2008. The United States Supreme Court denied EchoStar's petition for a writ on certiorari on October 6, 2008.

9. Following the decision by the Federal Circuit, the parties conducted a status conference on May 30, 2008 with the District Court Judge in the Texas litigation concerning EchoStar's alleged attempts to design around the claims of the '389 patent and TiVo's request for a determination of contempt on the part of EchoStar. Less than an hour after the status conference concluded, EchoStar (now known as Dish Network Corporation) filed a declaratory judgment action in Delaware concerning the same patent. The co-pending litigation in the United States District Court for the District of Delaware is styled *DISH*

Network Corporation et al. v. TiVo Inc, Case No. 1:08-CV-00327-JJF. A decision on transfer to E.D. Texas is pending.

10. On November, 10, 2008, EchoStar filed the second request for reexamination of the '389 patent, directed solely to claims 31 and 61 (Control No. 90/009,329).

11. On November 11, 2008, a reexamination certificate issued for the '389 patent in which all patent claims (including patent claims 31 and 61) were confirmed as being patentable, without amendment.

12. On January 7, 2009, by the Second Order, reexamination was ordered by CRU Primary Examiner Fred Ferris. An SNQ for claims 31 and 61 was alleged to exist only on the basis of the Krause and Thomason patents. Specifically, the SNQ was alleged to be that "[C]laims 31 and 61 are obvious under § 103(a) in view of Thomason et al (U.S. Patent No. 6,081,612 and submitted herewith as Exhibit 2) and Krause et al. (U.S. Patent No. 5,949,948 and submitted herewith as Exhibit 3.)

13. On February 17-19, 2009, the Court in the Eastern District of Texas held an evidentiary hearing regarding TiVo's motion that EchoStar be held in contempt of the Court's injunction. The Court took the matter under submission and a decision is pending.

The dispute between TiVo and EchoStar has been pending for many years. EchoStar has done everything it can to multiply the proceedings in an effort to continue its disrespect of TiVo's patent rights. EchoStar's Second Request is yet one more attempt to burden and harass TiVo, and to place a cloud over its patent. EchoStar's efforts should not be tolerated, especially without a showing that the Second Request meets the "substantial new question" threshold.

II. DISCUSSION

A. Congress Enacted the Substantial New Question Provision of Section 303 to Prevent Harassment of a Patent Owner

The *ex parte* reexamination statute (Public Law 96-517) was "part of a larger effort to revive United States industry's competitive vitality by restoring confidence in the validity of patents issued by the PTO." *Patlex v. Mossinghoff*, 758 F.2d 594, 601 (Fed. Cir. 1985). Such confidence, however, cannot be restored by permitting seriatim reexaminations that place a cloud over a patent for significant portions of its life without strictly imposed limitations. Congress, as a result, ensured that the rights of patentees are protected during reexamination proceedings. "As part of the original 1980 reexamination statute, Congress struck a balance between curing allegedly defective patents and preventing the harassment of patentees. It adopted a standard requiring a request for reexamination to raise a 'substantial new question of patentability.'" *See* H.R. Rep. No. 107-120, at 1; *See also In re Recreative Technologies*, 83 F.3d 1394, 1397 (Fed. Cir. 1996). Congress thus enacted 35 U.S.C. § 303 requiring the Commissioner to "determine whether a substantial new question of patentability affecting any claim of the patent concerned is raised by the request." This provision was intended to limit reexamination only to "new information about pre-existing technology which may have

escaped review at the time of the initial examination of the application." *See* H.R. Rep. No. 96-1307, 96th Cong., 2d Sess. 3 (1980).

The legislative record makes it abundantly clear that an important purpose of 35 U.S.C. § 303 is the protection of the patent owner:

> [The statute] carefully protects patent owners from reexamination proceedings brought for harassment or spite. The possibility of harassing patent holders is a classic criticism of some foreign reexamination systems and we made sure it would not happen here.

Comments by then PTO Commissioner Diamond, *Industrial Innovation & Patent & Copyright Law Amendments: Hearings on H.R. 6933, 6934, 3806, & 214 Before the Subcomm. On Courts, Civil Liberties and the Administration of Justice of the House Comm. On the Judiciary*, 96th Cong., 2d Sess. 594 (1980).

> This "substantial new question" requirement would protect patentees from having to respond to, or participate in unjustified reexaminations.

Report by Congressman Kastenmeier, H.R. Rep. No. 1307 (part I), 96th Cong., 2d Sess. 7 (1980).

> Because of the ... safeguards in the proposed reexamination procedure, it is unlikely that there will be any substantial amount of harassment ... The Commissioner must find that "a new question of patentability" has been created ... before ordering a reexamination.

Comments by Robert Benson on behalf of the American Bar Association, *Patent and Trademark Law Amendments of 1980: Hearings on H.R. 6933 Before the Subcomm. Of the House Comm. On Government Operations*, 96th Cong., 2d Sess. 178 (1980).

In light of a perceived overly strict interpretation by the Federal Circuit, Congress amended § 303 in 2002 to state that "[t]he existence of a substantial new question of patentability is not precluded by the fact that a patent or printed publication was previously cited by or to the Office or considered by the Office." H.R. Rep. No. 107-120, at 2, 7.

Nevertheless, this amendment was not in any way intended to remove the "substantial new question" standard. In fact, Congress stressed that "[w]hile this bill clarifies the basis for a reexamination determination and removes the overly-strict bar established by the court, which renders the available process useless in many obvious instances such as with previously considered prior art, the courts should judiciously interpret the 'substantial new question' standard to prevent cases of abusive tactics and harassment of patentees through reexamination." *Id.*, at 3. Congress further cautioned that the 2002 bill was "not a license to abuse patentees and waste the life of a patent." *Id.*, at 3. The "substantial new question" standard must continue to be strictly enforced, especially when considering art that was already of record in prior examinations.

B. The Manual of Patent Examining Procedures (MPEP) Requires that a Third Party Requester Show How a "Substantial New Question" Raised in a Request Is Substantially Different From Those Raised in Prior Examination.

The Manual of Patent Examining Procedures (MPEP) describes the procedures for the PTO determination of whether a "substantial new question of patentability" has been raised. *See MPEP § 2216.* Specifically, MPEP § 2216 requires that the reexamination request "***must*** point out how any questions of patentability raised are substantially different from those raised in the previous examination of the patent before the Office." *MPEP § 2216.* (emphasis added). *Any* difference is not sufficient. The differences must be ***substantial***. MPEP § 2216 further requires that "[i]t must first be demonstrated that a patent or printed publication that is relied upon in a proposed rejection presents a new, non-cumulative technological teaching that was not previously considered and discussed on the record during the prosecution of the application that resulted in the patent for which reexamination is requested, and during the prosecution of any other prior proceeding involving the patent for which reexamination is requested." *Id.*

Thus, MPEP § 2216 places the burden on the third party requester to demonstrate that the questions of patentability raised are ***substantially*** different than those raised in previous examinations. This procedure is consistent with the legislative history:

> The party requesting the reexamination would ***have the burden*** of convincing the Commissioner of Patents that a new question of patentability has been raised ...

Comments by Robert Benson on behalf of the American Bar Association, *Patent and Trademark Law Amendments of 1980: Hearings on H.R. 6933 Before the Subcomm. Of the House Comm. On Government Operations*, 96th Cong., 2d Sess. 178 (1980)(emphasis added). This burden cannot and should not be shifted to the patentee.

C. EchoStar Failed to Meet Its Evidentiary Burden.

In the Second Request for Reexamination of the '389 patent, EchoStar failed to meet its burden of demonstrating how the questions of patentability raised in this reexamination request differed substantially from those raised in previous examinations. Accordingly, the Order granting EchoStar's Second Request was *ultra vires*, and must be vacated.

On October 17, 2005, EchoStar filed a first reexamination request (the "First Request") against the '389 patent. The First Request sought reexamination of claims 1, 6, 20, 21, 23, 32, 27, 51, and 52. Reexamination was ordered by the Office on December 15, 2005 (*See* Reexamination Control No. 90/007,750). In its Order Granting Request for *Ex Parte* Reexamination ("the First Order"), the Examiner *sua sponte* examined all claims, including claims 31 and 61. The Examiner expressly stated that "**All claims will be reexamined.**" (*See* First Order, p. 12.) As part of the first reexamination proceeding, the Examiner evaluated all claims against the references of record, which, as discussed below, included the references at issue in the Second Request.

Shortly after the Office issued a Notice of Intent to Issue a Reexamination Certificate in the First Reexamination confirming the patentability of all claims of the '389 patent,

EchoStar filed this Second Request for reexamination of the '389 patent, presenting U.S. Patent No. 6,018,612 to Thomason ("Thomason") and U.S. Patent No. 5,949,948 to Krause ("Krause") as allegedly raising substantial new questions of patentability. **Both Thomason and Krause were considered during the first reexamination.** To support its use of Thomason and Krause, EchoStar included a broad conclusory statement - "The [first] request did not seek reexamination of software claims 31 and 61, nor did it raise any question of patentability based on Thomason alone or Thomason with Krause as to any claims." (Second Request, p. 5.) EchoStar presented no evidence (or even attorney argument) as to how Thomason or Krause is now being applied in a new light as compared to their application in the first reexamination. Further, EchoStar presented no evidence (or even attorney argument) as to how Thomason or Krause is different from the other references considered by the Examiner in the first reexamination request, and similarly provided no evidence (or even attorney argument) as to how Thomason or Krause is non-cumulative to those references. EchoStar's broad, conclusory, self-serving statement, is no substitute for evidence. EchoStar plainly failed to meet its burden of showing, on the face of its reexamination request, a substantial new question of patentability.

A second reexamination cannot be based on a request as devoid of evidence as EchoStar's Second Request, especially where it is clear that EchoStar's primary, if not only, goal is to harass TiVo. The '389 patent underwent a first reexamination lasting approximately three years. During that time, the party requesting the reexamination (EchoStar) unsuccessfully challenged, *inter alia*, the validity of claims 31 and 61 of the '389 patent in federal district court, and unsuccessfully appealed the district court's ruling upholding the validity of claims 31 and 61 to the Federal Circuit. EchoStar then unsuccessfully sought a rehearing and a rehearing en banc from the Federal Circuit as well as review by the Supreme Court. The present reexamination was requested by the same party

(EchoStar) at the conclusion of the first reexamination and has the likelihood of lasting another three to five years or more, if appealed. The combined duration of the reexaminations amounts to placing a cloud over TiVo's property right for almost half of its period of enforceability. This legal strategy designed to waste the life of TiVo's property right is the exact situation that Congress sought to prevent by enacting 35 U.S.C. § 303.

The 2002 House of Representatives Report on Substantial New Question of Patentability in Reexamination Proceedings acknowledged that the "agency has discretion in this determination to permit reexamination, ***but it is not absolute.***" *Id.*, at 3. (emphasis added.) The action by the Office of granting the second reexamination request based only on a conclusory statement by the third party requester has the effect of shifting the burden of proof to the Patent Owner, the party that 35 U.S.C. § 303 was specifically designed to protect. Thus, the Office's action negated the limited protections that Congress sought to provide to a Patent Owner. The Order granting a reexamination request in which EchoStar failed to produce any evidence to support its contention that a substantial new question of patentability, substantially different from and non-cumulative to those raised in previous examinations, exists, is an *ultra vires* act. Accordingly, the grant of the present reexamination must be vacated.

D. EchoStar Failed to Meet Its Burden of Presenting Substantial Evidence that Examiner Harvey and Examiner Escalante Did Not Properly Consider or Understand Thomason and Krause

EchoStar based its Second Request solely on the Thomason and Krause patents, which were already considered in the first reexamination. Yet EchoStar failed to meet its burden of presenting in its Second Request substantial (or any) evidence that Thomason and Krause are now being presented in a "new light." Accordingly, the Order granting EchoStar's Second Request was *ultra vires*, and must be vacated.

As discussed above, the reexamination statute was carefully crafted to balance the need to provide a mechanism to remedy defective governmental action against harassment of a Patent Owner and the waste of patent life. To that end, reexamination was limited to "new information about pre-existing technology which may have escaped review at the time of the initial examination of the application." H.R. Rep. No. 96-1307, 96th Cong., 2d Sess. 3 (1980), reprinted in 1980 U.S.C.C.A.N. 6460, 6462. Thus, to establish a substantial new question of patentability, the request must provide ***new*** information about pre-existing technology that was not reviewed at the time of the earlier examination. "The appropriate test to determine whether a 'substantial new question of patentability' exists should not merely look at the number of references or whether they were previously considered or cited but their combination in the appropriate context of a new light as it bears on the question of the validity of the patent." H.R. Rep. No. 107-120, at 3.

When enacting the 2002 Amendments to 35 U.S.C. § 303, Congress intended to set a high evidentiary burden on a third party requester seeking reexamination based on an old reference presented in a new light:

> The point must be stressed that the past requirement of a "substantial new question of patentability" has not been diminished. The issue raised must be more that just questioning the judgment of the examiner. There should be ***substantial evidence that the examiner did not properly understand the reference, or did not consider a portion of the reference in making his decision***. That substantial new question must be put forward clearly in the request for examination.

H.R. Rep. No. 107-120, at 3. (emphasis added).

As discussed below, Thomason and Krause, were considered by both Primary Examiner Harvey and Primary Examiner Escalante of the CRU, and by their respective conferees, during the first reexamination proceeding. EchoStar was required to meet the increased burden of providing substantial evidence that both of these seasoned Examiners and their conferees did not properly understand Thomason and Krause. EchoStar failed to meet

this burden. Instead, EchoStar merely stated that "in the co-pending reexamination, Thomason (or its combination with Krause) was not used to reject any claims or even discussed on the record." (Second Request, p. 5.) Thus, EchoStar appears to argue that the application of Thomason and Krause in a proposed rejection that was not made in the prior examination is a sufficient basis for a substantial new question of patentability. However, this argument goes simply to the manner of applying the technical teachings of Thomason and Krause in a rejection, which is a requirement separate from the substantial new question of patentability requirement. *See* 37 C.F.R. § 1.510(b). EchoStar failed to meet its burden of presenting any evidence, let alone substantial evidence, that this alleged new manner of application of Thomason and Krause was based on a misunderstanding of the technical teachings of the references by the prior Examiners.

As discussed in the legislative history of the 2002 amendment to § 303, the context of a prior consideration of a reference is critical when determining whether a request includes a substantial new question of patentability. In the Second Request, EchoStar acknowledged that Thomason was included in an Information Disclosure Statement filed in March 2006 by TiVo. Citing MPEP § 2258, EchoStar attempted to diminish the importance of this disclosure by arguing that because the statement "did not explain the content or relevance of any of the listed references" the scope of the Examiner's consideration should be limited. However, MPEP § 2258 states that limiting the scope of consideration of a reference in an Information Disclosure Statement is only appropriate where there is no "indication to the contrary in the record." [2]

[2] Where patents, publications, and other such items of information are submitted by a party (patent owner or requester) in compliance with the requirements of the rules, the requisite degree of consideration to be given to such information will be normally limited by the degree to which the party filing the information citation has explained the content and relevance of the information. The initials of the examiner placed adjacent to the citations on the form PTO/SB/08A and 08B or its equivalent, without an indication to the contrary in the

EchoStar failed to inform the Office in the Second Request that such an "indication to the contrary" did in fact exist in the first reexamination proceeding. Primary Examiner Harvey and Primary Examiner Escalante, both indicated that with respect to patent claims 31 and 61, "[t]he prior art of record does not show or suggest an object-based method/apparatus that is recited in claims 31 and 61." (Office Action in First Reexam, p. 19; *see also* Final Office Action in First Reexam, p. 22) Primary Examiners Harvey and Escalante therefore went beyond merely initialing a reference cited on an Information Disclosure Statement. They each affirmatively stated, in both the first And final Office Actions in the First Reexam, that claims 31 and 61 were patentable over the references of record in the reexamination proceeding, including Thomason and Krause; and they each listed explicit features of claims 31 and 61 not present in those references. There is no requirement for examiners to do more, nor should there be.

Statements such as those made by Primary Examiners Harvey and Escalante when allowing claims over cited references must be taken objectively, at their face value: that they considered all portions of the cited references they said were considered, and that they determined that those references do not invalidate the claims for the expressly stated reasons. In other words, examiners should not be forced to discuss in detail every single cited reference by name. If the rule were otherwise, Office Actions would become unwieldy and the Office would quickly become overwhelmed. Examiners would be compelled to discuss in detail every single reference, lest they invite seriatim reexaminations on the references that were not discussed by name. Such a rule would be contrary to the statutory mandate that reexaminations be handled with "special dispatch." Here, Primary Examiners Harvey and Escalante did everything they were supposed to: identify the references considered and provide an explicit statement as to what in the prior art of record – all of it, including

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record, do not signify that the information has been considered by the examiner any further than to the extent noted above. MPEP § 2258. (emphasis added)

Thomason and Krause – is missing from the patent claims. There was no reason for the Examiners to expressly list by name each of the references in the place of the phrase "prior art of record."

EchoStar, in fact, admits that Krause was used as a basis for a substantial new question of patentability in the first reexamination request. (Second Request, p. 5.) Despite this admission, EchoStar fails to provide any discussion or evidence that Examiners Harvey and Escalante did not properly understand Krause when allowing claims 31 and 61 in the first reexamination proceeding or any discussion or evidence that Examiners Harvey and Escalante did not consider a portion of Krause when making their separate patentability determinations. EchoStar made no showing that Krause was presented in a new light.

The same is true with respect to Thomason. Because Examiners Harvey and Escalante considered Thomason in its entirety, EchoStar's burden in the reexamination was to present substantial evidence that Thomason is being presented in a new light and that Examiners Harvey and Escalante did not properly understand the technical teachings of Thomason. EchoStar failed to present such evidence. The discussion of Thomason in the reexamination request therefore simply amounts to questioning the judgment of both Examiners, an argument that Congress explicitly stated was insufficient to support a substantial new question of patentability. A second reexamination, based on references that were already considered, should not be countenanced on such a sparse record.

Granting EchoStar's Second Request completely undermines the protections sought by Congress when enacting the substantial new question provision of Section 303. If the procedure followed by the Office here is allowed to stand, requesters can easily harass a patent owner by presenting reexamination request after reexamination request merely by altering the combination of "old references" presented in the rejection regardless of whether

the previous Examiners fully understood and appreciated the technical teachings of each of the references.

By ordering the reexamination despite EchoStar's failure to meet it's burden, the Office improperly shifted the burden to TiVo to show that there was no substantial new question of patentability. This shifting was contrary to the statutory mandate and legislative history of the reexamination statutes. Therefore, the Order granting the second reexamination request is an *ultra vires* act and must be vacated.

E. Any Office Procedures Allowing the Grant of a Reexamination Request Absent Substantial Evidence Is Contrary to the Statutory Mandate of 35 U.S.C. § 303, and Is, therefore, Void.

The Federal Circuit has expressly held that Office procedures which require the "PTO to resolve doubt in the direction of granting the request for reexamination are contrary to the statutory mandate of *35 U.S.C. § 303*, and void." *Patlex Corp. v. Mossinghoff*, 771 F.2d 480, 487 (Fed. Cir. 1985). By not requiring substantial (or any) evidence that a presented alleged new question of patentability is different from and non-cumulative to issues raised in prior examinations and that an alleged new question of patentability using only previously considered references is based on a misunderstanding by the previous Examiners or is based on different portions of the previously considered references, the Office has instituted procedures that resolve doubt in the direction of granting a request for reexamination. This is directly contrary to the Federal Circuit's express holding in *Patlex*.

In *Patlex*, 771 F.2d at 486, the plaintiff challenged §§ 2240 and 2244 of the MPEP that "require[d] the patent examiner, in implementation of *35 U.S.C. § 303*, to resolve any doubt as to whether a substantial new question of patentability is raised in favor of granting the request for reexamination." For example, prior MPEP § 2240 stated: "Where doubts exist, all questions should be resolved in favor of granting the request for reexamination." *Id.*

The *Patlex* Court stressed that "Congress' major purpose in enacting *§ 303* was to protect patentees against doubtful reexaminations." *Id.* at 487. The Court further stated that "[w]hen Congress enacted *35 U.S.C. § 303* for the purpose of protecting the patentee, it could not have intended an implementation that would negate this protection. We can not endorse such a diversion of the statutory purpose." *Id.* The Court then held that "those portions of the MPEP which require the PTO to resolve doubt in the direction of granting the request for reexamination are contrary to the statutory mandate of *35 U.S.C. § 303*, and void." *Id.*

In the present reexamination proceeding, the Office procedures allowed the grant of a reexamination request where a third party requester failed to produce any evidence that the proposed substantial new question of patentability was different from those raised in previous examinations of the patent before the Office and that the alleged new question of patentability, based solely on previously considered references, was being presented in a "new light." These procedures had the effect of resolving any doubt of whether a substantial new question of patentability existed in the request in favor of the grant of a reexamination and shifted the burden to the Patent Owner to prove lack of substantial new question of patentability.

Accordingly, Office procedures allowing a requester to produce no evidence or to meet no evidentiary burden are contrary to the statutory mandate of *35 U.S.C. § 303*, and are therefore void.

III.. CONCLUSION

A driving purpose behind the original *ex parte* reexamination legislation was to reinforce confidence and certainty in the validity of patent rights. Under the current reexamination procedures, however, a patent can be subjected to multiple serial reexaminations until the patent term expires. Left unchecked, multiple serial reexaminations, and the resulting harassment of patent owners, would weaken, not reinforce, the certainty of

patent rights. The intended gatekeeper against such harassing activity designed to waste the enforceable period of a patent is the "substantial new question of patentability" requirement. By not enforcing evidentiary burdens for establishing substantial new questions of patentability, particularly on serial reexamination requests, the Office is actually diminishing confidence in the certainty of patent rights. Precisely in situations such as this case, the "substantial new question" standard must be strictly enforced.

EchoStar failed to meet its evidentiary burdens for establishing a substantial new question of patentability in the request for reexamination. There is no such new question. Thus, the Order granting reexamination was an *ultra vires* action by the Office. TiVo respectfully requests that the Director vacate the Second Order and dismiss EchoStar's second request for reexamination of the '389 Patent.

Respectfully submitted,

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Date: May 27, 2009

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Under Reexamination: 6,233,389
Reexamination Control No.: 90/009,329
Examiner: Ferris, Fred
Art Unit: 3992

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

CERTIFICATION OF SERVICE OF PETITION OF PATENT OWNER UNDER 35 U.S.C. § 181, 182, AND/OR 37 C.F.R. § 1.183 TO VACATE THE ORDER GRANTING SECOND REEXAMINATION REQUEST

In compliance with 37 C.F.R. § 1.550(f), the undersigned, on behalf of the patent owner, hereby certifies that a copy of this paper has been served on the third-party requester by first class mail on May 27, 2009. The name and address of the party served is as follows:

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Electronic Patent Application Fee Transmittal

Application Number:	90009329
Filing Date:	10-Nov-2008
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Filer:	Lori Ann Gordon/Maya Bennett
Attorney Docket Number:	2513.002REX0

Filed as Large Entity

ex parte reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Petition fee- 37 CFR 1.17(f) (Group I)	1462	1	400	400
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**400**

Electronic Acknowledgement Receipt	
EFS ID:	5407624
Application Number:	90009329
International Application Number:	
Confirmation Number:	2859
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Customer Number:	26111
Filer:	Lori Ann Gordon/Maya Bennett
Filer Authorized By:	Lori Ann Gordon
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Receipt Date:	27-MAY-2009
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Deposit Account	
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		2513002REX0petition1.pdf	819587 c90d41b2df8f19c389eb20415d755177c9c19349f	yes	21

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Trans Letter filing of a response in a reexam	1	2
Receipt of Petition in a Reexam	3	20
Reexam Certificate of Service	21	21

Warnings:

Information:

2	Fee Worksheet (PTO-875)	fee-info.pdf	30133 562255edcce0772a1f0f802742fa184645047 1a	no	2

Warnings:

Information:

Total Files Size (in bytes):	849720

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Kavon Nasabzadeh
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*Admitted only in Maryland
* Admitted only in Virginia
•Practice Limited to Federal Agencies

May 27, 2009

WRITER'S DIRECT NUMBER:
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INTERNET ADDRESS:
EKESSLER@SKGF.COM

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Re: Reexamination of U.S. Patent No. 6,233,389
Reexam Control No. 90/009,329; Filed: November 10, 2008
For: **Multimedia Time Warping System**
Inventors: BARTON *et al.*
Our Ref: 2513.002REX0

Sir:

Transmitted herewith for appropriate action is the following document:

1. Petition of Patent Owner Under 35 U.S.C. § 181, 182, and/or 37 C.F.R. 1.183 to Vacate the Order Granting Second Reexamination Request;

2. Certification of Service of Petition of Patent Owner Under 35 U.S.C. § 181, 182, and/or 37 C.F.R. 1.183 to Vacate the Order Granting Second Reexamination Request;

3. Petition of Patent Owner under 37 C.F.R. § 1.182 to Temporarily Suspend *Ex Parte* Reexamination Proceeding;

4. Certification of Service of Petition of Patent Owner under 37 C.F.R. § 1.182 to Temporarily Suspend *Ex Parte* Reexamination Proceeding; and

5. Online Credit Card Payment Authorization for $800.00 to cover two (2) petition fees.

The above-listed documents are filed electronically through EFS-Web.

Fee payment is provided through online credit card payment. The U.S. Patent and Trademark Office is hereby authorized to charge any fee deficiency, or credit any overpayment, to our Deposit Account No. 19-0036

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Edward J. Kessler
Attorney for Patent Owner
Registration No. 25,688

EJK/LAG:mlb
Enclosures
984185_1.DOC

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re reexam of: U.S. Patent 6,233,389 (Barton)	Confirmation No.: 2859
Reexam Control No.: 90/009,329	Art Unit: 3992
Filed: November 10, 2008	Examiner: Ferris, Fred
For: **Multimedia Time Warping System**	Atty. Docket No.: 2513.002REX0

PETITION OF PATENT OWNER UNDER 37 C.F.R. § 1.182 TO TEMPORARILY SUSPEND *EX PARTE* REEXAMINATION PROCEEDING

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

TiVo Inc., the Patent Owner, petitions the Director, under 37 C.F.R. § 1.182 to temporarily suspend prosecution in *Ex Parte* reexamination control number 90/009,329 ("the '329 reexamination") pending a decision by the United States Patent and Trademark Office ("the Office") on the concurrently filed "Petition of Patent Owner Under 37 C.F.R. § 1.181 and/or 37 C.F.R. § 1.183 to Vacate the Order Granting Reexamination of U.S. Patent No. 6,233,389." ("Petition to Vacate")

The concurrently filed Petition to Vacate is directed to the issue of whether the Office had discretion to grant the '329 reexamination request. Should the Office grant the Petition to Vacate, the reexamination proceeding will be terminated and any further efforts expended by Examiner Ferris in the Central Reexamination Unit related to the reexamination prosecution will be wasted. Additionally, if an Office Action is issued in the '329 reexamination, it would be unfair to force the Patent Owner to expend resources and respond on the public record to issues that could be rendered moot by the decision. Furthermore, U.S. Patent No. 6,233,389 is the subject of two co-pending litigations - *TiVo, Inc. v. EchoStar Communications Corp., et al.*, Case No. 2-04CV-01 DF, in the United States District Court for the Eastern District of

Texas and *DISH Network Corporation et al. v. TiVo Inc*, Case No. 1:08-CV-00327-JJF, in the United States District Court for the District of Delaware. The issuance of any Office Action prior to decision on the co-pending petition would enable EchoStar to attempt to place an unjustified cloud over the patent in these litigations, based on an improper reexamination request that the Office had no authority to grant.

In the interest of conserving Office and Patent Owner resources, and in the interest of fundamental fairness, a temporary stay of the '329 reexamination prosecution is warranted until the larger issue of the ability of the Office to grant the reexamination request (and therefore the ability of the Office to continue prosecuting the reexamination proceeding) is resolved.

It is recognized that reexaminations are handled with special priority and progress as quickly as possible. However, a limited stay to allow for the efficient and orderly handling of the proceeding between the Office of Patent Legal Administration and the Central Reexamination Unit does not violate the statutory mandate of "special dispatch." In fact, the Manual of Patent Examining Procedures (MPEP) contemplates the grant of temporary stays in certain circumstances such as where decisions or actions in one proceeding may have a substantial impact on the handling of a second proceeding.[1] The possible grant of a Petition to Vacate the entire '329 reexamination proceeding is such a circumstance.

---

[1] *See* MPEP § 2283.II. ("For example, a suspension of a first reexamination proceeding may be issued to allow time for the patent owner's statement and the requester's reply in a second proceeding prior to merging. Further, after, the second proceeding *has been ordered*, it may be desirable to suspend the second proceeding where the first proceeding is presently on appeal before a Federal court to await the court's decision prior to merging.")(emphasis in original); *See also,* MPEP § 2285.II.B. ("If the reissue application examination has progressed to a point where a merger of the two proceedings is not desirable at that time, then the reexamination proceeding will generally be stayed until the reissue application examination is complete on the issues then pending.")

TiVo therefore respectfully requests that the Office temporarily stay the '329 reexamination proceeding pending a decision on the concurrently filed Petition to Vacate.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Edward J. Kessler
Attorney for Patent Owner
Registration No. 25,688

Date: May 27, 2009

1100 New York Avenue, N.W.
Washington, D.C. 20005-3934
(202) 371-2600

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Under Reexamination: 6,233,389
Reexamination Control No.: 90/009,329
Examiner: Ferris, Fred
Art Unit: 3992

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

CERTIFICATION OF SERVICE OF PETITION OF PATENT OWNER UNDER 37 C.F.R. § 1.182 TO TEMPORARILY SUSPEND *EX PARTE* REEXAMINATION PROCEEDING

In compliance with 37 C.F.R. § 1.550(f), the undersigned, on behalf of the patent owner, hereby certifies that a copy of this paper has been served on the third-party requester by first class mail on May 27, 2009. The name and address of the party served is as follows:

David L. Fehrman
Morrison & Foerster, LLP
555 W. Fifth Street, Suite 3500
Los Angeles, CA 90013

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Edward J. Kessler
Attorney for Patent Owner
Registration No. 25,688

Date: May 27, 2009

1100 New York Avenue, N.W.
Washington, D.C. 20005-3934
(202) 371-2600

984107_1.DOC

Electronic Patent Application Fee Transmittal

Application Number:	90009329
Filing Date:	10-Nov-2008
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Filer:	Lori Ann Gordon/Maya Bennett
Attorney Docket Number:	2513.002REX0

Filed as Large Entity

ex parte reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Petition fee- 37 CFR 1.17(f) (Group I)	1462	1	400	400
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**400**

Electronic Acknowledgement Receipt	
EFS ID:	5407658
Application Number:	90009329
International Application Number:	
Confirmation Number:	2859
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Customer Number:	26111
Filer:	Lori Ann Gordon/Maya Bennett
Filer Authorized By:	Lori Ann Gordon
Attorney Docket Number:	2513.002REX0
Receipt Date:	27-MAY-2009
Filing Date:	10-NOV-2008
Time Stamp:	17:46:53
Application Type:	Reexam (Patent Owner)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$400
RAM confirmation Number	4014
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		2513002REX0petition2.pdf	195422 08f0c772b323cb5189034644962aac1aa07706af	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Trans Letter filing of a response in a reexam	1	2
	Receipt of Petition in a Reexam	3	5
	Reexam Certificate of Service	6	6

Warnings:

Information:

2	Fee Worksheet (PTO-875)	fee-info.pdf	30133 29ebea55b4b90a5f53074937c4ac2176712c95acb	no	2

Warnings:

Information:

Total Files Size (in bytes):	225555

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

VIA EFS
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Ex Parte Reexamination of:
James M. BARTON et al.

Examiner: Fred O. Ferris, III

Serial No.: 90/009,329

Art Unit: 3992

Filed: November 10, 2008

For: Multimedia Time Warping System

OPPOSITION TO PATENT OWNER'S PETITION

TO VACATE THE REEXAMINATION ORDER

MS Ex Parte Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

On May 27, 2009, the Patent Owner filed a petition seeking to vacate the order granting the present reexamination. Under MPEP 2246(II), when a petition is filed to vacate a reexamination order, the Requester "may file a single submission in opposition to the petition." The Requester accordingly submits this opposition in response to the petition.

As discussed below, the petition should be denied. First, the petition is untimely and should be immediately denied on that basis alone. Moreover, it mischaracterizes the request for reexamination, ignores Examiner Ferris's clear order and fails to cite or discuss relevant case law. In short, the petition should be seen for what it is: an attempt to delay a proper reexamination and thwart the statutory mandate of "special dispatch."

la-1032111

A. The Patent Owner Mischaracterizes The Reexamination Request.

1. The Request

The Requester filed its reexamination request eight months ago on November 10, 2008. The Request was directed to only two claims – 31 and 61 – of U.S. Patent No. 6,233,389 (the '389 patent). It was based on a combination of two references. The primary reference was U.S. Patent No. 6,018,612 to Thomason et al. ("Thomason"), and the secondary reference was U.S. Patent No. 5,949,948 to Krause et al. ("Krause").

In the Request, the Requester explained that both Thomason and Krause had been individually considered in an earlier reexamination. (Request, at 5-6.) Krause had been submitted with the request for the earlier reexamination, and Thomason had been subsequently submitted by the Patent Owner in an information disclosure statement submitting more than 200 references. The statement did not explain the content or relevance of any of the listed references, including Thomason. Nor was there any further discussion of Thomason at all for the remainder of the reexamination. Thus, when the earlier reexamination concluded, the record was clear that Thomason in combination with Krause had not been considered at all.

The Request explained that this previously unconsidered combination raised a substantial new question of patentability for claims 31 and 61. The '389 patent is directed to a system for simultaneously storing and playing back multimedia data, and it describes the use of object-oriented programming to implement its program logic. Claims 31 and 61 are directed to the program logic and recite various "objects." The Request showed that Thomason describes an object-based method and system that, in combination with Krause, met every element of claims 31 and 61. (Request, at 16-29.) Thus, the Requester concluded that the question raised by the combination was both substantial and new, given that the combination of Thomason and Krause had never been considered. (Request, at 30.)

2. The Patent Owner's Mischaracterizations

The Patent Owner repeatedly argues that the Requester failed to show a substantial new question of patentability in the Request. For example, at page 10, the Patent Owner asserts:

> EchoStar presented no evidence (or even attorney argument) as to how Thomason or Krause is now being applied in a new light as compared to their application in the first reexamination.

This is *not* an accurate description of the Request. The Request explained in detail that Thomason disclosed an object-based method and system. This application was certainly different than how Thomason was applied in the earlier examination, given that Thomason was not even discussed in that reexamination at all, by either the Patent Owner or the Examiners. Moreover, Thomason was applied in *combination* with Krause. The combination presented the two references in a new light that was different than their *individual* consideration in the earlier reexamination. Indeed, when Thomason was considered in combination with Krause, it disclosed every element of claims 31 and 61 as the Request showed. The Request thus provided ample evidence of a substantial new question of patentability, notwithstanding the Patent Owner's contrary characterizations in the petition.

B. The Patent Owner Ignores The Order Granting Reexamination.

Nowhere in the lengthy petition does the Patent Owner address Examiner Ferris's reasoning for granting the reexamination. This silence is telling. Examiner Ferris diligently followed the statutory and PTO requirements that the Patent Owner lists in its petition, but he reached the exact opposite conclusion and ordered reexamination. His Order, as discussed below, was well-reasoned and proper.

The Examiner first analyzed the previous reexamination in his Order. He found that Thomason and Krause had been considered and that claims 31 and 61 were confirmed "based on the belief that 'The prior art of record does not show or suggest an object-based method/apparatus that is recited in claims 31 and 61 . . . .'" (Order, at 4.)

The Examiner then noted that the scope of reexamination had been expanded by the 2002 amendment to § 303(a). (*Id.*, at 5.) That amendment provided that "[t]he existence of a substantial new question of patentability is not precluded by the fact that a patent or printed publication was previously cited by or to the Office or considered by the Office." The Examiner explained that "reliance on previously cited/considered art, i.e., 'old art,' does not necessarily preclude the existence of a substantial new question of patentability (SNQ) that is based exclusively on that old art." (*Id.*) Examiner Ferris's summary of the reexamination standard was thus accurate.

Examiner Ferris lastly considered the facts and applied them to the reexamination standard. Thomason was found to teach "a system and method that is object based" by the Examiner. (*Id.*, at 7 (emphasis in original).) He then analyzed Krause and concluded:

> [T]he combination of Thomason and Krause appears to render obvious the very features that were believed to be lacking in prior art during the previous reexamination proceeding. Namely, an object-based method and apparatus for simultaneous playback and storage of media as required by claims 31 and 61. Hence, an SNQ is raised when taking into account the features that were believed missing during the previous reexamination, and ultimately lead to the confirmation of claims 31 and 61.

(*Id.*, at 8.) This analysis shows that the *combination* of Thomason and Krause raised a substantial new question of patentability that had not been considered in the earlier reexamination. Indeed, the question raised in the Request went to the heart of whether those claims were patentable. Moreover, the question was new even though it was based on the considered Thomason and Krause references, because they were "now being viewed in a new light by being in combination." (*Id.* at 5.)

It is not surprising that the Patent Owner ignored the reasoning in Examiner Ferris's Order. It completely undermines its claim that the Order was *ultra vires*. Examiner Ferris properly recognized the standard for reexamination and found that the Request's presentation of Thomason and Krause, *in combination*, showed the two previously considered references *in a new light*. The new light exposed what was believed missing when claims 31 and 61 were confirmed in the earlier reexamination. The Office should accordingly use the Order as a road-map to deny the petition,

thereby making clear that Examiner Ferris's judgment has been questioned without justification by the Patent Owner.

C. The Patent Owner Fails To Cite Relevant Case Law.

Perhaps recognizing that the combination of Thomason and Krause was appropriate for granting reexamination, the Patent Owner makes a fall-back argument. It contends that a reexamination request based on old art must provide evidence that the earlier Examiner did not properly understand the old art. (Petition, at 12.) The Patent Owner lectures for pages on the history of the reexamination laws to support its position. Astonishingly, the Patent Owner fails to discuss the most relevant Federal Circuit case on this issue: *In re Swanson*, 540 F.3d 1368 (Fed. Cir. 2008).

In *Swanson*, the Federal Circuit considered whether a previously considered reference raised a substantial new question of patentability. The reference had been used during the original examination as a secondary reference under § 103 to reject certain dependent claims. In the reexamination, the reference was used as an anticipatory reference for a different set of claims. The Court held that the reference raised a substantial new question of patentability, even though it had been applied in a rejection in the original examination. *Id.*, at 1381.

In reaching this holding, the Court emphasized that the amendment to § 303(a) requires "a more context-specific approach that is based on the analysis of what the PTO actually did." *Id.*, at 1380. Part of the analysis requires evaluating the "scope of the prior consideration" which "will generally require an analysis of the record proceeding to determine if and how the examiner used the reference in making his initial decision." *Id.*, at 1380-81. The reference in *Swanson* was considered in the original examination only as a secondary reference in an obviousness rejection and, thus, its use an anticipatory reference was a substantial new question of patentability. *Id.* at 1381.

Swanson confirms that Examiner Ferris properly considered the combination of Thomason and Krause as raising a substantial new question of patentability, even though both references were

of record in the earlier reexamination. The record indicates that Thomason was never discussed *at all*: *not* in a rejection, *not* in a response and *not* even in passing. The lack of *any* discussion with respect to Thomason makes the "scope of the prior consideration" of Thomason in *combination* with Krause nonexistent. This is decidedly less than the situation in *Swanson*, where a substantial new question of patentability was found based on a reference that was used to *reject* claims. Thus, Examiner Ferris properly found that Thomason and Krause raised a substantial new question of patentability, because the context of the earlier reexamination made clear that their combination was never considered.

Swanson also undermines the Patent Owner's reliance on information disclosure statements initialed by the Examiners. The Patent Owner argues that the Examiners' consideration and their statements of confirmability should be taken at face value. However, *Swanson* made clear that the analysis is not whether the reference was considered, but the context:

> The bright-line rule in *In re Portola Packaging* was based on a presumption that the examiner had properly discharged his duties and thus considered all question of patentability raised by any reference before him. 110 F.3d 790. Congress, however, has now rejected this presumption of full consideration. Section 303(a) as amended instead requires a more context-specific approach that is based on an analysis of what the PTO actually did.

Id., at 1380. What the PTO *actually* did in the earlier reexamination was perform a limited review of Thomason. The initials next to Thomason do not constitute proof of a detailed consideration of Thomason in combination with Krause absent further consideration on the record. (*See* MPEP 2256.) This is especially so in view of the fact that Thomason was submitted along with more than 200 references. Thus, the Examiner's statement as to the confirmability of claims 31 and 61 must be considered with this perspective: that the claims were confirmed based on limited review of the references individually. Any other approach would lead the PTO toward the presumption of full consideration that *Swanson* clearly rejected.

D. The Petition Is Untimely.

Not only is the petition without merit, it is untimely. MPEP 2246(II) provides that a petition to vacate a reexamination order must be raised under 37 C.F.R. 1.181. Section (f) of Rule 181 requires that "[a]ny petition under this part not filed within two months of the mailing date of the action or notice from which relief is requested may be dismissed as untimely, except as otherwise provided." The Order in the present reexamination was mailed on January 7, 2009 which established a deadline of March 7, 2009 to challenge the Order.

The Patent Owner waited until May 27, 2009 to file this petition. This is almost *five months* after the Order and more than two months past the deadline. Moreover, the Patent Owner does not provide any reason whatsoever for filing so late. The lack of any explanation is particularly striking in view of the Patent Owner's repeated statements in the present petition on the impropriety of the second reexamination. (*See, e.g.*, Petition, at 11 ("The combined duration of the reexaminations amounts to placing a cloud over TiVo's property right for almost half of its period of enforceability. This legal strategy designed to waste the life of TiVo's property right is the exact situation that Congress sought to prevent . . . .").) If the second reexamination placed such a cloud over the Patent Owner's "property right," one would have expected that the Patent Owner would have filed its petition immediately after the Order and within the time limit provided.

Without any explanation from the Patent Owner for its untimely petition, the Office should see the petition for what it is: a delay tactic. The Patent Owner waited two months after the Order, it waited until the file was forward to the Examiner on March 25 and it waited more than two months after *that*. Moreover, it has also petitioned to suspend the reexamination until the Office makes its decision on the petition to vacate, to ensure as much delay as possible while the reexamination is transferred between the Central Reexamination Unit and the Office of Patent Legal Administration. Such delay is unacceptable. The Office is statutorily mandated to perform the reexamination with "special dispatch." 35 U.S.C. § 305. By not denying the petitions as untimely, the Office will thwart this statutory mandate and reward the Patent Owner for its gamesmanship. The petition should therefore be immediately denied as being untimely.

E. Conclusion

The Office should deny the petition to vacate the Order and the accompanying petition to suspend the reexamination proceeding until the petition to vacate is decided. A review of the Request, reexamination Order and *Swanson* makes clear that the request properly found a substantial new question of patentability. It was based on a combination that was never considered in the original examination and earlier reexamination. In view of the clarity of the record, the Patent Owner's petition should be seen as gamesmanship to impede the statutory mandate of "special dispatch" for the reexamination of the '389 patent.

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, the Requester petitions for any required relief, including extensions of time, and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952**.

Dated: June 10, 2009

Respectfully submitted,

By _____

David L. Fehrman
Registration No.: 28,600
Morrison & Foerster LLP
555 W. Fifth Street
Los Angeles, CA 90013

CERTIFICATE OF SERVICE

Pursuant to 37 CFR 1.550, the undersigned, on behalf of the Requester, hereby certifies that a copy of the each of the following documents:

1. Transmittal dated June 10, 2009 (1 page); and
2. Opposition to Patent Owner's Petition to Vacate the Reexamination Order dated June 10, 2009 (9 pages, including this certificate of service);

was served on the Patent Owner via first class mail on June 10, 2009. The name and address of the party served is as follows: Edward Kessler, Sterne Kessler Goldstein Fox, 1100 New York Ave, N.W., Washington, D.C. 20005.

David Fehrman

Electronic Acknowledgement Receipt

EFS ID:	5494637
Application Number:	90009329
International Application Number:	
Confirmation Number:	2859
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Customer Number:	26111
Filer:	David L. Fehrman/Dena Wells
Filer Authorized By:	David L. Fehrman
Attorney Docket Number:	2513.002REX0
Receipt Date:	10-JUN-2009
Filing Date:	10-NOV-2008
Time Stamp:	20:11:09
Application Type:	Reexam (Third Party)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Oppositiondtd61009.pdf	460567 fd1198bb8952fb38d1e1f2955b075d60674b5446	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Reexam Miscellaneous Incoming Letter	1	1
	Reexam - Opposition filed in response to petition	2	9
	Reexam Certificate of Service	10	10
Warnings:			
Information:			
	Total Files Size (in bytes):	460567	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
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PTO/SB/21 (11-08)
Approved for use through 12/31/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission	10

Application Number	90/009,329
Requested	November 10, 2008
First Named Inventor	James M. Barton
Art Unit	3992
Examiner Name	Fred O. Ferris, III
Attorney Docket Number	454032800200

ENCLOSURES (*Check all that apply*)

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

Opposition to Patent Owner's Petition to Vacate the Reexamination Order (9 pgs)

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	MORRISON & FOERSTER LLP		
Signature			
Printed name	David L. Fehrman		
Date	June 10, 2009	Reg. No.	28,600

EFS-WEB

PTO/SB/21 (09-08)
Approved for use through 10/31/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FORM

Control No.	90/009,329
Filed	November 10, 2008
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ENCLOSURES (*Check all that apply*)

- [ ] Fee Transmittal Form
  - [ ] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
  - [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
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- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to TC (Appeal Notice, Brief, Reply Brief) – **(including Appendices and Certificate of Service)**
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) (please Identify below):

1) Notice Under 37 C.F.R. § 1.565 and MPEP 2282 (including the Certificate of Service)
2) Copy of District Court's Order dated June 2, 2009
3) Copy of Federal Circuit's Order dated July 1, 2009

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	MORRISON & FOERSTER LLP (Customer No. 25224)		
Signature	/MehranArjomand/		
Printed name	Mehran Arjomand		
Date	July 7, 2009	Reg. No.	48,231

EFS-WEB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reexamination of:
James M. BARTON et al.

Examiner: Fred O. Ferris, III

Application No.: 90/009,329

Art Unit: 3992

Filed: November 10, 2008

For: MULTIMEDIA TIME WARPING SYSTEM

NOTICE UNDER 37 C.F.R. § 1.565 AND MPEP 2282

MS Ex Parte Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The above-identified reexamination of U.S. Patent No. 6,233,389 is co-pending with an action styled *TiVo, Inc. v. EchoStar Corp., et al.* in the United States District Court for the Eastern District of Texas.

Pursuant to 37 C.F.R. § 1.565 and MPEP 2282, the Requester hereby notifies the Patent Office that the Court found the defendants (collectively, "EchoStar") in contempt of its permanent injunction based, in part, on finding that the parsing limitation of claims 31 and 61 is met by PID filtering. Attached is a copy of the District Court's Order dated June 2, 2009.

On July 1, the United States Court of Appeals for the Federal Circuit ordered that the District Court's June 2 Order be stayed pending appeal, as it found that EchoStar met its burden of demonstrating the requisites for a stay including, at minimum, a substantial case on the merits. The Federal Circuit ordered an expedited briefing schedule with EchoStar's opening brief due on July 17, TiVo's brief due on August 25 and EchoStar's reply brief due on September 4 in anticipation of a November hearing. Attached is a copy of the Federal Circuit's Order dated July 1, 2009.

la-1035646

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, the Requester petitions for any required relief and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952**.

Dated: July 7, 2009

Respectfully submitted,

By /MehranArjomand/
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la-1035646

CERTIFICATE OF SERVICE

The undersigned, on behalf of the Requester, hereby certifies that a copy of each of the following documents:

1. Transmittal Letter (1 page);
2. Notice Under 37 C.F.R. § 1.565 and MPEP 2282 (3 pages, including this certificate);
3. Copy of District Court's Order dated June 2, 2009 (35 pages); and
4. Copy of Federal Circuit's Order dated July 1, 2009 (3 pages)

was served on the Patent Owner via first class mail on July 7, 2009. The name and address of the party served is as follows: Edward Kessler, Sterne Kessler Goldstein Fox, 1100 New York Ave, N.W., Washington, D.C. 20005.

/MehranArjomand/
Mehran Arjomand

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

TIVO INC.,	§	
	§	
Plaintiff,	§	
	§	
vs.	§	**CIVIL ACTION NO. 2:04-CV-01 (DF)**
	§	
DISH NETWORK CORPORATION, et al.,	§	
	§	
	§	
Defendants.	§	

MEMORANDUM OPINION

Before the Court are TiVo's Motion to Hold EchoStar In Contempt For Violation Of This Court's Permanent Injunction and the parties' Post-Hearing Proposed Findings of Fact and Conclusions of Law. Dkt. Nos. 832, 919, and 920. Also before the Court are the transcripts and evidence from hearings regarding EchoStar's alleged contempt; those hearings were held on September 4, 2008 (Dkt. Nos. 859-860) and on February 17-19, 2009 (Dkt. Nos. 907-915). Having considered the papers in light of the testimony, evidence, and relevant case law, the Court now addresses all issues raised by TiVo's motion to hold EchoStar in contempt.

This opinion will begin by discussing the background and procedural history of this case, which is both lengthy and complex. What follows is a brief discussion of the basic legal principles for contempt proceedings in patent cases. Specifically, this Court will outline the Federal Circuit's seminal case, *KSM Fastening Systems, Inc. v. H.A. Jones Company, Inc.*, 776 F.2d 1522 (Fed. Cir. 1985), and also address the relevance of particular evidence and the movant's burden of proof. Next, the opinion will analyze the modifications made to EchoStar's DVRs, that is whether the modified

DVR software is more than colorably different from the adjudged software and whether the modified software continues to infringe TiVo's patent. Finally, the opinion will analyze EchoStar's alleged facial violation of this Court's injunction, that is whether EchoStar failed to comply with the specific directives of this Court's orders.

I.

In this patent infringement action, tried to a jury in March of 2006, Plaintiff TiVo, Inc. (hereafter "TiVo") accused Defendants EchoStar Communications Corporation,[1] EchoStar DBS Corporation, EchoStar Technologies Corporation, EchoStar Satellite LLC, and EchoSphere LLC of infringing certain claims of U.S. Patent No. 6,233,389 ("the '389 Patent"). Dkt. No. 3 (Amended Complaint). Defendants (collectively referred to as "EchoStar") are a group of inter-related companies who together operate or support the satellite television service marketed as "Dish Network." EchoStar designs digital video recorders ("DVRs"), which are provided to customers as part of its satellite service. Such DVR technology is central to the '389 Patent, which is entitled "Multimedia Time Warping System" and generally describes a DVR system that allows for simultaneous storage and playback of television signals from sources such as cable and satellite providers.

At trial, TiVo accused EchoStar DVR receivers of infringing nine claims of the '389 Patent. Specifically, TiVo asserted claims 1, 5, 21, 23, 32, 36, and 52 (the "Hardware Claims"), as well as claims 31 and 61 (the "Software Claims"). The accused receivers fell into two categories depending on what processing chip controlled the DVR. The first category—containing model numbers

[1] DISH Network Corporation has been substituted for EchoStar Communications Corporation and EchoStar Corporation has been joined as a defendant in this action. Dkt. No. 863.

DP-501, DP-508, and DP-510—operate using a chip from ST Microelectronics and are referred to as the "50X Products." The second category—containing model numbers DP-522, DP-625, DP-721, DP-921, and DP-942—operate using a Broadcom chip and are appropriately referred to as the "Broadcom Products."

In its verdict, the jury found that all asserted claims of the '389 Patent were valid and that EchoStar's accused DVRs infringed each of those claims. *See* Dkt. No. 690 (verdict form). Specifically, the jury found that the 50X Products literally infringed all claims, while the Broadcom Products literally infringed the Hardware Claims and infringed the Software Claims under the doctrine of equivalents. Finally, the jury awarded TiVo $73,991,964 in damages and found by clear and convincing evidence that EchoStar's infringement was willful.

Following the jury's verdict, EchoStar immediately assigned some of its best engineers the task of designing around the '389 Patent. Dkt. No. 919 at 71-74. Although this Court, as more fully explained below, enjoined EchoStar from further infringement and ordered it to disable the DVR capability in the infringing products, that order was stayed pending an appeal to the Federal Circuit. By the time that stay was lifted and this Court's injunction was once again in effect, EchoStar had long since downloaded its design-around effort—modified DVR software—into its DVR products. It is TiVo's position, however, that EchoStar never complied with this Court's order and to this date provides infringing DVR service to its customers on the very products that the jury found to infringe. As a result, TiVo requests that EchoStar be found in contempt. Dkt. No. 832. In response, EchoStar contends that it has successfully designed around the '389 Patent. Dkt. No. 839. As a result, EchoStar believes that this Court's injunction, meant to enjoin only infringing activities, cannot cover EchoStar's modified products. *Id.*

A.

Following the jury verdict in its favor, TiVo asked this Court to issue an injunction prohibiting EchoStar from further infringement of the '389 Patent and requiring EchoStar to disable the DVR functionality in its infringing products. Dkt. No. 733. EchoStar opposed TiVo's request and asked the Court to stay any injunction that might issue pending appeal. Dkt. Nos. 737 and 754. After considering both parties' positions, this Court entered its Final Judgment and Permanent Injunction on August 17, 2006. Dkt. No. 776. This Court also denied EchoStar's request to stay the injunction pending appeal. Dkt. No. 773. The Court's injunction, as later amended by joint motion (Dkt. No. 800), reads:

> Each Defendant, its officers, agents, servants, employees and attorneys, and those persons in active concert or participation with them who receive actual notice hereof, are hereby restrained and enjoined, pursuant to 35 U.S.C. § 283 and Fed. R. Civ. P. 65(d), from making, using, offering to sell, selling or importing in the United States, the Infringing Products, either alone or in combination with any other product and all other products that are only colorably different therefrom in the context of the Infringed Claims, whether individually or in combination with other products or as part of another product, and from otherwise infringing or inducing others to infringe the Infringed Claims of the '389 patent.
>
> Defendants are hereby further ordered to, within thirty (30) days of the issuance of this order, disable the DVR functionality (i.e. disable all storage to and playback from a hard disk drive of television data) in all but 192,708 units of the Infringing Products that have been placed with an end user or subscriber. The DVR functionality, (i.e. disable all storage to and playback from a hard disk drive of television data) shall not be enabled in any new placement of the Infringing Products.

Dkt. No. 806 at 2.

As can be seen, the injunction contained two major provisions. First, it contained an "Infringement Provision," which prohibited further infringement of the '389 Patent by the infringing DVRs. Second, it contained a "Disablement Provision," which required EchoStar to disable the DVR functionality, as specifically defined by the Court, in the infringing DVRs. The Disablement Provision did provide an exception for 192,708 DVR units, the number of units for which TiVo received lost profit damages and against which TiVo did not pursue an injunction. *See* Dkt. No. 747 at 16.

EchoStar took issue with the exact language of the Disablement Provision. Specifically, EchoStar argued that the provision was overbroad and EchoStar contended that the "appropriate scope of the injunction, if one were to issue, would enjoin *only the provision of infringing DVR software* to those boxes upon activation." *Id.* (emphasis added). TiVo opposed EchoStar's proposal and warned that it would be "an invitation for EchoStar to engage in mischief . . . [and] would only result in EchoStar providing what it deemed as 'non-infringing' DVR software to its already-found-to-be-infringing DVRs, creating the opportunity for interminable disputes to determine what exactly is 'infringing DVR software.'" Dkt. No. 747 at 15. Such a dispute is presently before this Court.

While the parties were disputing the form that the injunction should take, EchoStar was already well on its way to implementing its design-around effort. Before this Court entered its Amended Final Judgment and Permanent Injunction on September 8, 2006, EchoStar's development efforts were so far advanced that it had obtained three written opinions of counsel. *Id.*; *see also* PX3028, PX3029, and PX3030. At that time, however, EchoStar had not informed this Court of any design-around efforts.

After this Court entered its permanent injunction, EchoStar asked the Federal Circuit to stay the injunction during EchoStar's pending appeal. In that request, EchoStar represented that without the stay it would be unable to provide DVR service and would risk losing a significant portion of its existing or potential customers, which could cost the company $90 million per month. *See* Dkt. No. 920 at 20 (citing EchoStar's Reply Brief In Support of Its Emergency Motion to Stay the District Court's Injunction, at 9). EchoStar never mentioned its design-around efforts to the Federal Circuit. As a result of EchoStar's representations, however, the Federal Circuit granted EchoStar's request for a stay of the injunction on October 3, 2006. Dkt. No. 812. Later that month, EchoStar began downloading modified software into its customers' DVRs (Dkt. No. 839 at 8); this fact did not become known to any court until May 2008, after the appellate process had concluded.

TiVo contests whether EchoStar actually downloaded the modified software into all of its infringing products. Indeed, EchoStar has admitted that it "do[es] not have a way to check if every unit actually received the new software." Dkt. No. 912 at 30:11-15. For the purposes of this opinion, however, the Court will assume that the new software was downloaded to all infringing DVRs.

B.

On appeal, EchoStar challenged this Court's claim construction on a number of grounds. *See TiVo, Inc. v. EchoStar Commc'ns Corp.*, 516 F.3d 1290, 1295-1307 (Fed. Cir.), *cert. denied*, 129 S. Ct. 306 (2008). While most of those challenges concerned the Hardware Claims, EchoStar did challenge this Court's interpretation of one term—"object"—within the Software Claims. *Id.* at 1306-07. Although the Federal Circuit reversed this Court's construction of certain terms within the Hardware claims (*id.* at 1304-05), it affirmed this Court's construction of "object" in the Software

claims. *Id.* at 1306-07. EchoStar did not challenge the construction of any other term within the Software Claims. *Id.* In addition, the Circuit found that there was sufficient evidence to support the jury's finding of infringement regarding the Software Claims. *Id.*

At no point during the appellate process did EchoStar challenge the language or scope of this Court's injunction. As a result, the Federal Circuit's stay dissolved once EchoStar's appeal become final. *See id.* at 1312. Thus, when the mandate in this case issued on April 18, 2008, this Court's injunction was reinstated without alteration.

Shortly after the mandate issued, this Court requested letter briefs from the parties on how best to proceed in light of the Circuit's decision. Dkt. No. 822. Those letters were provided to the Court in May 2008. Dkt. Nos. 825 and 826. The substance of those letters raised, for the first time, the issue of EchoStar's design-around efforts and TiVo's belief that EchoStar was in contempt of this Court's injunction. *Id.* At that time, it became apparent that TiVo believes there are at least two theories under which EchoStar could be found in contempt. *See* Dkt. No. 825. First, TiVo believes that EchoStar violated the "face of the injunction," particularly the Disablement Provision, by never disabling DVR functionality in the infringing products. *Id.* Second, TiVo believes that EchoStar's modifications are not a sufficient design-around—that is, the new software downloaded into EchoStar's DVRs still infringes the '389 Patent. *Id.* EchoStar responds by arguing that its software modifications no longer infringe the '389 Patent and that EchoStar has fully complied with both the letter and the spirit of the injunction. Dkt. No. 825.

On May 30, 2008, this Court held a brief status conference related to these issues. Dkt. No. 830 (transcript). At that conference, this Court gave the parties a timeline under which TiVo could bring a motion requesting that EchoStar be found in contempt. *Id.* The Court, however, denied

TiVo's request for limited discovery on EchoStar's design-around. Dkt. No. 829. This Court deemed it necessary to determine first whether EchoStar should be held in contempt for violating the Disablement Provision on its face. *Id.* Presented with the prospect of contempt proceedings in this Court, Echostar filed, less than an hour after the status conference had concluded, a declaratory judgment action in Delaware seeking a declaration that its modified software no longer infringes the '389 Patent.[2] *See* Dkt. No. 832 at 9.

This Court held a hearing on September 4, 2008 to determine whether EchoStar had facially violated the Disablement Provision. Dkt. No. 860 (transcript). After that hearing, however, this Court concluded that an additional hearing was necessary to determine whether EchoStar's modified DVRs are more than colorably different from the adjudged devices and whether the modified DVRs continue to infringe the '389 Patent.[3] Dkt. No. 864. The Court set the additional hearing for February 2009 and ordered the parties to engage in related discovery. *Id.* Believing this to be an improper course of action under Federal Circuit precedent, EchoStar immediately filed a petition for writ of mandamus with the Circuit and requested that this Court stay the additional proceedings

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[2] The Delaware Court recently denied TiVo's motion to dismiss the declaratory judgment action. *Dish Network Corp. v. TiVo, Inc.*, Civil Action No. 08-327-JJF (March 31, 2009). The Delaware court found that it had jurisdiction to decide the action under *MedImmune, Inc. v. Genentech, Inc.*, 549 U.S. 118 (2007) and that EchoStar was not engaged in improper forum shopping because TiVo is a Delaware corporation. The Delaware court, however, found that it was "unable to make a concrete determination as to whether the redesigned products present more than a 'colorable difference' over the infringing products." That determination, in the opinion of the Delaware court, is one best made by this Court given its experience with the case. Accordingly, the parties have been ordered by the Delaware Court to brief whether transfer of the declaratory judgment action to this Court would be appropriate.

[3] In its original formulation, the February hearing would have considered the continued infringement of both the Software Claims and the Hardware Claims. Dkt. No. 864. Although the jury's finding of literal infringement of the Hardware Claims had been overturned, the Federal Circuit did not render an opinion regarding EchoStar's infirngement of those claims under the doctrine of equivalents. *TiVo*, 516 F.3d at 1304-05. The Circuit remanded that issue for further proceedings should TiVo wish to pursue such. *Id.* TiVo, however, indicated that it did not wish to do so in these contempt proceedings, so the Hardware Claims have been dropped from consideration at this time.

pending the appellate court's decision. Dkt. No. 865. This Court denied EchoStar's request for stay; due to the agreement of the parties, however, the Court limited the scope of the February hearing. Dkt. No. 869 and 870. The Court limited the hearing to two discrete issues:

> (1) whether the software downloaded to EchoStar's DP-501, DP-508, DP-510, DP-522, DP-625, DP-721, DP-921, and DP-942 is no more than colorably different from the adjudged software; and (2) whether those receivers continue to infringe claims 31 and 61 of U.S. Patent No. 6,233,389, either literally or under the doctrine of equivalents.

Dkt. No. 870. With these changes in hand, EchoStar voluntarily moved to dismiss its mandamus petition. Dkt. No. 873.

After the parties had conducted discovery, the Court held a hearing to address these issues on February 17-19, 2009. Dkt. Nos. 910-914 (transcripts). Now that the parties have submitted proposed findings of fact and conclusions of law for this Court's consideration (Dkt. Nos. 919 and 920), this Court addresses all issues raised by TiVo's motion to hold EchoStar in contempt.

II.

A contempt proceeding for violation of an injunction issued in a patent case, "while primarily for the benefit of the patent owner, nevertheless, involves also the concept of an affront to the court for failure to obey its order." *KSM Fastening Sys., Inc. v. H.A. Jones Co.*, 776 F.2d 1522, 1524 (Fed. Cir. 1985). The process of contempt, however, is a "severe remedy, and should not be resorted to where there is *fair ground of doubt* as to the wrongfulness of the defendant's conduct." *Id.* at 1525 (quoting *Cal. Artificial Stone Paving Co. v. Molitor*, 113 U.S. 609, 618 (1885)). Such restraint is even more warranted when an enjoined party has taken steps to reform its conduct. *See id.* ("[W]here the patent owner seeks to enforce an injunction against an enjoined infringer by reason

of a manufacture which was not the subject of the original litigation, the courts have been uniform in exercising restraint . . . .").

In determining whether such restraint should be set aside and contempt found in a patent case, a court must address two separate questions. First, the court must decide whether contempt proceedings are the appropriate forum to determine whether the modified device infringes. *Id.* at 1530-32; *see also Additive Controls & Measurement Sys., Inc. v. Flowdata, Inc.*, 154 F.3d 1345, 1349 (Fed. Cir. 1998). In making this threshold determination, the court must compare the adjudged and modified products; if the products are "more than colorably different" such that "substantial open issues" of infringement exist, then contempt proceedings are inappropriate. *KSM*, 776 F.2d at 1528-32; *Additive Controls*, 154 F.3d at 1349. In the event that contempt proceedings are inappropriate, the patent owner must enforce its rights in a separate infringement action. *KSM*, 776 F.2d at 1530-32; *Additive Controls*, 154 F.3d at 1349.

If the court, however, finds that contempt proceedings are appropriate, then it must resolve a second question—whether the modified products continue to infringe the claims of the patent at issue. *KSM*, 776 F.2d at 1532; *Additive Controls*, 154 F.3d at 1349. In addressing this second question, "the court cannot avoid looking at the claims of the patent." *KSM*, 776 F.2d at 1528. The scope of those claims must be interpreted using the court's previous rulings and may not be broadened so as to catch the modified product. *Id.* at 1529. In some cases, however, it may "only be necessary to determine that the modified device has not been changed from the adjudged device in a way which affects an element of a claim." *Id.* at 1528-29. In such a case, the modified and adjudged devices may be treated as the same. *Id.* at 1529.

Within the general constraints of this two-step test, "the district court has broad discretion to determine how best to enforce its injunctive decrees." *Additive Controls*, 154 F.3d at 1349. To this end, a court may request the benefit of expert testimony to determine whether more than colorable differences and continued infringement exist. *See id.* ("Although [Federal Circuit] case law suggests that the need for expert testimony counsels against the use of contempt proceedings . . . the district court satisfied the procedural requirements of *KSM* by separately analyzing the questions whether contempt proceedings were appropriate and whether the redesigned device infringed the patent."); *Abbot Labs. v. Torpharm, Inc.*, 503 F.3d 1372, 1379 (Fed. Cir. 2007) (court did not abuse discretion in electing to try issues in contempt proceedings even though expert testimony was needed).[4]

A.

As mentioned above, the Federal Circuit has cautioned that contempt is a "severe remedy," which should not be resorted to lightly. *KSM*, 776 F.2d at 1525; *see also Arbek Mfg., Inc. v. Moazzam*, 55 F.3d 1567, 1569 (Fed. Cir. 1995). As a result, the Federal Circuit has stated that "the movant bears the heavy burden of proving violation by clear and convincing evidence." *KSM*, 776 F.2d at 1524 (citing 11 CHARLES ALAN WRIGHT & ARTHUR R. MILLER, FEDERAL PRACTICE AND PROCEDURE: CIVIL § 2960 at 591).

There is some question, however, as to whether a clear and convincing burden applies to both steps of the *KSM* test. EchoStar argues that it does (Dkt. No. 919 at 17-19), while TiVo argues that

[4] Given the complex technology in this suit, this Court believes that expert testimony was helpful in resolving both steps of the *KSM* test, as both steps required this Court to analyze the source code in EchoStar's modified software. Although expert testimony may not be necessary with regard to more tangible technology, the Court found it helpful under the circumstances of this case.

the heightened burden applies only to step two, infringement by the modified device (Dkt. No. 920 at 27-29). After reviewing both *KSM* and its progeny, this Court agrees with TiVo.

The Federal Circuit's only mention of the "clear and convincing" burden in the *KSM* decision comes at the very beginning of the opinion. *KSM*, 776 F.2d at 1525. At that point in the opinion, Judge Nies is discussing contempt proceedings in their broadest sense. *See id.* ("Contempt proceedings are generally summary in nature and may be decided by the court . . . without the formalities of trial, although the movant bears the heavy burden of proving violation by clear and convincing evidence."). Once the opinion turns to its two-step test, however, the Circuit is silent regarding this heightened burden.

In later iterations, however, the Circuit has suggested that the clear and convincing burden only applies to the second step of the *KSM* test. Specifically, the Circuit has stated that to "show contempt, the patent owner must prove by clear and convincing evidence that 'the modified device falls within the admitted or adjudicated scope of the claims and is, therefore, an infringement." *Arbek*, 55 F.3d at 1569 (quoting *KSM*, 776 F.2d at 1530). This comparison of modified device to the claims and the connected conclusion that the modified device is or is not an infringement is what the second *KSM* step is designed to accomplish. *Compare Arbek*, 55 F.3d at 1569, *with KSM*, 776 F.2d at 1529-30, *and Additive Controls*, 154 F.3d at 1349 (discussing second step).

While a heightened burden clearly applies to step two of the *KSM* test, it is less clear what, if any, burden applies to the first step. Recall that under the *KSM* two-step test, the first and threshold question determines whether contempt proceedings are even appropriate given the facts of a case. *KSM*, 776 F.2d at 1530-32; *Additive Controls*, 154 F.3d at 1349. Although some district courts have applied a heightened burden to this threshold determination (*see e.g. Brine, Inc. v. STX,*

L.L.C., 367 F. Supp. 2d 61, 67 (D. Mass. 2005)), this Court does not believe that such is proper. Instead, this Court finds that no burden attaches to the first *KSM* step as it is a purely "procedural standard" entrusted to the discretion of the trial court. *See KSM*, 776 F.2d at 1532.

To clarify this Court's finding, it is helpful to quote *KSM* at length. After determining that the "colorable differences" test should be used over a competing doctrine-of-equivalents-based test, the Circuit concluded as follows:

> With respect to the issue of when contempt proceedings will be allowed, we conclude that the *procedural analysis* used by the majority of courts should be adopted as the general rule. A *standard based on procedural considerations* is more likely to meet due process requirements, considering the usual summary nature of contempt proceedings. Under *a procedural standard*, the district court is able to utilize principles of claim and issue preclusion (*res judicata*) to determine what issues were settled by the original suit and what issues would have to be tried. Such a determination may vary depending upon whether the original suit was settled by consent or fully litigated. If there are substantial open issues with respect to infringement to be tried, contempt proceedings are inappropriate. The presence of such disputed issues creates a fair ground for doubt that the decree has been violated. *So long as the district court exercises its discretion to proceed or not to proceed by way of contempt proceedings within these general constraints*, this court must defer to its judgment on this issue.
>
> In sum, the initial question to be answered in ruling on a motion for contempt is whether contempt proceedings are appropriate. That question is *answered by the trial court's judging* whether substantial disputed issues must be litigated. The second question, whether an injunction against infringement has been violated, requires, at a minimum, a finding that the accused device is an infringement.

Id. (emphasis added, internal citations omitted).

Thus, the threshold question of whether contempt proceedings are appropriate is left entirely to the discretion of the trial court. It is not for one party to *prove* that such proceedings are or are not appropriate. If, and only if, the trial court determines that contempt proceedings are appropriate does

the movant bear a burden of proving the second question—infringement by the modified device—by clear and convincing evidence.

B.

Answering the steps of the *KSM* test requires comparisons between the original product, the modified product, and the claims. The first step determines whether there are more than merely colorable differences between the products. *KSM*, 776 F.2d at 1530-32. As such, the first step "turns on a comparison between the original infringing product and the redesigned device." *Additive Controls*, 154 F.3d at 1549. The actual claims of the patent are not truly at issue in *KSM*'s first step, though to be certain, any difference between the products must relate to some claim element. *See id.* at 1350 (finding no more than colorable differences or substantial questions of infringement because the differences related to "no elements of the pertinent patent claim").

If no more than colorable differences are found such that there are no substantial open issues of infringement, then the second step of the *KSM* test compares the redesigned product to the patent claims as previously adjudged. *KSM*, 776 F.2d at 1529-30. In making this comparison, the Court is bound by its previous rulings on the scope of the claims and may not broaden the scope of the claims to catch the modified device. *Id.* at 1530. This Court also finds, however, that the scope of the patent claims is not, as EchoStar contends (Dkt. No. 919 at 19-45), limited by a jury's verdict or a patentee's theories at trial. As the second step of the *KSM* analysis is nothing more than a normal patent infringement analysis involving the modified product, the proper scope of the patent claims is governed by the trial court's prior decisions on claim construction as upheld by the Federal Circuit. *See Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed. Cir. 1995), *aff'd*, 517 U.S. 370 (1996) ("An infringement analysis entails two steps. The first step is determining the

meaning and scope of the patent claims asserted to be infringed. The second step is comparing the properly construed claims to the device accused of infringing." (citation omitted)).

Finally, the comparisons in either step of the *KSM* test do not, as EchoStar also contends (*see* Dkt. No. 919 at 70-77), involve the infringer's intent or good faith. The general rule in civil contempt proceedings is that "a party need not intend to violate an injunction to be found in contempt." *Additive Controls*, 154 F.3d at 1353 (citing *McComb v. Jacksonville Paper Co.*, 336 U.S. 187, 191 (1947)). Moreover, "good faith is irrelevant as a defense to a civil contempt order." *Id.* (quoting *Waffenschmidt v. MacKay*, 763 F.2d 711, 723-26 (5th Cir. 1985)).

As a result, this Court will focus its analysis on EchoStar's DVR software (both old and new) and the Software Claims of TiVo's '389 Patent as construed by this Court and upheld by the Federal Circuit.

III.

EchoStar concedes that its DVRs—both its 50X Products and Broadcom Products—continue to satisfy most of the limitations in claims 31 and 61 as they did at trial. EchoStar believes, however, that it has changed its 50X Products in one significant way and has changed its Broadcom Products in two significant ways. Dkt. No. 920 at 10-15.

With respect to EchoStar's 50X Products, EchoStar contends that it has modified its DVR software to implement a "indexless" system. Dkt. No. 839 at 4-5; Dkt. No. 919 at 53-55. EchoStar's receivers at trial detected start codes in the incoming broadcast data and created an index of those start codes for use in "trick play" operations. *Id.* After trial, EchoStar modified the software in its 50X Products to remove this start-code detection capability. Dkt. No. 910 at 164:22-165:3; DX5160. At present, EchoStar's receivers perform trick play operations by transferring incoming data directly

to a hard drive and using average frame rate statistics collected during playback to estimate the location of stored video data. Dkt. No. 910 at 201:19-205:15. This method of playback requires greater processing power by the DVR hardware and EchoStar refers to the method as a "brute-force" search. *Id.*; PX3277, PX3278.

EchoStar contends that the move to an "indexless" or "brute-force" system means that its DVR software no longer satisfies the "parses" limitation of the '389 Patent's Software Claims. Dkt. No. 910 at 197:25-198:15; Dkt. No. 912 at 168:6-169.18; Dkt. No. 919 at 53-55, 92-119. Claim 31 of the '389 Patent claims a "process for the simultaneous storage and play back of multimedia data," which is further comprised of numerous steps.[5] '389 Patent at 14:52-53. The first such step requires "providing *a physical data source*, wherein said physical data source accepts broadcast data from an input device, *parses video and audio data from said broadcast data*, and temporarily stores said video and audio data[.]" *Id.* at 14:54-57 (emphasis added).

TiVo argues that this limitation is still satisfied by EchoStar's modified 50X Products because those products still analyze the broadcast signal. During claim construction, this Court construed the term "parses" in all claims to mean "analyzes," and therefore defined "parses video and audio data from said broadcast data" in claims 31 and 61 as "analyzes video and audio data from the broadcast data." Dkt. No. 185 at 22. On appeal, EchoStar did not challenge this Court's construction of the term "parses." *See TiVo*, 516 F.3d at 1295-1307. Since parsing is defined as analyzing rather than indexing, TiVo contends that EchoStar's modified receivers still satisfy the limitation even though they may no longer index the incoming signal. Dkt. No. 920 at 36-41; Dkt.

[5] Claim 61 is similar to claim 31, except that it recites an apparatus rather than a process. '389 Patent at 18:3-30. For all intents and purposes, however, the parties have treated the two claims alike for these proceedings.

No. 910 at 66:9-67:19. Specifically, TiVo contends that the limitation is still met by PID filtering, which involves analyzing the incoming data stream and selecting the appropriate packets of data associated with a program or channel selected by the viewer. *Id.* In support of this position, TiVo cites to testimony at the 2006 trial in which experts, including EchoStar's own experts, testified that PID filtering satisfied the parsing limitation in the Software Claims. Dkt. No. 716 at 110:10-111:14; Dkt. No. 722 at 99:17-100:23.

In response, EchoStar argues that judicial estoppel bars TiVo from arguing that PID filtering satisfies the parsing limitation. Dkt. No. 919 at 21-38, 92-98. EchoStar contends that TiVo argued at trial that the parsing limitation was satisfied by start-code detection and indexing. *Id.* Because the jury agreed with this position, in that it returned a verdict favorable to TiVo, EchoStar believes that TiVo cannot now assert that parsing is met by something other than start-code detection and indexing. *Id.* In addition, EchoStar argues that PID filtering does not involve the analyzing of data; instead, it involves merely looking at the header of an incoming packet of data rather than its payload. Dkt. No. 912 at 171:14-172:2; Dkt. No. 919 at 99-103. Moreover, EchoStar contends that the '389 Patent's specification makes it clear that PID filtering is not parsing and that PID filtering, common to digital receivers without DVR capability, is not central to the invention embodied in the '389 Patent. Dkt. No. 919 at 29-33, 103-107

With respect to EchoStar's Broadcom Products, EchoStar contends that it made two changes. First, EchoStar implemented the same "indexless" system found in the 50X Products. Dkt. No. 919 at 53-55. Thus, EchoStar argues that its Broadcom Products also do not satisfy the "parses" limitation of the Software Claims. Dkt. No. 919 at 92-119. Second, EchoStar modified the

buffering structure used to record data to the Broadcom Product's hard drive. *See* Dkt. No. 919 at 38-42, 55-58.

At the time of trial, EchoStar's infringing Broadcom receivers utilized a pool of ten buffers (collectively the "transport buffer") and an intermediate "record buffer." Dkt. No. 910 at 219:24-223:20. When one of the ten buffers in the transport buffer was full, EchoStar's software would copy the data from that single buffer into the record buffer. That data would then be written to the hard drive from the record buffer. Additional data would not be transferred from any of the nine remaining buffers to the record buffer until the record buffer's data had been transferred to the hard drive. In other words, EchoStar's infringing product would never extract data from the transport buffer until the record buffer was empty and available. This "blocking of access to the record buffer" prevented data already in the record buffer from being overwritten. *Id.*; Dkt. No. 919 at 55-58.

EchoStar modified its software by removing the record buffer such that data is now transferred directly from the transport buffer to the hard drive. Dkt. No. 910 at 110:7-112:8, 217:6-218:19. Thus, EchoStar contends that the "blocking" function performed by the record buffer is no longer present in its modified receivers. Because it removed this blocking function, EchoStar believes that its DVR software no longer satisfies the "automatic flow control" limitation of the Software Claims. Dkt. No. 910 at 226:1-231:14; Dkt. No. 912 at 222:15-235:19; Dkt. No. 919 at 119-139. The fifth step of claim 31's storage and playback process requires a "source object [that] is *automatically flow controlled* by said transform object." '389 Patent at 15:1-2 (emphasis added).

TiVo argues that this limitation is still satisfied by EchoStar's modified Broadcom Products because data transfer is still self-regulated in those products. During claim construction, this Court construed the term "automatically flow controlled" in claims 31 and 61 to mean "self-regulated."

Dkt. No. 185 at 24. On appeal, EchoStar did not challenge this Court's construction of that term. *See TiVo*, 516 F.3d at 1295-1307. TiVo argues that self-regulation is not limited to the "blocking" of data flow. Dkt. No. 910 at 87:9-25; Dkt. No. 920 at 41-44, 53-56. As EchoStar's modified products still operate using ten buffers in a "circular" formation, in which data is written into one buffer at a time, TiVo argues that self-regulation is still present. Dkt. No. 910 at 86:9-117:19.

In response, EchoStar once again argues that judicial estoppel bars TiVo's arguments. Dkt. No. 919 at 38-42, 119-25. Echostar contends that TiVo argued at trial that the record buffer provided automatic flow control. *Id.* Because the jury agreed with this position, in that it returned a verdict favorable to TiVo, EchoStar believes that TiVo cannot now argue that the redesigned Broadcom receivers infringe notwithstanding the removal of the record buffer. *Id.* In addition, EchoStar argues that a circular buffer cannot by itself provide for flow control because overflow is still a possibility in such a system. Dkt. No. 910 at 221:15-222:9; Dkt. No. 912 at 227:24-228:5; Dkt. No. 919 at 130-32. Finally, EchoStar contends that the redesigned circular buffer system lacks the required source object and transform object. Dkt. No. 919 at 129-130.

To summarize, EchoStar contends that it made one change to its 50X Products—it removed start-code detection and implemented a indexless system. Under this system, EchoStar believes that its products no longer parse incoming data as required by the '389 Patent. EchoStar also implemented this indexless system in its Broadcom Products. Moreover, EchoStar changed the buffering structure in its Broadcom Products—it removed an intermediate buffer dubbed the "record buffer." EchoStar believes that its Broadcom Products, in the absence of this record buffer, are no longer automatically flow controlled as required by the '389 Patent.

Having now outlined the parties' basic positions with respect to the actual changes made to the infringing products, the Court will address EchoStar's judicial estoppel arguments before analyzing EchoStar's modifications under the two-step *KSM* test.

A.

The doctrine of judicial estoppel "prohibits a party from taking inconsistent positions in the same or related litigation." *Transclean Corp. v. Jiffy Lube Intl'l, Inc.*, 474 F.3d 1298, 1307 (Fed. Cir. 2007) (citation omitted). The doctrine is designed to protect the integrity of the judicial process and may be invoked by the court at its discretion. *New Hampshire v. Maine*, 532 U.S. 742, 749-50 (2001). In determining whether to invoke judicial estoppel courts typically look to several factors: (1) whether a party's later position is "clearly inconsistent" with its earlier position; (2) whether the party has succeeded in persuading the court to accept that party's earlier position, so that acceptance of the later position would create "the perception that either the first or second court was misled"; and (3) whether the party seeking to assert an inconsistent position would cause unfair prejudice if not estopped. *Id.*

Here, EchoStar argues that TiVo should be estopped from taking positions that EchoStar believes are inconsistent with positions taken at trial. Dkt. No. 919 at 19-45. Specifically, EchoStar argues that TiVo should be prevented from arguing that start-code detection is not necessary to claims 31 and 61 when it argued at trial that start-code detection satisfied the parsing limitation. In addition, TiVo should be prevented from arguing that those claims do not require the blocking of access to buffers to prevent the overflow of data when it argued at trial that automatic flow control was satisfied by such blocking.

This Court is unpersuaded by EchoStar's arguments. The Court finds that the positions taken by TiVo during these contempt proceedings and previously at trial are not "clearly inconsistent" with one another. There is nothing inconsistent with TiVo's position that EchoStar's past and present products fall within the scope of the '389 Patent as construed by this Court. If this action involved real property, past and present trespasses to TiVo's land may occur in dissimilar ways (i.e. entry from the west versus entry from the south). As long as the trespasser is crossing the metes and bounds of TiVo's property, TiVo may argue that both are trespasses. There is nothing inconsistent in those positions.

Here, the metes and bounds of TiVo's property are the patent claims as construed by this Court and affirmed by the Federal Circuit. TiVo's position that those boundaries have been crossed and continue to be crossed by EchoStar's products is not inconsistent. Thus, TiVo may argue that automatic flow control is satisfied by EchoStar's modified products even though the exact manner of infringement may be slightly different. Likewise, TiVo may argue that EchoStar's modified products continue to parse incoming data though the manner in which that is accomplished might have changed slightly. If this Court disallowed such arguments, then future infringers could easily side-step this and other courts' orders by making insignificant changes to their products. It would be tantamount to allowing an enjoined trespasser re-entry onto the land in dispute because he is now using a different road and compounding the injustice by silencing the property owner when he asked the court to enforce its decree.

This Court is also cognizant of the fact that TiVo made certain arguments at trial due to the fact that both Hardware and Software Claims were being asserted at that time. This Court finds that arguments made by TiVo regarding Hardware Claims should not limit the Software Claims. It is

undisputed that the Hardware Claims—no longer an issue in the present proceedings—contain limitations not found in the Software Claims. In particular, the Hardware Claims require a "Media Switch" that both parses *and* separates the incoming data stream. '389 Patent at 12:48-50 (claim 1). TiVo argued at trial that EchoStar's products contained such a Media Switch, which satisfied the parsing and separating requirement of the Hardware Claims through start-code detection and indexing. Moreover, TiVo argued that the Media Switch could also be the "physical data source" that "parses video and audio data" as required by the Software Claims.

The fact that TiVo argued that a Media Switch satisfied the "physical data source" requirement of the Software Claims, however, does not limit those claims. This Court has never held that the "physical data source" in the Software Claims is limited to a Media Switch. The Media Switch must parse *and* separate the incoming data, whereas the physical data source of the Software Claims need only parse. As a result, the physical data source of the Software Claims is less specific—in that it performs less functions—than the Media Switch of the Hardware Claims. Although the Media Switch could satisfy the Software Claims, there are potentially other, more generic physical data sources that could be sufficient.

By arguing that parsing in the Software Claims must be limited to start-code detection and/or indexing, this Court believes that EchoStar is trying to import the Media Switch or an equivalent into the Software Claims. This Court declines to do so. TiVo's positions at trial regarding a Media Switch must not be read onto the physical data source limitation of the Software Claims. Because the Software Claims require less of the physical data source than the Hardware Claims require of the Media Switch, it is possible for the physical data source to operate differently than the Media Switch and still meet the required limitation. Thus, whereas the Media Switch considered at trial carried

out start-code detection and indexing, it is possible for the physical data source to do less. In other words, the physical data source could carry out a much simpler task than start-code detection and indexing while still satisfying the parsing limitation of the Software Claims. TiVo may take this position without being inconsistent, without creating the perception that the Court was misled, and without the danger of unfair prejudice to EchoStar.

Finally, EchoStar's argument that this Court must accept "the scope of the claims as adjudicated by the jury" (Dkt. No. 910 at 33:5-6) is unpersuasive. EchoStar would have this Court introduce start-code detection, indexing, or blocking requirements into claims 31 and 61. EchoStar believes such is proper because the jury seemingly accepted TiVo's arguments at trial. Dkt No. 910 at 32:15-25. As a result, EchoStar argues that the adjudicated scope of the claims was determined by jury deliberations rather than this Court's claim construction. Dkt. No. 910 at 23:23-24:2 (modifications attempted to "design-around the scope of the claims as adjudicated by the jury"), 33:5-6 ("We have to be looking at contempt in the scope of the claims as adjudicated by the jury.").

EchoStar's position is erroneous in a number of ways. First, this Court instructed the jury as to the meaning of the claims. The jury was told that it had to apply this Court's interpretations of the claims. Dkt. No. 691 at 6. The Court must assume that the jury complied with its instruction and did not apply its own interpretation to the claims. Second, even if this Court accepted EchoStar's position, there is no way to determine the thought process of the jury. Some or even all members of the jury may have believed from the testimony that parsing was satisfied by PID filtering rather than start-code detection. Finally, EchoStar's position would allow experts to once again argue about the scope of claim terms. Indeed, at the February hearing EchoStar's expert, Dr. Rhyne, testified that he considered "what had been successful in the eyes of the jury" to determine his

opinion of claim scope. Dkt. No. 912 at 168:6-169:9. Such postulation by experts as to the scope of patent claims has been repeatedly deemed improper by the Federal Circuit. *Markman*, 52 F.3d at 970-721 ("the interpretation and construction of patent claims, which define the scope of the patentee's rights under the patent, is a matter of law exclusively for the court"); *O2 Micro Int'l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1362 (Fed. Cir. 2008).

In the end, this Court finds EchoStar's judicial estoppel argument to be a thinly veiled attempt to reargue claim construction and limit the scope of the '389 Patent. Such is not proper. This Court's constructions, which were affirmed by the Federal Circuit, are the settled law of the case and must be applied without further broadening or limitation. *W.L. Gore & Assocs. v. Garlock, Inc.*, 842 F.2d 1275, 1279 (Fed. Cir. 1988). As such, "parses," in the context of the Software Claims, means "analyzes" and is not limited to start-code detection or indexing. Likewise, "automatic flow control" means "self-regulated" and is not limited to the blocking of access to buffers to prevent overflow.

B.

The Court now turns to the first step of the *KSM* test. Recall that this first step—the threshold question of whether contempt proceedings are appropriate—requires a comparison between the infringing and modified products. This comparison must be made in light of the claims; any difference will be deemed more than colorable if, and only if, it touches on some claim limitation. EchoStar argues that the changes made to its DVR software were significant. To that end, EchoStar points to the amount of source code that it changed—5,000 of the 10,000 lines of DVR code. Dkt. No. 912 at 26:8-14. TiVo argues that this change is insignificant when compared

to the millions of lines of code found in the EchoStar boxes, of which hundreds of thousands could be characterized as DVR code. Dkt. No. 920 at 32; Dkt. No. 708 at 44:1-22.

In addition, EchoStar contends that it invested 8,000 man-hours of work and over $700,000 in its redesign efforts. Dkt. No. 912 at 19:1-16. TiVo points out, however, that these amounts are minimal when compared to the more than $120 million that EchoStar spent on advertising during the same time period, including $50 million on a campaign utilizing the slogan "Better than TiVo." Dkt. No. 291 at 140-12-141-13; PX3101, PX3102. The price-tag of EchoStar's alleged design-around effort is also well below its CEO's previous estimates that such a design-around could cost tens of millions of dollars. Dkt. No. 793 at 43:8-44:2 (noting that litigation would have cost less than pursuing a viable design-around). Although the Court notes the amount of money spent by EchoStar in its design-around effort and the amount of source code that was modified, this evidence has no effect on the *KSM* analysis. In the end, such evidence is just as insignificant as the amount of money EchoStar spent on advertising.

EchoStar also points to opinion of counsel letters received during the development of its new software and relies on the testimony of the letters' authors. Dkt. No. 912 at 59:17-61:10, 67:2-13, 97:18-98:2; DX5073, DX5074, DX5076. The Court, however, chooses to give this evidence little weight. For the most part, the letters and testimony are evidence of EchoStar's alleged good faith, which is irrelevant in these proceedings. *See Additive Controls*, 154 F.3d at 1353. To the extent that the letters and testimony analyze EchoStar's modifications, their conclusions are cumulative of the testimony provided by EchoStar's expert, Dr. Rhyne. Furthermore, as the letters were drafted early in the modification process, their authors did not have benefit of the actual source code that implemented the modifications. Dkt. No. 912 at 61:11-19, 97:2-7.

Instead of considering evidence of the amount of money the EchoStar spent on advertising, the amount of man-hours spent designing the modifications, or the fact that EchoStar obtained opinions of counsel, the Court limits itself to a comparison between the infringing and modified products in light of the claim language and the Court's construction thereof.

The only limitations at issue are those noted above. EchoStar has presented no evidence that its modifications affect any limitation other than the "parses video and audio data from said broadcast data" and the "wherein said source object is automatically flow controlled by said transform object" limitations found in claims 31 and 61. On their face, EchoStar's modifications do not read onto the language of the claims as construed. EchoStar's own characterizations of its modifications ("start-code detection," "indexing," and "blocking") appear nowhere in the claim language as written or construed. Because these modifications do not relate to elements of the pertinent patent claims, this Court finds that any differences between the infringing and modified products are no more than colorable. *See Additive Controls*, 154 F.3d at 1350 (affirming district court's decision to hold contempt proceedings where modifications did not affect "elements of the pertinent patent claim"). Although this Court could end the threshold analysis here and find that contempt proceedings are appropriate, further analysis is prudent.

With regard to EchoStar's "indexless" or "brute-force" modification, which allegedly affects the parsing limitation, this Court notes that EchoStar's own experts at trial testified that PID filtering satisfied that limitation. Dkt. No. 716 at 110:10-20. Moreover, Echostar's own engineers refer to PID filtering as "parsing." Dkt. No. 912 at 41:19-42:1. Because both the adjudicated and modified products utilize PID filtering and thus may infringe the Software Claims in the same manner, this Court finds that the two products are not more than colorably different. This conclusion is bolstered

by EchoStar's own internal documents, which originally referred to its modified software by the moniker "Indexless DVR and *TS Parsing*." PX3277 (emphasis added). Only in a later drafts did EchoStar remove the word "parsing" from its product characterization and begin referring to its modified DVR as an "Indexless / Brute Force DVR." PX3278; Dkt. No. 910 at 81:3-82:3. Although EchoStar now refers to its product as operating with brute-force, its own internal correspondence suggests that "pure brute force won't work." PX3170; Dkt. No. 910 at 83:8-24.

With regard to Echostar's buffering change, which allegedly affects the automatic flow control limitation, this Court notes that when EchoStar's modified DVRs were tested, 99% of them never exhibited any data loss. Dkt. No. 910 at 117:20-118:14. In the small percent that did exhibit data loss, that loss was extremely small, in the range of 0.0002%. Dkt. No. 910 at 120:12-21. This amount data loss is minimal. Moreover, EchoStar admits that such data loss would occur in both the infringing products and the modified products; the only difference is the manner in which the software deals with that data loss. Dkt. No. 912 at 244:20-245:1. Thus, the modified software is not more than colorably different from the infringing software. In addition, there is substantial evidence suggesting that both the modified and original products operate using the same circular buffer structure—each of the ten buffers (or "descriptors") within the structure having a 140,000 byte capacity. Dkt. No. 910 at 91:14-98:16, 122:3-25. EchoStar's efforts to re-brand its modified buffer as a linear buffer are misplaced. *Compare* PX3298, *and* Dkt. No. 912 at 32:13-16, *with* PX3161, *and* Dkt. No. 910 at 89:3-17, *and* Dkt. No. 43:24-44:2. The actual change, the removal of the "record buffer," which in essence is a change from eleven buffers to ten, is not more than colorably different from the original product.

For these reasons, this Court finds that any differences between the infringing and modified products are no more than colorable and that no substantial open issues of infringement exist. As a result, contempt proceedings in this case are appropriate.[6]

C.

The Court now turns to second step of the *KSM* test. Recall that this step requires a comparison between the modified products and the patent claims as construed by the court to determine if those products continue to infringe. The movant must demonstrate continued infringement by clear and convincing evidence.

The Federal Circuit has allowed, however, that in some cases it may "only be necessary to determine that the modified device has not been changed from the adjudged device in a way which affects an element of a claim." *KSM*, 776 F.2d at 1528-29. In such a case, the modified and adjudged devices may be treated as the same. *Id.* at 1529. As discussed above, EchoStar's modifications do not affect express elements of the disputed claims. The disputed claims do not require "start-code detection," "indexing," and/or "blocking." The disputed claims also do not require a specific buffering structure, much less a specific number of buffers. Instead, the claims require that the incoming data be "parsed," which this Court has construed to mean "analyzed," and also require "automatic flow control," which this Court has construed to mean "self-regulated."

If this Court was to adopt EchoStar's view of the claim requirements, then it would effectively be re-construing the claims. The time for this has long passed. Even if this Court believed that its constructions were overly broad, it is bound by its earlier constructions as affirmed

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[6] This Court finds that no burden of proof is attached to step one of the *KSM* test (as it is ultimately a "procedural" determination). If, however, EchoStar is correct and TiVo must prove no colorable differences by clear and convincing evidence, then this Court finds that TiVo has also met this heightened burden.

by the Federal Circuit. *See Del Mar Avionics, Inc. v. Quinton Instrument Co.*, 836 F.2d 1320, 1324 (Fed. Cir. 1987) ("The prior determination of certain issues, including the issues of claim construction . . ., bars judicial redetermination of those issues . . . . [T]he relitigation of issues previously decided is barred on principles of finality and repose."). This Court's constructions as affirmed are the law of the case. *See W.L. Gore & Assocs.*, 824 F.2d at 1279. If EchoStar wished to argue for a more limited interpretation of "parsing" or "automatic flow control," then it should have done so on appeal. Because EchoStar did not, it has waived any argument that this Court's constructions are incorrect.

Because Echostar's modifications do not affect elements of the disputed claims as construed, this Court finds that the infringing and modified devices may be treated as the same. As such, this Court finds that EchoStar's modified software continues to infringe the Software Claims of the '389 Patent.

Furthermore, even if this Court were to assume that EchoStar's modifications affected elements of the Software Claims, this Court still finds that the modifications continue to infringe the '389 Patent and that TiVo has proven such by clear and convincing evidence.

With regard to EchoStar's "indexless" or "brute-force" modification, this Court finds by clear and convincing evidence that the modified products—both the 50X and Broadcom Products—still "parse[] video and audio data from said broadcast data." It is undisputed that EchoStar's products filter incoming data using a PID filter. Internally, EchoStar engineers refer to PID filtering as parsing. Dkt. No. 912 at 41:19-42:1. Furthermore, an EchoStar technical document on the modification uses the term "TS Parsing" to describe the design-around. PX3277. Numerous experts, some of them EchoStar's own, have testified that PID filtering is a form of parsing. Dkt. No. 716

at 110:10-20; Dkt. No. 719 at 38:2-8; Dkt. No. 910 at 66:9-67:19. A PID filter can be classified as a "physical data source" as required by the claims. A PID filter is transport demultiplexor, which is a type of physical data source envisioned by the '389 Patent. Dkt. No. 900 at 103; '389 Patent at 6:30-32. Finally, the claims do not require that parsing be completed on the payloads of the incoming data rather than their headers. EchoStar's arguments to this effect are thus inapposite. Therefore, this Court finds that PID filtering satisfies the parsing limitation of the Software Claims, the PID filter is a physical data source that parses incoming data.

With regard to Echostar's buffering change, this Court finds by clear and convincing evidence that the Broadcom Products still operate using a "source object [that] is automatically flow controlled by said transform object." The patent does not require the blocking of data flow, nor does it require that there never be data loss within the DVR. The patent only requires that data flow be self-regulated. Dkt. No. 185 at 24 (citing '389 Patent at 8:48-49). As explained above, EchoStar's system utilizes ten buffers in a circular arrangement. EchoStar's software manages the flow of data into and out of those buffers. Dkt. No. 910 at 91:14-98:16. Read and write "pointers" and "descriptors" manage the process by which data is deposited into and extracted from the circular buffer. *Id.* Furthermore, there is evidence that certain data structures, including a "no sync" structure, provide communication between the read and write processes within the modified receivers. Dkt. No. 910 at 128:18-130:11, 225:10-25; Dkt. No. 914 at 46:5-14. In addition, EchoStar's software contains a timed "semaphore," which paces the extraction process. Dkt. No. 912 at 5:1-4. Also, in the event that the read process falls behind in its extraction of data from the circular buffer, EchoStar's modified software catches up by extracting data from multiple buffers at once and writing that data to the hard drive. Dkt. No. 912 at 184:11-195:6. Thus, this Court finds

that EchoStar's software retains a collection of data and operations—a transform object—that is self-regulating with respect to the source object. Lastly, in the rare instance of overflow (0.0002% of the time in 1% of receivers), EchoStar's software handles the situation by flushing all ten buffers and correcting the error condition. Dkt. No. 910 at 114:23-115:8. Based on all this evidence, the Court finds that the flow of data in EchoStar's Broadcom products is self-regulated. Therefore, this Court finds that EchoStar's buffering system satisfies the automatic flow control limitation of the Software Claims.

Finally, EchoStar's modifications do not affect any other limitations in the Software Claims. Dkt. No. 910 at 57:5-58:5; Dkt. No. 912 at 158:10-22. Thus, all remaining limitations are met by the modified products in the exact same manner as they were met in the infringing products. Because all limitations in claims 31 and 61 of the '389 Patent are practiced by EchoStar's modified 50X and Broadcom Products, those products continue to infringe TiVo's patent. TiVo has proven such by clear and convincing evidence.

Accordingly, this Court finds EchoStar in contempt of this Court's permanent injunction. Specifically, EchoStar is in contempt of the Infringement Provision of this Court's order, which enjoined EchoStar from "making, using, offering to sell, selling or importing in the United States, the Infringing Products, either alone or in combination with any other product and all other products that are only colorably different therefrom in the context of the Infringed Claims."

IV.

Even if EchoStar had achieved a non-infringing design-around, this Court would still find that EchoStar is in contempt of this Court's permanent injunction. EchoStar never complied with the Disablement Provision of this Court's order, which ordered EchoStar to "disable the DVR

functionality (i.e. disable all storage to and playback from a hard disk drive of television data) in all but 192,708 units of the Infringing Products that have been placed with an end user or subscriber."

Whether EchoStar did or did not comply with the Disablement Provision of this Court's order does not raise any issue unique to patent law. As a result, the regional circuit law of the Fifth Circuit applies to this issue. *See Eagle Comtronics, Inc. v. Arrow Commc'n Labs., Inc.*, 305 F.3d 1303, 1313 (Fed. Cir. 2002) (applying regional circuit law to civil contempt proceedings). In civil contempt proceedings, "the party seeking an order of contempt need only establish (1) that a court order was in effect, and (2) that the order required certain conduct by the respondent, and (3) that the respondent failed to comply with the court's order." *FDIC v. LeGrand*, 43 F.3d 163, 170 (5th Cir. 1995) (citation omitted). The movant must prove such by clear and convincing evidence. *Id.*; *Martin v. Trinity Indus., Inc.*, 959 F.2d 45, 47 (5th Cir. 1992).

This Court's permanent injunction, which was issued on September 8, 2006, was stayed by the Federal Circuit pending EchoStar's appeal. On appeal, EchoStar did not challenge the language or validity of this Court's injunction. Thus, the Federal Circuit upheld the injunction and dissolved its stay once EchoStar's appeal became final, which occurred on April 18, 2008. *TiVo*, 516 F.3d at 1312.

This Court, aware of the Federal Circuit's general disdain for broad or vague prohibitions of future infringement, drafted its permanent injunction in narrow terms that captured particular infringing devices and required EchoStar to take certain action regarding those devices. *See KSM*, 776 F.2d at 1526 ("those against whom an injunction is issued should receive fair and precisely drawn notice of what the injunction actually prohibits"). In particular, EchoStar was ordered to disable DVR functionality in the infringing products that had been placed with an end-user. For the

sake of clarity, this Court provided EchoStar with a definition of DVR functionality: "storage to and playback from a hard disk drive of television data."

Although EchoStar did not challenge the scope of this Court's order on appeal, EchoStar now argues that the injunction only covers "Infringing Products," which in terms of the Software Claims would be infringing software. *See* Dkt. No. 839 at 10-12. EchoStar argues that it complied with this Court's order when it downloaded new software into the infringing receivers, thus disabling their infringing DVR functionality. This Court's order, however, was not limited to infringing software; rather the infringing receivers in their entirety were subject to the order. Indeed, although claims 31 and 61 have been referred to as the "Software Claims" they actually cover a process and apparatus that may also contain hardware elements. *See TiVo*, 516 F.3d at 1309 ("[T]he hardware/software distinction made by EchoStar is unhelpful. What matters is whether the operations performed by the interaction of software and hardware in the accused DVRs, taken as a whole, are covered by the claim term."). By not disabling DVR functionality in adjudged receivers that had been placed with end-users, EchoStar failed to comply with the plain language of this Court's order.

If EchoStar believed that this Court's order was overly broad or that it improperly covered non-infringing practices, then EchoStar should have requested that this Court modify its order or should have challenged the scope of this Court's order on appeal. Because EchoStar failed to do either, it has waived any argument that this Court's order is overbroad. *See W. Water Mgmt., Inc. v. Brown*, 40 F.3d 105, 108 (5th Cir. 1994) ("[C]ollateral attack on an injunction during contempt proceedings is prohibited if earlier review of the injunction was available."). Instead of requesting review of this Court's order by itself or another court, EchoStar merely ignored this Court's order because it subjectively believed it to be improper or overly broad. This cannot be allowed. *See GTE*

Sylvania, Inc. v. Consumers Union, 445 U.S. 375, 386-87 (1980) ("[P]ersons subject to an injunctive order issued by a court with jurisdiction are expected to obey that decree until it is modified or reversed, even if they have proper grounds to object to the order."); *Carborundum Co. v. Molten Metal Equip. Innovations, Inc.*, 72 F.3d 872, 883 (Fed. Cir. 1995). A party may not unilaterally decide whether it will or will not comply with a court order.

Accordingly, this Court finds by clear and convincing evidence that a court order, which required certain conduct by EchoStar, was in effect as of April 18, 2008, and that EchoStar failed to comply with that order. Therefore, this Court finds EchoStar in contempt of this Court's permanent injunction. Specifically, EchoStar is in contempt of the Disablement Provision, which ordered EchoStar to "disable the DVR functionality (i.e. disable all storage to and playback from a hard disk drive of television data) in all but 192,708 units of the Infringing Products that have been placed with an end user or subscriber."

V.

For the reasons set forth above, this Court finds EchoStar in contempt of its permanent injunction. EchoStar's modified software is not more than colorably different from the products adjudged to infringe; furthermore, EchoStar's products continue to infringe TiVo's patent. Finally, EchoStar failed to comply this Court's order that it disable the DVR functionality in the infringing products.

The harm caused to TiVo by EchoStar's contempt is substantial. EchoStar has gained millions of customers since this Court's injunction issued, customers that are now potentially unreachable by TiVo. *See* Dkt. No. 773 at 10. As this Court has noted in the past, "loss of market share and of customer base as a result of infringement cause severe injury," and "every day of

Defendant's infringement affects Plaintiff's business." *Id.* at 10-11. Although EchoStar requests that this Court stay its injunction further, this Court declines to do so. EchoStar has escaped this Court's injunction for over two years and further delay will be manifestly unjust to TiVo and cause TiVo substantial harm.

Although EchoStar is required to bring itself into compliance with this Court's permanent injunction, the Court will defer any ruling on the issue of monetary sanctions at this time. Additionally, EchoStar is required to inform this Court of any future attempts to design-around the '389 Patent and obtain Court approval before any such design-around is implemented.

An Order and an Amended Final Judgment and Permanent Injunction will soon be entered in accordance with this opinion.

SIGNED this 2nd day of June, 2009.

DAVID FOLSOM
UNITED STATES DISTRICT JUDGE

NOTE: This order is nonprecedential.

United States Court of Appeals for the Federal Circuit

2009-1374

TIVO, INC.,

Plaintiff-Appellee,

v.

ECHOSTAR CORPORATION,
ECHOSTAR DBS CORPORATION,
ECHOSTAR TECHNOLOGIES CORPORATION,
ECHOSPHERE LIMITED LIABILITY COMPANY,
ECHOSTAR SATELLITE LLC,
and DISH NETWORK CORPORATION,

Defendants-Appellants.

Appeal from the United States District Court for the Eastern District of Texas
in case no. 2:04-CV-01, Judge David Folsom.

ON MOTION

Before MICHEL, Chief Judge, LOURIE and BRYSON, Circuit Judges.

BRYSON, Circuit Judge.

ORDER

EchoStar Corporation et al. (EchoStar) move for a stay, pending appeal, of the order of the United States District Court for the Eastern District of Texas (1) holding EchoStar in contempt of its previous injunction, (2) enjoining EchoStar, and (3) requiring that EchoStar take certain steps in light of its contempt holdings. TiVo, Inc. opposes. EchoStar replies. The Association for Competitive Technology, Inc. moves for leave to file a brief amicus curiae in support of TiVo regarding the motion. EchoStar opposes. The Association replies.

In deciding whether to stay an injunction, pending appeal, this court "assesses the movant's chances of success on the merits and weighs the equities as they affect the parties and the public." E.I. Dupont de Nemours & Co. v. Phillips Petroleum Co., 835 F.2d 277, 278 (Fed. Cir. 1987); see also Standard Havens Prods. V. Gencor Indus., 897 F.2d 511 (Fed. Cir. 1990). To prevail, a movant must establish a strong likelihood of success on the merits or, failing that, must demonstrate that it has a substantial case on the merits and that the harms factors militate in its favor. Hilton v. Braunskill, 481 U.S. 770, 778 (1987).

Without prejudicing the ultimate disposition of this case by the merits panel, we determine based upon the arguments raised in the motions papers that EchoStar has met its burden of demonstrating the requisites for a stay of the order, pending appeal.

Accordingly,

IT IS ORDERED THAT:

(1) The motion for a stay of the order is granted.

(2) The motion for leave to file an amicus brief is granted.

(3) The briefing schedule is expedited. EchoStar's opening brief is due no later than July 17, 2009. TiVo's brief is due no later than August 25, 2009. EchoStar's reply brief and the joint appendix are due no later than September 4, 2009. The case will be placed on the November calendar, if practicable.

FOR THE COURT

JUL 01 2009
Date

/s/ Jan Horbaly
Jan Horbaly
Clerk

cc: Seth P. Waxman, Esq.
Donald R. Dunner, Esq.

s19

Electronic Acknowledgement Receipt

EFS ID:	5659567
Application Number:	90009329
International Application Number:	
Confirmation Number:	2859
Title of Invention:	MULTIMEDIA TIME WARPING SYSTEM
First Named Inventor/Applicant Name:	6233389
Customer Number:	26111
Filer:	Mehran Arjomand/Dena Wells
Filer Authorized By:	Mehran Arjomand
Attorney Docket Number:	2513.002REX0
Receipt Date:	07-JUL-2009
Filing Date:	10-NOV-2008
Time Stamp:	19:42:28
Application Type:	Reexam (Third Party)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Noticedtd7709.pdf	120516 d20a316022a0d7fae1666f9d26bb1a69ba9c021b	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Trans Letter filing of a response in a reexam	1	1
	Reexam Notice of Court Action	2	3
	Reexam Certificate of Service	4	4

Warnings:					
Information:					
2	Reexam Miscellaneous Incoming Letter	Memorandum.pdf	1729812 6a20c3daf45ec966b6d0f5f278c25a3f265c494a	no	35
Warnings:					
Information:					
3	Reexam Miscellaneous Incoming Letter	Order.pdf	82382 56bc31f0c274a030e4d3e9d8b9f9c08fd2ef880	no	3
Warnings:					
Information:					
		Total Files Size (in bytes):	1932710		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reexam: 6,233,389	Confirmation No.: 2859
BARTON, *et al*	Art Unit: 3992
Control No. 90/009,329	Examiner: FERRIS, Fred
Filed: November 10, 2008	Atty. Docket: 2513.002REX0
For: **Multimedia Time Warping System**	

Information Disclosure Statement

Mail Stop Ex Parte Reexam

Attn: Central Reexamination Unit
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

Listed on accompanying IDS Forms are documents that may be considered material to the patentability of this reexamination as defined in 37 C.F.R. §§ 1.56 and 1.555. Copies of documents FP1-FP19 and NPL24-NPL42 are submitted. However, in accordance with 37 C.F.R. § 1.98(a)(2), no copies of the U.S. patents cited on the attached IDS Forms are submitted.

Patent owner has attached as Exhibit A a diagram illustrating the current family tree for U.S. Patent No. 6,233,389 (Barton '389). Patent Owner wishes to bring to the Examiner's attention the members of the '389 family, including those members sharing a common specification with the Barton '389 patent – U.S. Patent Application Nos. 09/827,029, 10/081,776, 11/051,347, 11/726,054, 11/725,909, and 12/430,024.

In accordance with 37 C.F.R. § 1.97, the filing of this IDS should not be construed to be an admission that the information cited in the statement is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b). Further, the Patent Owner has listed publication dates on the attached IDS Form based on

information presently available to the undersigned. However, the listed publication dates should not be construed as an admission that the information was actually published on the date indicated.

A concise explanation of the relevance of the non-English language documents appears below in accordance with 37 C.F.R. § 1.98(a)(3):

- Document FP12 (CN 1189045 A) appears to describe a double-image display device and method. An English language abstract of document FP12 is enclosed as document NPL37.
- Document FP14 (JP 7-44907 A) appears to describe an information recording and reproducing device. An English language abstract of document FP14 is enclosed as document NPL38.
- Document FP15 (JP 8-279273 A) appears to describe a recording and reproducing device for data, and method thereof. An English language abstract of document FP15 is enclosed as document NPL39.
- Document FP16 (JP 10-56620 A) appears to describe a television receiver, recording and reproducing device, data recording method and data reproducing method. An English language abstract of document FP16 is enclosed as document NPL40.
- Document FP17 (JP 11-203135 A) appears to describe a RISC Type Data Processor and Method. A partial English language translation of document FP17 is enclosed as document NPL41.
- Document FP18 (JP 2000-295560 A) appears to describe a multiple information storage/reproduction device. A partial English language translation of document FP18 is enclosed as document NPL42.

Patent Owner reserves the right to establish the patentability of the claimed invention over any of the information provided herewith, and/or to prove that this

information may not be prior art, and/or to prove that this information may not be enabling for the teachings purportedly offered. This IDS submission should not be construed as a representation that a search has been made, or that information more material to the examination of the present reexamination does not exist. The Examiner is specifically requested not to rely solely on the material submitted herewith.

It is respectfully requested that the Examiner initial and return a copy of the enclosed IDS Form, and indicate in the official file wrapper of this reexamination that the documents have been considered.

It is not believed that any fees are required with submission of this IDS. (*See* MPEP § 2202.) However, if necessary, the U.S. Patent and Trademark Office is hereby authorized to charge any fee deficiency, or credit any overpayment, to our Deposit Account No. 19-0036.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Edward J. Kessler
Attorney for Patent Owner
Registration No. 25,633

Date: 28 July 2009

1100 New York Avenue, N.W.
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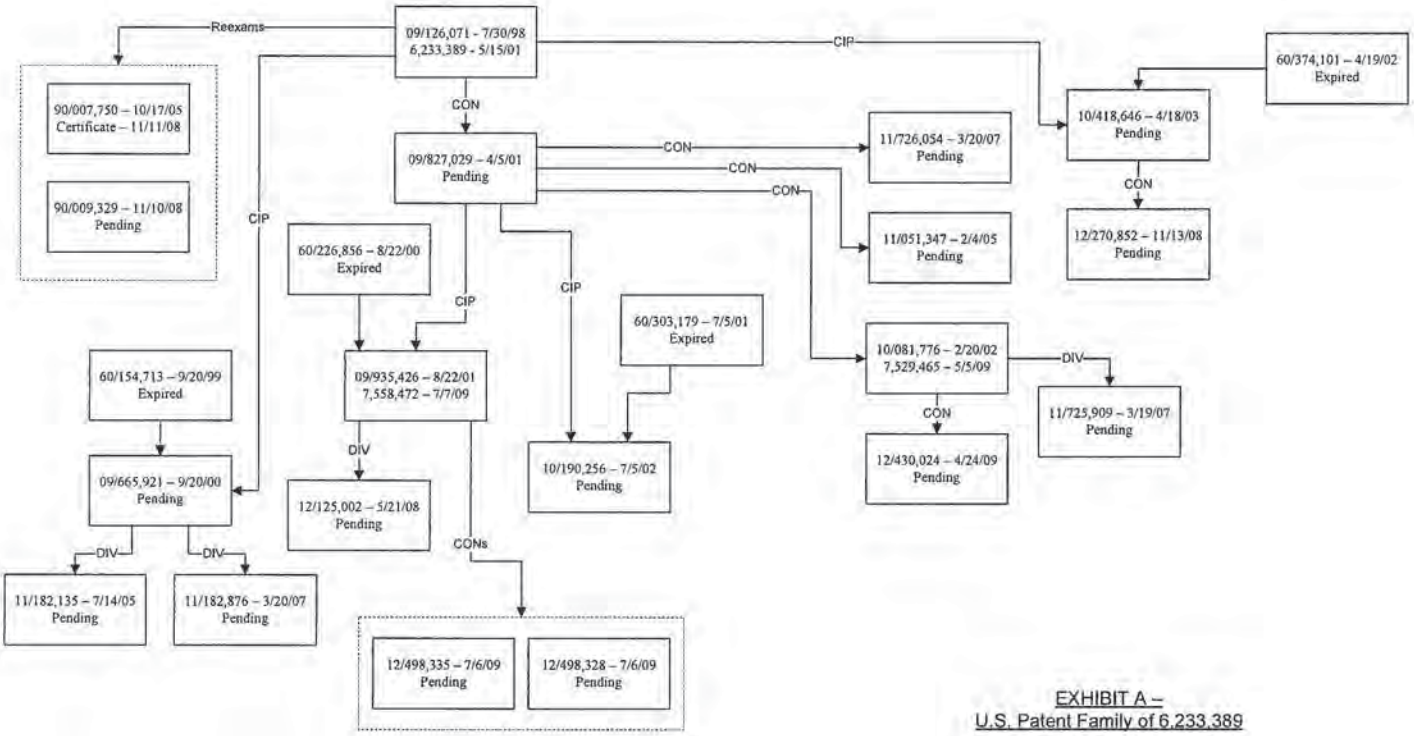

EXHIBIT A –
U.S. Patent Family of 6,233,389

Substitute for form 1449/PTO				*Complete if Known*	
INFORMATION DISCLOSURE STATEMENT BY PATENT OWNER *(Use as many sheets as necessary)*				Application Number	90/009,329
				Filing Date	November 10, 2008
				First Named Inventor	James M. BARTON
				Art Unit	3992
				Examiner Name	Ferris III, Fred O.
Sheet	1	of	2	Attorney Docket Number	2513.002REX0

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (If Known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	US1	2005/0122335 A1	06-09-2005	MacInnis *et al.*	
	US2	2008/0288998 A1	11-20-2008	Locket *et al.*	
	US3	4,221,176	09-09-1980	Besore *et al.*	
	US4	5,388,264	02-07-1995	Tobias, II *et al.*	
	US5	5,475,498	12-12-1995	Radice	
	US6	5,596,581	01-21-1997	Saeijs *et al.*	
	US7	5,600,379	02-04-1997	Wagner	
	US8	5,862,342	01-19-1999	Winter *et al.*	
	US9	6,282,209 B1	08-28-2001	Kataoka *et al.*	
	US10	6,353,461 B1	03-05-2002	Shore *et al.*	
	US11	6,363,212 B1	03-26-2002	Fujinami *et al.*	
	US12	7,272,298 B1	09-18-2007	Lang	
	US13	5,438,423 C1	08-27-2002	Lynch *et al.*	
	US14	5,535,008	07-09-1996	Yamagishi *et al.*	
	US15	5,598,352	01-28-1997	Rosenau *et al.*	
	US16	5,703,655	12-30-1997	Corey *et al.*	
	US17	5,832,085	11-03-1998	Inoue *et al.*	
	US18	5,909,257	06-01-1999	Ohishi *et al.*	
	US19	6,263,396 B1	07-17-2001	Cottle *et al.*	
	US20	6,480,667 B1	11-12-2002	O'Connor	

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	FP1	CA 2 137 745 C	07-27-2004	Stutz *et al.*		
	FP2	EP 0 651 328 A1	05-03-1995	Seaman *et al.*		
	FP3	EP 0 762 756 A2	03-12-1997	Sasaki *et al.*		
	FP4	EP 0 766 476 A2	04-02-2007	Hasegawa		
	FP5	GB 2 286 282 A	08-09-1995	Schultheiss		
	FP6	WO 93/16557 A1	08-19-1993	Koz *et al.*		
	FP7	WO 94/17626 A1	08-04-1994	Staron		
	FP8	WO 95/33336 A1	12-07-1995	Yang *et al.*		
	FP9	WO 98/56188 A2	12-10-1998	Hsu *et al.*		

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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				Examiner Name	Ferris III, Fred O.
Sheet	2	of	2	Attorney Docket Number	2513.002REX0

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	US21	5,930,493	07-27-1999	Ottesen *et al.*	
	US22	6,546,556 B1	04-08-2003	Kataoka *et al.*	
	US23				
	US24				
	US25				
	US26				
	US27				
	US28				
	US29				
	US30				
	US31				
	US32				
	US33				
	US34				
	US35				
	US36				
	US37				
	US38				
	US39				

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	FP10	WO 00/33568 A1	06-08-2000	Gordon *et al.*		
	FP11	WO 03/019932 A1	03-06-2003	Locket *et al.*		
	FP12	CN 1189045 A	07-29-1998	Bainan *et al.*		
	FP13	GB 2333017 A	07-07-1999	Ryu		
	FP14	JP 7-44907 A	02-14-1995	Shunichi *et al.*		
	FP15	JP 8-279273 A	10-22-1996	Taiji		
	FP16	JP 10-56620 A	02-24-1998	Masamitsu *et al.*		
	FP17	JP 11-203135 A	07-30-1999	Koichi		
	FP18	JP 2000-295560 A	10-20-2000	Kiyoshi *et al.*		
	FP19	WO 98/48566 A2	10-29-1998	Mankovitz		

Examiner Signature		Date Considered	

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				First Named Inventor	James M. BARTON
				Art Unit	3992
				Examiner Name	Ferris III, Fred O.
Sheet	1	of	2	*Attorney Docket Number*	2513.002REX0

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T[2]
	NPL24	Peuker, Thomas, "An Object-Oriented Architecture for the Real-Time Transmission of Multimedia Data Streams", Institute fur Mathematische Maschinen und Datenverarbeitung (Informatik) IV, Lehrstul fur Betriebssyteme Universitat Erlangen-Nurnberg, Erlangen, March 17, 1997.	
	NPL25	Mayer-Patel, Ketan et al., "Synchronized Continuous Media Playback Through the World Wide Web", U.C. Berkeley, Computer Science Divisiocn, Berkeley Multimedia Research Center, Published:1996, Berkeley, CA.	
	NPL26	Chatterjee, Amit et al., "Microsoft Directshow: A New Media Architecture", SMPTE Journal, pp. 865-871, December 1997.	
	NPL27	Fung, Chi-Leung et al., "MOCS: an Object-Oriented Programming Model for Multimedia Object Communication and Synchronization", Department of Computer Science, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, 1994 IEEE.	
	NPL28	Gibbs, Simon, "Composite Multimedia and Active Objects", Centre Universitaire d"lnformatique, Universite de Geneve, Proc., appeared in OOPSLA '91.	
	NPL29	"New Graphics Enhancements Will Be On Display at NAB (National Association of Broadcasters Exhibition", Broadcasting, v118, n11, p57, March 12, 1990.	
	NPL30	"Next Video Recorder -- Tape or Disc?", Consumer Electronics, v33, n8, February 22, 1993.	
	NPL31	McLarnon, Zed, et al., "Digital Image Meets Digital Audio; Sync Problems Faced by Multimedia Producer Now", Advanced Imaging, v9, n1, p62, January 1994.	
	NPL32	Nelson, Lee J. "The Latest In Compression Hardware & Software (Product Survey)", Advanced Imaging, v9, n1, p56, January 1994.	
	NPL33	Leek, Matthew R., et al., "MPEG Q&A (Moving Pictures Expert Group Digital Video Compression Standard)", CD-ROM Professional, v7, n4, p41, July-August 1994.	

Examiner Signature		Date Considered	

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

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

Equivalent of Form PTO/SB/08b (2-09)

Substitute for form 1449/PTO				*Complete if Known*	
INFORMATION DISCLOSURE STATEMENT BY PATENT OWNER *(Use as many sheets as necessary)*				*Application Number*	90/009,329
				Filing Date	November 10, 2008
				First Named Inventor	James M. BARTON
				Art Unit	3992
				Examiner Name	Ferris III, Fred O.
Sheet	2	of	2	*Attorney Docket Number*	2513.002REX0

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T[2]
	NPL34	Ceccarelli, M. *et al.*, "A sequence analysis system for video databases," *Time-Varying Image Processing and Moving Object Recognition, 4*, Elsevier Science B.V., pp. 133-138, 1997.	
	NPL35	Hanjalic *et al*, "Automation of systems enabling search on stored video data," *SPIE/IS&T Electronic Imaging '97*, Vol. 3022, pp. 427-438, January 15, 1997.	
	NPL36	DMA, published in Embedded Systems Programming, 4 pages, October 1994.	
	NPL37	English language abstract for Chinese Patent Publication No. CN 1189045 A, published July 29, 1998, 1 page.	
	NPL38	English language abstract for Japanese Patent Publication No. JP 7-44907 A, published February 14, 1995, 1 page.	
	NPL39	English language abstract for Japanese Patent Publication No. JP 8-279273 A, published October 22, 1996, 1 page.	
	NPL40	English language abstract for Japanese Patent Publication No. JP 10-56620 A, published February 24, 1998, 1 page.	
	NPL41	Partial English language translation for Japanese Patent Publication No. JP 11-203135 A, published July 30, 1999, 2 pages.	
	NPL42	Partial English language translation for Japanese Patent Publication No. JP 2000-295560 A, published October 20, 2000, 3 pages.	
	NPL		

Examiner Signature		Date Considered	

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

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

(19) Canadian Intellectual Property Office
An Agency of Industry Canada

Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

(11) CA 2 137 745 (13) C

(40) 27.07.2004
(43) 14.06.1995
(45) 27.07.2004

(12)

(21) 2 137 745

(51) Int. Cl.[5]: G06F 9/40

(22) 09.12.1994

(30) 08/166,976 US 13.12.1993

(72) STUTZ, DAVID S. (US).
ZIMMERMAN, CHRISTOPHER A. (US).

(73) MICROSOFT CORPORATION
One Microsoft Way REDMOND XX (US).

(74) OYEN WIGGS GREEN & MUTALA

(54) METHODE ET SYSTEME POUR LA CREATION DYNAMIQUE DE CONNEXIONS
(54) METHOD AND SYSTEM FOR DYNAMICALLY GENERATING OBJECT CONNECTIONS

(57)

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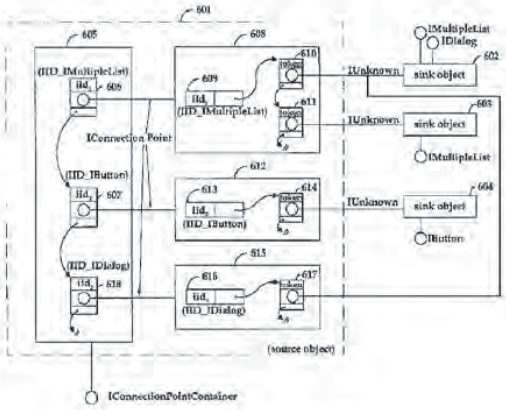

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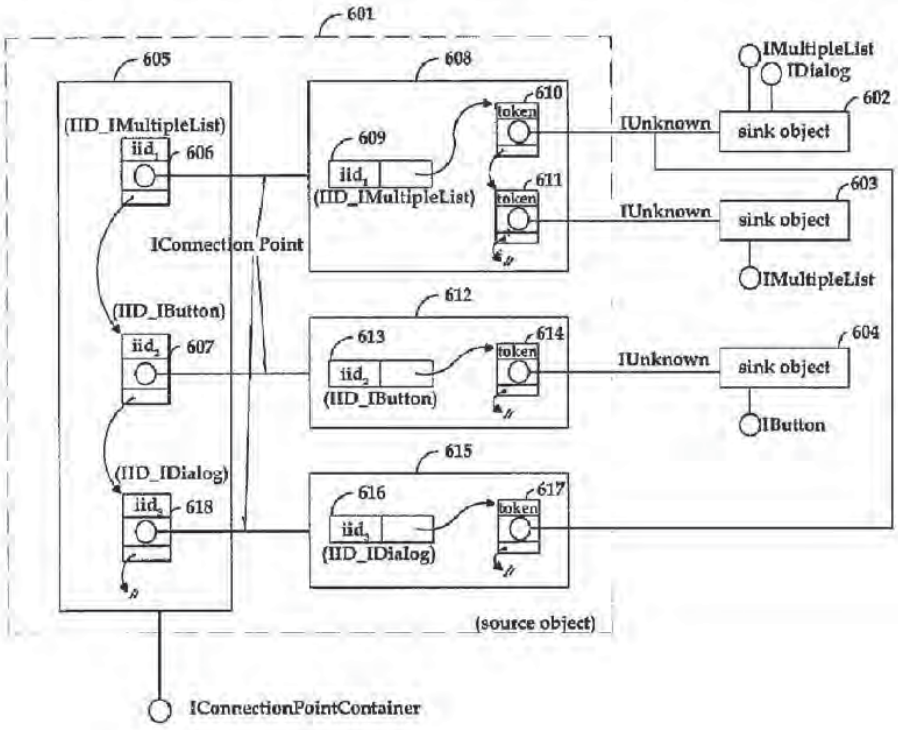

(57) Abrégé/Abstract:
A method and system for dynamically generating object connections is provided. In a preferred embodiment, a connection can be generated between a source object and a sink object using a connection point object. A source object has connection point

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(57) Abrégé(suite)/Abstract(continued):
objects where each connection point object corresponds to a particular interface. A sink object implements one or more notification interfaces for connecting to a source object. A connection point object of a source object can connect to multiple notification interfaces, which belong to one or more sink objects. A connection point object keeps track of pointers to the notification interfaces to which it has been connected. In order to generate a connection, a sink object requests from a source object a connection point object corresponding to a particular interface. The source object determines whether it supports such a connection point object, and if so returns a pointer to the connection point interface of the determined connection point object. The sink object then requests to be connected to the connection point object using the returned connection point interface pointer and passes a reference to a notification interface of the sink object corresponding to the particular interface. The connection point object then stores the reference to the notification interface of the sink object, creating a connection between the sink object and the source object. At some later time, the source object can utilize the connection to notify the sink object through the connected notification interfaces.

METHOD AND SYSTEM FOR DYNAMICALLY GENERATING OBJECT CONNECTIONS

Abstract of the Disclosure

A method and system for dynamically generating object connections is provided. In a preferred embodiment, a connection can be generated between a source object and a sink object using a connection point object. A source object has connection point objects where each connection point object corresponds to a particular interface. A sink object implements one or more notification interfaces for connecting to a source object. A connection point object of a source object can connect to multiple notification interfaces, which belong to one or more sink objects. A connection point object keeps track of pointers to the notification interfaces to which it has been connected. In order to generate a connection, a sink object requests from a source object a connection point object corresponding to a particular interface. The source object determines whether it supports such a connection point object, and if so returns a pointer to the connection point interface of the determined connection point object. The sink object then requests to be connected to the connection point object using the returned connection point interface pointer and passes a reference to a notification interface of the sink object corresponding to the particular interface. The connection point object then stores the reference to the notification interface of the sink object, creating a connection between the sink object and the source object. At some later time, the source object can utilize the connection to notify the sink object through the connected notification interfaces.

Description

METHOD AND SYSTEM FOR DYNAMICALLY GENERATING OBJECT CONNECTIONS

Technical Field

The present invention relates generally to a computer system for connecting objects and, more specifically, to a method and system for generating object connections for notification purposes.

Background of the Invention

Often times software is created that needs to communicate with other software when certain events occur. For example, in a computer windowing system, when a user selects a window on the display, the window system needs to notify the software that is drawing information in the window that the window has been selected. In prior systems, the software needing notification of certain events registers the events for which it wants to be notified with the software that raises the events. In some prior systems, as part of the registration mechanism, the software needing notification registers a notification function by which it can be notified. Then, when the software raises an event that was previously registered, the registered notification function is called. This is known in the prior art as a callback mechanism.

An overview of well-known object-oriented programming techniques is provided, since the present invention is described below using object-oriented concepts. Two common characteristics of object-oriented programming languages are support for data encapsulation and data type inheritance. Data encapsulation refers to the binding of functions and data. Inheritance refers to the ability to declare a data type in terms of other data types.

In the C++ language, object-oriented techniques are supported through the use of classes. A class is a user-defined type. A class declaration describes the data members and function members of the class. For example, the following declaration defines data members and a function member of a class named CIRCLE.

```
class CIRCLE
{ public:
        int x, y;
        int radius;
        void draw();
};
```

Variables x and y specify the center location of a circle and variable radius specifies the radius of the circle. These variables are referred to as data members of the class CIRCLE. The function draw is a user-defined function that draws the circle of the specified radius at the specified location. The function draw is referred to as a function member of class CIRCLE. A function member is also referred to as a method of a class. The data members and function members of a class are bound together in that the function operates on an instance of the class. An instance of a class is also called an object of the class.

In the syntax of C++, the following statement declares the objects a and b to be of type class CIRCLE.

```
CIRCLE a, b;
```

This declaration causes the allocation of memory for the objects a and b. The following statements assign data to the data members of objects a and b.

```
a.x     = 2;
a.y     = 2;
a.radius = 1;
b.x     = 4;
b.y     = 5;
b.radius = 2;
```

The following statements are used to draw the circles defined by objects a and b.

```
a.draw();
b.draw();
```

A derived class is a class that inherits the characteristics--data members and function members--of its base classes. For example, the following derived class CIRCLE_FILL inherits the characteristics of the base class CIRCLE.

```
class CIRCLE_FILL : CIRCLE
{ public:
        int pattern;
        void fill();
};
```

This declaration specifies that class CIRCLE_FILL includes all the data and function members that are in class CIRCLE in addition to those data and function members introduced in the declaration of class CIRCLE_FILL, that is, data member pattern and function member fill. In this example, class CIRCLE_FILL has data members x, y, radius, and pattern and function members draw and fill. Class CIRCLE_FILL is said to "inherit" the characteristics of class CIRCLE. A class that inherits the characteristics of another class is a derived class (e.g., CIRCLE_FILL). A class that does not inherit the characteristics of another class is a primary (root) class (e.g., CIRCLE). A class whose characteristics are inherited by another class is a base class (e.g., CIRCLE is a base class of CIRCLE_FILL). A derived class may inherit the characteristics of several classes, that is, a derived class may have several base classes. This is referred to as multiple inheritance.

A derived class may specify that a base class is to be inherited virtually. Virtual inheritance of a base class means that only one instance of the virtual base class exists in the derived class. For example, the following is an example of a derived class with two nonvirtual base classes.

```
class CIRCLE_1 : CIRCLE {...};
class CIRCLE_2 : CIRCLE {...};
class PATTERN : CIRCLE_1, CIRCLE_2{...};
```

In this declaration class PATTERN inherits class CIRCLE twice nonvirtually through classes CIRCLE_1 and CIRCLE_2. There are two instances of class CIRCLE in class PATTERN.

The following is an example of a derived class with two virtual base classes.

```
class CIRCLE_1 : virtual CIRCLE {...};
class CIRCLE_2 : virtual CIRCLE {...};
class PATTERN: CIRCLE_1, CIRCLE_2{...};
```

The derived class PATTERN inherits class CIRCLE twice virtually through classes CIRCLE_1 and CIRCLE_2. Since the class CIRCLE is virtually inherited twice, there is only one object of class CIRCLE in the derived class PATTERN. One skilled in the art would appreciate virtual inheritance can be very useful when the class derivation is more complex.

A class may also specify whether its function members are virtual. Declaring that a function member is virtual means that the function can be overridden by a function of the same name and type in a derived class. In the following example, the function draw is declared to be virtual in classes CIRCLE and CIRCLE_FILL.

```
class CIRCLE
{ public:
        int x, y;
        int radius;
        virtual void draw();
};

class CIRCLE_FILL : CIRCLE
{ public:
        int pattern;
        virtual void draw();
};
```

If a virtual function is declared without providing an implementation, then it is referred to as a pure virtual function. A pure virtual function is a virtual function declared with the pure specifier, "= Ø". If a class specifies a pure virtual function, then any derived class needs to specify an implementation for that function member before that function member may be invoked.

In order to access objects, the C++ language provides a pointer data type. A pointer holds values that are addresses of objects in memory. Through a pointer, an object can be referenced. The following statement declares variable c_ptr to be a pointer on an object of type class CIRCLE and sets variable c_ptr to hold the address of object c.

```
CIRCLE *c_ptr;
c_ptr = &c;
```

Continuing with the example, the following statement declares object a to be of type class CIRCLE and object b to be of type class CIRCLE_FILL.

```
CIRCLE a;
CIRCLE_FILL b;
```

The following statement refers to the function draw as defined in class CIRCLE.

```
a.draw();
```

Whereas, the following statement refers to the function draw defined in class CIRCLE_FILL.

```
b.draw();
```

Moreover, the following statements type cast object b to an object of type class CIRCLE and invoke the function draw that is defined in class CIRCLE_FILL.

```
CIRCLE *c_ptr;
c_ptr = &b;
c_ptr->draw();          // CIRCLE_FILL::draw()
```

Thus, the virtual function that is called is function CIRCLE_FILL::draw.

Figure 1 is a block diagram illustrating typical data structures used to represent an object. An object is composed of instance data (data members) and member functions, which implement the behavior of the object. The data structures used to represent an object comprise instance data structure 101, virtual function table 102, and the function members 103, 104, 105. The instance data structure 101 contains a pointer to the virtual function table 102 and contains data members. The virtual function table 102 contains an entry for each virtual function member defined for the object. Each entry contains a reference to the code that implements the corresponding function member. The layout of this sample object conforms to the model defined in U.S. Patent Application Serial No. 07/682,537 (now U.S. Patent No. 5,297,284, entitled

"Method and System for Implementing Virtual Functions and Virtual Base Classes and Setting a This Pointer for an Object-oriented Programming Language"). In the following, an object will be described as an instance of a class as defined by the C++ programming language. One skilled in the art would appreciate that objects can be defined using other programming languages.

An advantage of using object-oriented techniques is that these techniques can be used to facilitate the sharing of objects. In particular, object-oriented techniques facilitate the creation of compound documents. A compound document is a document that contains objects generated by various computer programs. (Typically, only the data members of the object and the class type are stored in a compound document.) For example, a word processing document that contains a spreadsheet object generated by a spreadsheet program is a compound document. A word processing program allows a user to embed a spreadsheet object (e.g., a cell) within a word processing document. To allow this embedding, the word processing program is compiled using the class definition of the object to be embedded to access function members of the embedded object. Thus, the word processing program would need to be compiled using the class definition of each class of objects that can be embedded in a word processing document. To embed an object of a new class into a word processing document, the word processing program would need to be recompiled with the new class definition. Thus, only objects of classes selected by the developer of the word processing program can be embedded. Furthermore, new classes can only be supported with a new release of the word processing program.

To allow objects of an arbitrary class to be embedded into compound documents, interfaces are defined through which an object can be accessed without the need for the word processing program to have access to the class definitions at compile time. An abstract class is a class in which there is at least one virtual function member with no implementation (a pure virtual function member). An interface is an abstract class with no data members and whose virtual functions are all pure. Thus, an interface provides a protocol for two programs to communicate. Interfaces are typically used for derivation: a program implements classes that provide implementations for the interfaces the classes are derived from. Thereafter, objects are created as instances of these derived classes.

The following class definition is an example definition of an interface. In this example, for simplicity of explanation, rather than allowing any class of object to be embedded in its documents, a word processing program allows spreadsheet objects to be embedded. Any spreadsheet object that provides this interface can be embedded, regardless of how the object is implemented. Moreover, any spreadsheet

object, whether implemented before or after the word processing program is compiled, can be embedded.

```
class   ISpreadSheet
{       virtual void File() = 0;
        virtual void Edit() = 0;
        virtual void Formula() = 0;
        virtual void Format() = 0;
        virtual void GetCell (string RC, cell *pCell) = 0;
        virtual void Data() = 0;
}
```

The developer of a spreadsheet program would need to provide an implementation of the interface to allow the spreadsheet objects to be embedded in a word processing document.

When the word processing program embeds a spreadsheet object, the program needs access to the code that implements the interface for the spreadsheet object. To access the class code, each implementation is given a unique class identifier. For example, code implementing a spreadsheet object developed by Microsoft Corporation may have a class identifier of "MSSpreadsheet," while code implementing a spreadsheet object developed by another corporation may have a class identifier of "LTSSpreadsheet." A persistent registry in each computer system is maintained that maps each class identifier to the code that implements the class. Typically, when a spreadsheet program is installed on a computer system, the persistent registry is updated to reflect the availability of that class of spreadsheet objects. So long as a spreadsheet developer implements each function member defined by the interface and the persistent registry is maintained, the word processing program can embed instances of the developer's spreadsheet objects into a word processing document. The word processing program accesses the function members of the embedded spreadsheet objects without regard to who has implemented them or how they have been implemented.

Various spreadsheet developers may wish, however, to implement only certain function members. For example, a spreadsheet developer may not want to implement database support, but may want to support all other function members. To allow a spreadsheet developer to support only some of the function members, while still allowing the objects to be embedded, multiple interfaces for spreadsheet objects are

defined. For example, the interfaces IDatabase and IBasic may be defined for a spreadsheet object as follows.

```
class   IBasic
{       virtual void File() = 0;
        virtual void Edit() = 0;
        virtual void Formula() = 0;
        virtual void Format() = 0;
        virtual void GetCell (string RC, cell *pCell) = 0;
}

class   IDatabase
{       virtual void Data() = 0;
}
```

Each spreadsheet developer would implement the IBasic interface and, optionally, the IDatabase interface.

At run time, the word processing program would need to determine whether a spreadsheet object to be embedded supports the IDatabase interface. To make this determination, another interface is defined (that every spreadsheet object implements) with a function member that indicates which interfaces are implemented for the object. This interface is named IUnknown (and referred to as the unknown interface or the object management interface) and is defined as follows.

```
class IUnknown
{ virtual HRESULT QueryInterface (REFIID iid, void **ppv) = 0;
  virtual ULONG AddRef() = 0;
  virtual ULONG Release () = 0;
}
```

The IUnknown interface defines the function member (method) QueryInterface. The method QueryInterface is passed an interface identifier (e.g., "IDatabase") in parameter iid (of type REFIID) and returns a pointer to the implementation of the identified interface for the object for which the method is invoked in parameter ppv. If the object does not support the interface, then the method returns a false. The type HRESULT indicates a predefined status, and the type ULONG indicates an unsigned long integer.

Code Table 1

```
HRESULT XX::QueryInterface(REFIID iid, void **ppv)
{       ret = TRUE;
        switch (iid) {
          case IID_IBasic:
                *ppv = *pIBasic;
                break;
          case IID_IDatabase:
                *ppv = *pIDatabase;
                break;
          case IID_IUnknown:
                *ppv = this;
                break;
          default;
                ret = FALSE;
        }
        if (ret == TRUE) {AddRef();};
        return ret;
}
```

Code Table 1 contains pseudocode for C++ source code for a typical implementation of the method QueryInterface for class XX, which inherits the class IUnknown. If the spreadsheet object supports the IDatabase interface, then the method QueryInterface includes the appropriate case label within the switch statement. The variables pIBasic and pIDatabase point to a pointer to the virtual function tables of the IBasic and IDatabase interfaces, respectively. The method QueryInterface invokes to method AddRef (described below) to increment a reference count for the object of class XX when a pointer to an interface is returned.

Code Table 2

```
void XX::AddRef() {refcount++;}
void XX::Release() {if (--refcount==0) delete this;}
```

The interface IUnknown also defines the methods AddRef and Release, which are used to implement reference counting. Whenever a new reference to an interface is created, the method AddRef is invoked to increment a reference count of the object. Whenever a reference is no longer needed, the method Release is invoked to decrement the reference count of the object and, when the reference count goes to zero, to deallocate the object. Code Table 2 contains pseudocode for C++ source code for a

typical implementation of the methods AddRef and Release for class XX, which inherits the class IUnknown.

The IDatabase interface and IBasic interface inherit the IUnknown interface. The following definitions illustrate the use of the IUnknown interface.

```
class IDatabase : public IUnknown
{ public:
        virtual void Data() = 0;
}

class IBasic : public IUnknown
{ public:
        virtual void File() = 0;
        virtual void Edit() = 0;
        virtual void Formula() = 0;
        virtual void Format() = 0;
        virtual void GetCell (string RC, cell *pCell) = 0;
}
```

The following pseudocode illustrates how a word processing program uses an IUnknown interface to determine whether a spreadsheet object supports the IDatabase interface.

```
if (pSpreadsheet->QueryInterface("IDatabase", &pIDatabase))
// IDatabase supported
else
// IDatabase not supported
```

The pointer pSpreadsheet is a pointer to an instance of a spreadsheet class. As discussed above, the spreadsheet object may include some interfaces and not others. If the object supports the IDatabase interface, the method QueryInterface sets the pointer pIDatabase to point to a IDatabase data structure and returns true as its value.

Figure 2 is a symbolic representation of a spreadsheet object. In the following, an object data structure is represented by the shape 201 labeled with the interfaces through which the object may be accessed.

Summary of the Invention

It is an object of the present invention to provide a method and system for dynamically generating object connections.

It is another object of the present invention to provide a method and system for connecting an arbitrary interface for subsequent notification purposes.

It is another object of the present invention to provide multiple points of connection connecting with multiple notification routines.

It is another object of the present invention to provide a mechanism for determining whether an object has a particular interface for connecting.

Is another object of the present invention to provide a method and system for invoking previously connected notification routines without any knowledge of what tasks they perform.

It is another object of the present invention to provide a method and system for event handling using application independent object interfaces.

These and other objects, which will become apparent as the invention is more fully described below, are obtained by an improved method and system for dynamically generating object connections. In a preferred embodiment, the present invention comprises a source object and a sink object. The source object contains one or more connection point objects, each of which contains a connection point interface for connecting to sink objects. Each sink object has a notification interface for communicating to the sink object. To establish a connection, the source object determines which connection point object to use for a particular connection request. Using this determined connection point object, the sink object requests to be connected to the source object passing an indication of a notification interface to be used for further communication. The source object then stores the indicated notification interface in a data structure managed by the connection point object. Later, the source object determines what notification interfaces have been stored in a particular connection point object and invokes a particular method of each stored notification interface to notify each sink object that has connected a notification interface. Such notification typically occurs in response to an event, for example, movement from a user input device.

Brief Description of the Drawings

Figure 1 is a block diagram illustrating typical data structures used to represent an object.

Figure 2 is a symbolic representation of a spreadsheet object.

Figure 3 is a block diagram of a preferred connection mechanism architecture.

Figure 4 is a block diagram of a connection between a source object, a delegate object and a sink object.

Figure 5 is a block diagram of a visual programming environment display used to create an open file dialog box for an application program.

Figure 6 is a block diagram of object connections and data structures after connecting the objects shown in Figure 5 using the present invention.

Figure 7 is a flow diagram of a function SetUpConnection for connecting a specified sink object to a specified source object for a specified notification interface.

Figure 8 is a flow diagram for the method FindConnectionPoint of the IConnectionPointContainer interface.

Figure 9 is a flow diagram of a method that uses an established connection between a source object and a sink object.

Figure 10 is a flow diagram of a function defined by a sink object to disconnect a specified notification interface.

Detailed Description of the Invention

The present invention provides a method and system for generating object connections between source objects and sink objects. These connections can be used to support multiple types of event handling mechanisms for objects; the invention provides an underlying connection mechanism architecture for object communication. A source object refers to an object that raises or recognizes an event, and a sink object refers to an object that handles the event. A connection between a source and sink object may be directly initiated by either object or by a third object, referred to as an initiator object. In a typical event handling environment, the source object raises or recognizes an event and notifies the sink object or initiator object by invoking a notification method. If the notification method belongs to the initiator object, then the initiator object is responsible for invoking an appropriate method of the sink object to handle the event.

In a preferred embodiment, the methods and systems of the present invention are implemented on a computer system comprising a central processing unit, memory, and input/output devices. In a preferred embodiment of the present invention, a source object comprises connection point objects and a connection point container object for managing the connection point objects. Preferably, the connection point container object is implemented as part of the source object and the connection point

objects are implemented as subobjects of the source object. The subobjects isolate the application independent behavior of the present invention. The connection point container object provides an interface comprising a method that can enumerate the contained connection point objects and a method that can find a connection point object corresponding to a particular interface identifier ("ID"). A connection point object is associated with a certain type of interface (identified by an interface ID) through which it notifies sink objects to which it is connected. A connection point object preferably provides an interface that comprises methods for connecting a notification interface, for disconnecting a previously connected notification interface, and for enumerating the connected notification interfaces. A connection point object preferably can optionally store references to multiple notification interfaces (belonging to one or more sink objects). A connected notification interface acts as an event set. That is, by virtue of the definition of an interface, each object supporting a documented interface must provide a certain set of methods. Thus, when a sink object connects a notification interface, the source object automatically knows what methods are supported by the notification interface. From this perspective, the methods supported loosely correspond to events, and the entire notification interface loosely corresponds to a set of events.

Once connected, the source object can use the connection point objects in a variety of manners. In typical operation, the source object, upon receiving an event notification, consults the connection point object(s) that is (are) associated with the interface ID corresponding to the received event to obtain the connected notification interfaces. The source object then forwards the event notification to each connected notification interface by invoking a predetermined method of the notification interface. In this manner, several sink objects can be notified upon the occurrence of a single event.

Figure 3 is a block diagram of a preferred connection mechanism architecture. This figure shows a source object 301 connected to two sink objects 302 and 303 through two connection point objects 305 and 306. The source object 301 implements a connection point container object 304 for managing the connection point objects 305 and 306. The connection point container object 304 implements an IConnectionPointContainer interface 307 for enumerating and finding connection point objects. The connection point objects 305 and 306 are accessed by the connection point container object 304 through their respective IConnectionPoint interfaces, 308 and 309. The connection point objects 305 and 306 are connected to the sink objects 302 and 303 through their respective notification interfaces 310 and 311. The source object 301 notifies the sink objects 302 and 303 of the occurrence of an event by locating the

IConnectionPoint interface corresponding to the event and invoking a method of the notification interface of the sink object.

As mentioned above, a connection between a source and sink object can be initiated by an initiator object. The initiator object can either connect a notification interface of the sink object to the source object or can connect a notification interface of its own "delegate" object. A delegate object is simply an object that resides between the sink object and the source object. The delegate object is transparent to both the source and sink object because it provides an implementation for the interface corresponding to the connection point object, just as the sink object provides. The delegate object is responsible for forwarding any event notifications to the sink object. In this manner, the delegate object can be used as a security mechanism, deciding whether or not to forward an event notification based upon the comparative authorization privileges of the source and sink objects.

Figure 4 is a block diagram of a connection between a source object, a delegate object, and a sink object. The connection illustrated in Figure 4 comprises three objects: a connection point object 401, a delegate object 402, and a sink object 403. The delegate object 402 is connected to the connection point object 401 through a particular notification interface 404. This same notification interface is used to connect the sink object 403 to the delegate object 402. Thus, the two notification interfaces 404 and 405 are different implementations of the same interface definition and thus have the same interface ID.

A typical application of the present invention involves connecting objects in a visual programming environment. Visual programming is a computer programming technique that allows for rapid development of visually oriented programs (visual programs). A visual programming environment typically includes a list of predefined components (objects) that can be interconnected to create a visual program. Each component may include input and output ports and a visual interface. When creating a visual program, a visual programmer specifies the visual components and their location on the display. The visual programmer also specifies the interconnection between various ports. The visual components then use these connections to communicate with each other.

For example, a dialog box for an application program can be created using a visual programming environment. Figure 5 is a block diagram of a visual programming environment display used to create an open file dialog box for an application program. An open file dialog box is used for scrolling through a list of file names to select files to open. The visual programming environment display comprises two parts: a workspace display area 501 and a command area 502. The workspace

display area 501 shows multiple objects being created and connected to program a dialog box visually. The objects currently shown in the workspace display area 501 include an open file dialog box object 503 and four code objects 504-507. Each object in turn comprises several subobjects. For example, the open file dialog box object 503 comprises a title bar object 508, a multiple selection list box object 509, and a button object 510. In the state shown, the multiple selection list box object 509 is currently selected by the user for creating connections with other objects. An input port 511 and an output port 512 corresponding to the selected object 509 are shown as highlighted objects. Using the various commands provided by the buttons in the command area 502, a visual programmer has connected the output port 516 of the open file dialog box object 503, the input and output ports 511 and 512 of the multiple selection list box object 509, and the input and output ports 513 and 514 of the button object 510 to code objects 504-506. Specifically, the output port 516 of the open file dialog box object 503 has been connected to the input port 517 of the code object 504, which contains code for updating the list of files shown in the multiple selection list box object 509. Also, the input port 511 of the multiple selection list box object 509 has been connected to the output port 518 of the code object 504. Therefore, when a user selects the open file dialog box object 503, the list of files shown in multiple selection list box object 509 is updated to reflect additions or deletions of files since the dialog box was last selected. The output port 512 of the multiple selection list box object 509 has been connected to the input port 519 of the code object 505 which contains code for tracking the files selected in the multiple selection list box object 509. This output port has also been connected to the input port 517 of the code object 504 so that the file list displayed in the multiple selection list box is updated each time the user selects a file. The input port 513 of the button object 510 has been connected to the output port 520 of the code object 505 so that the list of selected files is passed to the button object 510 each time a file is selected. The output port 514 of the button object 510 has been connected to the input port 521 of the code object 506, which contains code that opens each file in the list of selected files once the user has pressed the OK button implemented by button object 510.

Once created using this visual programming environment, the open file dialog box operates by responding to particular system events, for example, events raised from user input devices. For example, when the user selects the open file dialog box 503, a MouseLeftButtonDown selection event is sent to the open file dialog box object 503. Upon receiving this selection event, the open file dialog box object 503 forwards the notification to the code object 504, because the input port 517 of the code object 504 has been previously connected to the output port 516 of the open file dialog

box object 503. The code object 504, which implements code for updating the list of displayed files, then sends an updated file list to the multiple selection list box object 509, because the output port 518 of the code object 504 has been previously connected to the input port 511 of the multiple selection list box object 509. Also, when a user selects a file in the list box implemented by the multiple selection list box object 509 using a mouse input device, a MouseLeftButtonDown selection event is sent to the multiple selection list box object 509. This event is then forwarded to the code object 505 to keep track of the user selection because the input port 519 of the code object 505 has been previously connected to the output port 512 of the multiple selection list box object 509. The code object 505 then sends a list of selected files to the button object 510, because the output port 520 of the code object 505 has been previously connected to the input port 513 of the button object 510. In addition, when a user selects the OK button implemented by the button object 510, a system selection event (for example, a MouseLeftButtonDown selection event) is sent to the button object 510. The button object 510 then forwards its output (which in this case is the list of selected files) to the code object 506, because the output port 514 of the button object 510 has been previously connected to the input port 521 of the code object 506. Upon receiving this button selection event, the code object 506 opens the files selected by the user.

In one example application, the present invention can be used to dynamically generate the object connections needed by the visual programming example illustrated in Figure 5. Figure 6 is a block diagram of object connections and data structures after connecting the objects shown in Figure 5 using the present invention. Figure 6 shows four objects: a source object 601, which corresponds to the open file dialog box object 503 in Figure 5 and three sink objects 602-604, which correspond to the code objects 504-506 in Figure 5. The source object 601, corresponding to the open file dialog box object 503, contains subobjects corresponding to the title bar object 508, the multiple selection list box object 509, and the button object 510. (None of the subobjects are shown.) Alternatively, using the present invention, one could create a source object for each of the subobjects contained in the open file dialog box object 503 and then connect each of the source objects with the appropriate code object (sink object).

Because the open file dialog box object 503 deals with system events corresponding to the selection of the open file dialog box object 503, the selection of files within the multiple selection list box object 509, and user selection of the OK button implemented by the button object 510, the source object 601 supports connection point objects associated with different event sets. Specifically, the source object 601 contains a connection point container object 605 and three connection point

objects 608, 612, and 615. Connection point object 608 is associated with the IMultipleList interface used to support the multiple selection list box object 509. Connection point object 612 is associated with the IButton interface used to support the button object 510. Connection point object 615 is associated with the IDialog interface used to support the open file dialog box object 503. The connection point container object 605 provides the IConnectionPointContainer interface and maintains a list of pointers to connection point objects. In Figure 6, the list of pointers to connection point objects currently has three elements 606, 607, and 618. Each element contains an indicator of the interface ID associated with the connection point object, a pointer to the IConnectionPoint interface of the connection point object, and a pointer to the next element of the list. One skilled in the art would realize that other data structures could be used to manage the set of created connection point objects. Also, more or less information could be associated with each list element for efficiency reasons. For example, each element need not store the interface ID, as the interface ID is readily accessible from the connection point object.

Each connection point object provides the IConnectionPoint interface and maintains a list of references to notification interfaces belonging to sink objects. A reference to a notification interface of a sink object is added to this list whenever the sink object requests a connection from a connection point object using the IConnectionPoint interface. The connection point object 608, which is referenced by the list element 606 in the connection point container object 605, currently shows a list of references to notification interfaces containing two elements 610 and 611. A header for the list of references to notification interfaces 609 is provided for quick access to the associated interface identifier and to the first list element. Each list element contains a token uniquely identifying the connection, a pointer to the IUnknown interface of the connected sink object, and a pointer to the next element in the list. For example, list element 610 contains a token uniquely identifying the connection with sink object 602, which corresponds to the code object 504 for updating the list of files displayed by the multiple selection list box object 509. List element 610 also contains a pointer to the IUnknown interface of sink object 602 in order to access the IMultipleList interface (the notification interface) of sink object 602. List element 610 also provides a pointer to list element 611. List element 611 analogously connects to sink object 603, which corresponds to code object 505 for keeping track of the selected files.

Connection point object 612 implements the connection between the button object 510 and the sink object 604, which corresponds to the code object 506 for opening files selected by the user. In an analogous manner to connection point object 608, connection point object 612 contains a list with one element 614. Element 614

contains a pointer to the IUnknown interface of sink object 604, which corresponds to code object 506. In addition, connection point object 615 is analogously connected to a notification interface of sink object 602. Note that the notification interface of sink object 602 that is connected to the connection point object 615 (IDialog) is different from the notification interface of the same sink object (IMultipleList) that is connected to connection point object 608. However, in this embodiment, both connection point objects 608 and 615 contain a pointer to the IUnknown interface of sink object 602. As shown in Figure 6, a connection point object can be connected to more than one notification interface (of one or more sink objects) and a sink object can be connected to one or more connection point objects.

Referring to Figure 6, when the source object 601 receives the event associated with selecting the open file dialog box 503, the source object 601 will find the connection point object corresponding to the IDialog interface (615). The source object 601 will then notify the sink object 602, which updates the list of files using the IDialog interface of sink object 602. When the source object 601 receives a selection event associated with selecting the multiple selection list box object 509, the source object 601 will find the connection point object corresponding to the IMultipleList interface (608), and then will notify sink objects 602 and 603 using their connected notification interfaces (IMultipleList). Likewise, when the source object 601 receives a selection event associated with the user pressing the button object 510, the source object 601 will find the connection point object corresponding to the IButton interface (612), and then will notify sink object 604 using the connected notification interface (IButton). An example of the event notification corresponding to selecting the button object 510 is discussed with reference to Figure 9.

Code Table 3

```
interface IConnectionPoint: public IUnknown {
        virtual HRESULT GetConnectionInterface (REFIID piid) = 0;
        virtual HRESULT GetConnectionPointContainer (IConnectionPointContainer
                        **ppCPC) = 0;
        virtual HRESULT Advise (IUnknown *punk, DWORD *pdwToken) = 0;
        virtual HRESULT Unadvise (DWORD dwToken) = 0;
        virtual HRESULT EnumConnections (IEnumConnections **ppEnum) = 0;
        }
```

```
interface IEnumConnections: public IUnknown {
        virtual HRESULT Next (ULONG cConnections, CONNECTDATA *rgpunk,
                              ULONG *lpcFetched) = 0;
        virtual HRESULT Skip (ULONG cConnections) = 0;
        virtual HRESULT Reset ( ) = 0;
        virtual HRESULT Clone (IEnumConnection **ppEnum) = 0;
        }

struct tagCONNECTDATA {
        IUnknown *punk;
        DWORD dwToken;
        } CONNECTDATA;
```

Code Table 3 contains C++ pseudocode for a preferred definition of the interfaces IConnectionPoint and IEnumConnections and the data structure returned by the enumerator interface IEnumConnections. The IConnectionPoint interface contains methods for connecting and disconnecting to the connection point object and for enumerating the notification interfaces connected to the connection point object. The method GetConnectionInterface returns a pointer to the interface ID associated with the connection point object. The method GetConnectionPointContainer returns a pointer to the IConnectionPointContainer interface of the connection point container object containing the connection point object (its parent container object). When the connection point object is instantiated, the creation method of the connection point object is passed a pointer to the connection point container object for future use. The method Advise connects the notification interface specified by the parameter punk to the connection point object and, if successful, returns a unique token identifying the connection in parameter pdwToken. The unique token may be stored persistently. The method Unadvise disconnects the notification interface specified by the input parameter dwToken. The method EnumConnections returns an enumerator interface, an instance of the interface IEnumConnections, for iteration through the connected notification interfaces.

The interface IEnumConnections implements the enumerator used by the IConnectionPoint interface. This enumerator contains a set of methods for enumerating the notification interface connections for a particular connection point object. The two methods of interest include the method Reset, which reinitializes the enumerator to point to the first connected notification interface, and the method Next, which returns a pointer to the next connected notification interface. Code Table 3 shows a typical structure definition for the connection information returned by the enumerator method Next referred to as CONNECTDATA.

Code Table 4

```
interface IConnectionPointContainer: public IUnknown {
        virtual HRESULT EnumConnectionPoints (IEnumConnectionPoints **ppEnum) = 0;
        virtual HRESULT FindConnectionPoint (REFIID iid, IConnectionPoint **ppPoint) = 0;
}

interface IEnumConnectionPoints: public IUnknown {
        virtual HRESULT Next (ULONG cConnections, IConnectionPoint *rgpcn,
                              ULONG *lpcFetched) = 0;
        virtual HRESULT Skip (ULONG cConnections) = 0;
        virtual HRESULT Reset ( ) = 0;
        virtual HRESULT Clone (IEnumEmbeddedConnection **ppecn) = 0;
        }
```

Code Table 4 contains C++ pseudocode for preferred definitions of the interfaces IConnectionPointContainer and IEnumConnectionPoints. The IConnectionPointContainer interface implements methods for finding a particular connection point object and for enumerating the set of contained connection point objects. The IEnumConnectionPoints interface implements the enumerator method used by the IConnectionPointContainer interface. The IConnectionPointContainer interface contains a method FindConnectionPoint which returns a pointer to an IConnectionPoint interface given a specified interface ID. The method IEnumConnectionPoints returns a pointer to the interface IEnumConnectionPoints for iteration through the contained set of connection point objects. The interface IEnumConnectionPoints contains a method Reset for initializing the enumerator to point to the first connection object and a method Next for retrieving a pointer to the IConnectionPoint interface associated with the next connection point object stored in the connection point container object.

Corresponding to the example discussed with reference to Figures 5 and 6, an object comprising the visual programming environment depicted in Figure 5 acts as an initiator object to set up connection between the open file dialog box object 503 (the source object) and the code objects (sink objects) 504, 505, and 506. Figure 7 is a flow diagram of a function SetUpConnection for connecting a specified sink object to a specified source object for a specified notification interface. The initiator object (the code implementing the visual programming environment) could use this function to set up all of the connections shown in Figures 5 and 6. The function SetUpConnection provides one example of using the interfaces shown in Code Tables 3 and 4 to set up an event handling scheme. One skilled in the art would recognize that many uses of these interfaces and different functions than SetUpConnection are possible.

The function SetUpConnection determines the connection point object on the source object for connecting and connects the appropriate notification interface of the sink object to the connection point object. The function takes three input parameters: pSrc, which is a pointer to some interface of the source object to connect; pSink, which is a pointer to some interface of the sink object to connect; and iid, which is the interface identifier associated with the connection point object to which the sink object desires to connect. In step 701, the function calls the method QueryInterface of the specified source object to locate the IConnectionPointContainer interface of the specified source object. In step 702, the function uses the returned IConnectionPointContainer interface pointer to invoke the method FindConnectionPoint to retrieve a pointer to the connection point object for the specified iid. (This function is discussed further with reference to Figure 8.) In step 703, the function saves the returned pointer to the connection point object for use at some future time, for example, for disconnecting the sink object. In step 704, the function calls the method QueryInterface of the specified sink object to obtain a pointer to the IUnknown interface of the sink object. In step 705, the function calls the method Advise of the connection point object (returned in step 702) to connect the IUnknown interface of the sink object to the connection point object. The function passes the pointer to the IUnknown interface of the sink object in the call to Advise, and if successful, the method Advise returns the token uniquely identifying the connected notification interface. In step 706, if the connection was successfully performed by the method Advise, the function continues in step 707, else returns an error. In step 707, the function saves the token returned by the method Advise for later use in disconnecting the notification interface of the sink object, and then returns.

The function SetUpConnection incorporates one way of setting up connections between connection point objects and sink objects. One skilled in the art would realize that there are many alternatives. For example, an alternative to step 702 uses the enumerator method EnumConnectionPoints of the ConnectionPointContainer interface to determine the connection point object. Also, if a sink or initiator object already has a pointer to any connection point object in the source object, then the sink or initiator object can use the method GetConnectionPointContainer of the IConnectionPoint interface to retrieve a pointer to the connection point container object to search for a different connection point object. Also, if a sink or initiator object already has obtained the desired connection point object, then the sink or initiator object can call the method Advise directly, circumventing the preliminary steps. In addition, a preferred embodiment assumes that a pointer to the IUnknown interface of the specified sink object is the interface pointer stored in the specified connection point

object. The IUnknown interface is used to support the persistent storage of connection point objects and enable delayed binding to a connected sink or delegate object. Alternatively, one could store a pointer to the notification interface itself, without concern for delayed binding. Also, note that, in this function and those discussed below, reference counting has been omitted to simplify explanation. One skilled in the art would recognize that as object connections are created and destroyed, reference counts are preferably updated and that cyclical references are preferably avoided.

Figure 8 is a flow diagram for the method FindConnectionPoint of the IConnectionPointContainer interface. This method returns a pointer to an IConnectionPoint interface of a connection point object corresponding to a specified interface identifier. The specified interface identifier is passed as an input parameter to the method, and the method returns a pointer to the interface pointer in an output parameter. In steps 801-806, the method loops through the list of instantiated connection point objects looking for the connection point object corresponding to the specified interface identifier. In steps 807-810, if a corresponding connection point object has not been found, then the method instantiates a new connection point object if the requested interface identifier is supported by the source object; otherwise, the method returns an error. In step 801, a temporary variable is set to point to the IConnectionPoint interface pointer contained in the first list element. In step 802, the method GetConnectionInterface of the interface pointed to by the temporary variable is invoked to determine whether the interface ID associated with the connection point object referenced by the temporary variable (the current connection point object) matches the specified interface ID. In step 803, if the returned interface ID matches the specified interface ID, then the method continues at step 804, else continues at step 805. In step 804, the method sets the output parameter to point to the address of the IConnectionPoint interface pointer referenced by the temporary variable, and returns. In step 805, the temporary variable (which points to the current connection point object) is set to point to the IConnectionPoint interface of the next element in the list of instantiated connection point objects. In step 806, if the method has reached the end of the list, then the method continues at step 807, else the method returns to the beginning of the loop in step 801. In step 807, the method determines whether the specified interface ID corresponds to a connection interface that the source object supports, and if so, the method continues at step 808, else returns in error. In step 808, the method instantiates a new connection point object. In step 809, the method inserts the newly instantiated connection point object into the connection point container object's list of connection point objects. In step 810, the method sets the output parameter to point to the address of the newly instantiated connection point object, and returns.

The steps comprising the method FindConnectionPoint in Figure 8 assume that connection point objects are instantiated dynamically as needed. One skilled in the art would recognize that connection point objects can be established dynamically or statically at the discretion of the source object implementation. For example, upon instantiation of the source object, a connection point object corresponding to each connection interface identifier supported by the source object could be instantiated with empty lists of references to notification interfaces. Also, certain steps could be eliminated for efficiency reasons from the method FindConnectionPoint if the connection point container object is implemented with knowledge of the connection point object implementation structure. Such knowledge might typically occur if the source object implementation provides its own implementations for the connection point container object and the connection point objects. In addition, the method FindConnectionPoint assumes that the data structure used to store references to the connection point objects is a list structure as shown in Figure 6. This method could be alternatively written to handle various storage data structures.

Figure 9 is a flow diagram of a method that uses an established connection between a source object and a sink object. Specifically, Figure 9 illustrates a set of steps that could be performed by the source object corresponding to the open file dialog box object 503 in Figure 5 when the source object receives a system selection event indicating that a user has depressed the OK button object 510. This example assumes the connections have been appropriately established as discussed with reference to Figure 6. One skilled in the art would recognize that many other uses of and semantics for the object connection mechanism are possible.

When a user depresses the OK button object 510 in Figure 5, the system sends a selection event to the source object. The source object then invokes some internal routine to respond to the externally raised event. Figure 5 depicts an example of such a routine, which is the method OK_ButtonDown for the IDialogBox interface. The OK_ButtonDown method determines which connection point object corresponds to the interface identifier associated with the raised event and invokes a predetermined method of the notification interfaces connected to the determined connection point object. As described earlier, because the set of events that includes the raised event is represented by an interface, the source object has knowledge of what methods are supported by a connected sink object. Furthermore, in the source object routine handling the raised event (in this case, the OK_ButtonDown method), the source object can determine which particular method of the sink object it prefers to invoke to handle the raised event. In this particular example, the method determines that the method

MouseLeftButtonDown of the notification interface corresponding to the interface identifier IID_IButton is preferably invoked to respond to the raised selection event.

In step 901, the method obtains its own IConnectionPointContainer interface using the method QueryInterface. In step 902, the method uses the IConnectionPointContainer interface pointer to invoke the method FindConnectionPoint requesting the connection point object that corresponds to the interface identifier IID_IButton. In step 903, the method invokes the method EnumConnections of the connection point object returned in the previous step to obtain an enumerator for enumerating the contents of the connection point object. In step 904, the method resets the enumerator to start at the beginning of the list of references to notification interfaces. In step 905, the method invokes the method Next of the enumerator to obtain the connection data for the next referenced notification interface. In step 906, if the enumerator indicates no more references to notification interfaces are present, then the method returns, else the method continues in step 907. In step 907, the method calls the method QueryInterface of the IUnknown interface indicated in the connection point data structure requesting the notification interface corresponding to the interface identifier IID_IButton, using a remote procedure call if necessary. A remote procedure call is necessary if the connected notification interface belongs to an object contained within another process address space. In step 908, the method invokes the method MouseLeftButtonDown of the retrieved IButton interface (using a remote procedure call if necessary), and continues back to the beginning of the loop in step 905. One skilled in the art would recognize that multiple steps of this method could be eliminated for efficiency reasons if the implementations of the connection point container object and the connection point objects are known by the source object implementation.

Figure 10 is a flow diagram of a function defined by a sink object to disconnect a specified notification interface. The function has one input parameter, which is the interface ID of the notification interface the sink object desires to disconnect. In step 1001, the function retrieves the pointer to the IConnectionPoint interface of the connection point object for the specified interface ID, which was previously stored during the function SetUpConnection (see step 703 of Figure 7). The function also retrieves the token uniquely identifying the connection previously established for the specified interface ID (see step 707 of Figure 7). In step 1002, the function calls the method Unadvise of the retrieved IConnectionPoint interface, passing it the retrieved token, and returns. The method Unadvise of the IConnectionPoint interface uses the specified token to search through its list of references to notification interfaces to find the corresponding notification interface reference. The method

Unadvise then removes the references to the corresponding notification interface from the list of connected notification interfaces, thus disconnecting the corresponding notification interface.

Code Table 5

```
interface IProvideClassInfo: public IUnknown {
        virtual HRESULT GetClassInfo (ITypeInfo **ppti, CLID lcid) = 0;
        }
```

Code Table 5 contains C++ pseudocode for a preferred definition of the interface IProvideClassInfo, which can used by a sink object to obtain information about an unknown source object. The method GetClassInfo of the IProvideClassInfo interface can be used by a sink or initiator object to obtain class and type information from an unknown source object in order to connect to it. The ITypeInfo interface describes the interfaces implemented by the source object, what events its raises, and what properties it supports. A sink or initiator object can then use this information to set up compatible connections. The ITypeInfo interface is described in detail in U.S. Patent Application Serial No. 07/959,056 (now U.S. Patent No. 6,209,040, entitled "Method and System for Interfacing to a Type Library").

Although the present invention has been described in terms of a preferred embodiment, it is not intended that the invention be limited to this embodiment. Modifications within the spirit of the invention will be apparent to those skilled in the art. The scope of the present invention is defined by the claims which follow.

CLAIMS

1. A method in a computer system for generating an object connection between a source object and a sink object, the sink object having an instance of an interface that serves as a notification interface for receiving communications from the source object, the notification interface having an associated interface identifier, the source object having instances of a connection point interface, the method comprising the steps of:

receiving a request having an indication of the interface identifier associated with the notification interface of the sink object;

selecting an instance of the connection point interface from among the instances of the connection point interface of the source object, wherein the selection of the instance is based upon the interface identifier indicated in the receive request;

sending a reference to the selected connection point interface instance;

receiving, through the selected connection point interface instance, a request to connect the source object and the sink object, the request having a reference to the notification interface instance of the sink object; and

storing the reference to the notification interface instance, wherein the source object communicates with the sink object using the stored reference to the notification interface instance.

2. A method in a computer system for notifying a sink object from a source object, the sink object connected to the source object in accordance with the method of claim 1, including the step of, under control of the source object, invoking a member function of the notification interface instance referred to by the stored reference.

3. The method of claim 1, the selected connection point interface instance for connecting to a plurality of sink objects, wherein the steps of receiving the request to connect and storing the reference to the notification interface instance are performed for each sink object, and further including the step of:

for each sink object, invoking a member function of the notification interface instance referred to by the stored reference.

4. The method of claim 1, the source object having a connection point container object for managing interaction with the instances of the connection point interface and wherein the step of selecting the instance of the connection point interface includes the substep of requesting the instance of the connection point interface from the connection point container object.

5. The method of claim 1, the connection point interface having an advise member function for requesting a connection to the source object, wherein the step of receiving the request to connect is performed by invoking the advise member function of the selected connection point interface instance.

6. The method of claim 1 wherein the step of selecting the instance of the connection point interface is performed under the control of code of the source object.

7. The method of claim 6 wherein the step of receiving the request to connect is performed under the control of code of the source object.

8. The method of claim 6, further comprising the step of, under the control of code of the sink object, requesting a connection.

9. The method of claim 1 wherein the step of storing the reference to the notification interface instance is performed under the control of code of the source object.

10. The method of claim 9, further comprising the step of, under the control of code of the sink object, requesting a connection.

11. The method of claim 1, further comprising the step of, under control of code of the sink object, requesting a connection.

12. The method of claim 1, the computer system having an initiator object for setting up connections between the source object and the sink object, further comprising the step of, under control of the initiator object, requesting a connection.

13. A method in a computer system for registering with a source object an instance of an interface that serves as a notification interface of a sink object, the source object having a registration function member for registering the notification interface of the sink object, the notification interface instance for communicating with the sink object from the source object, the sink object having a plurality of notification interfaces, each notification interface having at least one instance, the method including the steps of:
receiving a reference to the registration function member of the source object;
selecting the instance of the notification interface to be registered from the plurality of instances of notification interfaces; and
requesting registration of the selected notification interface instance using the received reference to the registration function member of the source object, wherein the source object registers the selected notification interface instance and communicate with the sink object using the registered interface instance.

14. The method of claim 13, the source object having an advise member function for requesting registration of a notification interface, and wherein the step of requesting registration invokes the advise member function of the source object to make the request.

15. The method of claim 13, the sink object having an instance of an IUnknown interface for accessing other interfaces of the sink object, and wherein the step of selecting the instance of the notification interface selects the instance of the IUnknown interface of the sink object.

16. The method of claim 13 wherein the step of requesting registration is performed under the control of the sink object.

17. The method of claim 16 wherein the step of selecting the instance of the notification interface is performed under the control of the sink object.

18. The method of claim 13, the computer system having an initiator object for registering a notification interface of a sink object, wherein all steps are performed by the initiator object.

19. A method in a computer system for notifying a sink object from a source object using a delegate object, the sink object having a sink notification interface for notifying the sink object, the delegate object having a delegate notification interface for notifying the delegate object, the delegate notification interface having an associated interface identifier, the source object having instances of a connection point interface for connecting the delegate object, the method comprising the steps of:

storing, in the delegate object, a reference to an instance of the sink notification interface;

selecting an instance of the connection point interface from among the instances of the connection point interface of the source object, wherein the selection of the instance is based upon the interface identifier associated with the delegate notification interface;

sending, to the delegate object, a reference to the selected connection point interface instance;

receiving, through the selected connection point interface instance, a request to connect the source object and the delegate object, the request having a reference to an instance of the delegate notification interface;

storing the reference to the delegate notification interface instance;

invoking a method of the delegate notification interface instance that is referred to by the stored reference; and

invoking a method of the sink notification interface instance referred to by the stored reference in the delegate object to effect the notification of the sink object.

20. The method of claim 19, the computer system having an initiator object for setting up connections between the source object and the delegate object, and further comprising the step of, under control of the initiator object, requesting a connection.

21. A method in a computer system for generating an object connection between a source object and a sink object, the sink object having a notification interface for communicating with the sink object, the notification interface having an associated interface identifier, the source object having a plurality of connection point objects for connecting the sink object, each connection point object having an instance of the same connection point interface, the method comprising the steps of:
sending, to the source object, an indication of the interface identifier associated with the notification interface of the sink object;
selecting a connection point object from among the plurality of connection point objects based upon the indication of the interface identifier;
requesting a connection, from the instance of the connection point interface of the selected connection point object, to connect the source object and the sink object;
indicating an instance of the notification interface of the sink object in the connection request;
receiving the connection request; and
storing a reference to the indicated instance of the notification interface of the sink object.

22. The method of claim 21, further including the step of, under control of code of the source object, invoking a method of the indicated notification interface instance referred to by the stored reference.

23. The method of claim 21, the source object having connection point container object for managing interaction with the plurality of connection point objects and wherein the step of selecting the connection point object

includes the substep of requesting the connection point object from the connection point container object.

24. The method of claim 21, the connection point interface having an advise member function, wherein the step of requesting the connection from the instance of the connection point interface of the selected connection point object invokes the advise member function of the instance of the connection point interface to make the request.

25. The method of claim 21, the selected connection point object for connecting to a plurality of sink objects, wherein the steps of requesting the connection, indicating the notification interface instance of the sink object, receiving the connection request, and storing the reference to the indicated notification interface instance are performed for each sink object, and further including the step of:
invoking a method of the indicated notification interface instance referred to by the stored reference for each sink object.

26. A method in a computer system for generating an object connection between a source object and a sink object, the sink object having an instance of a notification interface for receiving communications from the source object, the notification interface having an associated interface identifier, the source object having instances of a connection point interface, the method comprising the steps of:
under control of the sink object, sending to the source object a request having an indication of the interface identifier associated with the notification interface of the sink object;
under control of the source object,
selecting an instance of the connection point interface from among the instances of the connection point interface of the source object, wherein the selection of the instance is based upon the interface identifier associated with notification interface of the sink object; and

sending, to the sink object, a reference to the selected connection point interface instance:

under control of the sink object, requesting a connection from the selected connection point instance to connect the source object and the sink object, the request having a reference to the notification interface instance of the sink object; and

under control of the source object, storing the reference to the notification interface instance.

27. A method in a computer system for generating an object connection between a source object and a sink object, the sink object implementing a plurality of notification interfaces for communicating with the sink object, each notification interface having an associated interface identifier, the source object having instances of a connection point interface, each instance of the connection point interface having an associated interface identifier, the method comprising the steps of:

selecting a notification interface from among the plurality of notification interfaces of the sink bject;

selecting an instance of the connection point interface of the source object, the selected instance having an associated interface identifier that corresponds to the interface identifier associated with the selected notification interface of the sink object;

using the selected connection point interface instance to request that the source object and the sink object be connected, wherein the request has a reference to an instance of the selected notification interface of the sink object; and

storing the reference to the instance of the selected notification interface, so that the sink object can be notified by the source object.

28. The method of claim 27, further including the step of invoking a method of the selected notification interface instance referred to by the stored reference.

29. The method of claim 27, the selected connection point interface instance for connecting to a plurality of sink objects, wherein the steps of using the selected connection point interface instance to request that the source object

and the sink object be connected and storing the reference to the selected notification interface instance are performed for each sink object, and further including the step of:

invoking a method of the selected notification interface instance referred to by the stored reference for each sink object.

30. The method of claim 27, the source object having a connection point container object for managing interaction with the instances of the connection point interface and wherein the step of selecting the instance of the connection point interface includes the substep of requesting the instance of the connection point interface from the connection point container object.

31. The method of claim 27, the connection point interface having an advise member function for requesting a connection to the source object, wherein the step of using the selected connection point interface instance invokes the advise member function of the selected connection point interface instance.

32. The method of claim 27 wherein the step of selecting the instance of the connection point interface is performed under the control of code of the source object.

33. The method of claim 32, further comprising the step of, under the control of code of the sink object, requesting a connection from the selected connection point interface instance.

34. The method of claim 33 wherein the step of selecting the notification interface is performed under the control of the sink object.

35. The method of claim 27 wherein the step of storing the reference to the notification interface instance is performed under the control of the source object.

36. The method of claim 35, further comprising the step of, under the control of the sink object, requesting a connection from the selected connection point interface instance.

37. The method of claim 27, further comprising the step of, under the control of the sink object, requesting a connection from the selected connection point interface instance.

38. The method of claim 27, the computer system having an initiator object for setting up connections between the source object and the sink object, further comprising the step of, under control of the initiator object, requesting a connection; and indicating an instance of the notification interface of the sink object in the connection request.

39. A computer system for dynamically connecting objects, the system comprising:
a plurality of sink objects, each sink object having a notification function member for communicating with the sink object from the source object; and
a plurality of source objects, each source object having a plurality of connection point objects, each connection point object storing a plurality of notification function members and returning an identification of one of the notification function members from the stored plurality of notification function members upon request.

40. The system of claim 39, further comprising a connection point container for storing the plurality of connection point objects within each source object, the connection point container determining which connection point object to use when an object connection is requested.

41. The system of claim 39, further comprising an invocation mechanism used by each of the connection point objects to invoke one of the stored notification function members.

42. A method in a computer system for generating an object connection between a source object and a sink object, the sink object having an instance of a notification interface for receiving communications from the source object, the notification interface having an associated interface identifier, the source object having instances of a connection point interface, each instance of the connection point interface having an associated interface identifier, the method comprising the steps of:

receiving a request to enumerate the instances of the connection point interface;

sending a reference to each instance of the connection point interface, wherein from each reference the sink object obtains an indication of the interface identifier associated with the instance;

receiving, through one of the instances of the connection point interface, a request to connect the source object and the sink object, the request having a reference to the notification interface instance of the sink object, wherein the interface identifier associated with the receiving connection point interface corresponds to the interface identifier associated with the notification interface of the sink object; and

storing the reference to the notification interface instance, wherein the source object communicates with the sink object using the stored reference to the notification interface instance.

43. A method in a computer system for generating an object connection between a source object and a sink object, the sink object implementing a plurality of notification interfaces for receiving communications from the source object, each notification interface having an associated interface identifier, the source object having instances of a connection point interface, each instance of the connection point interface having an associated interface identifier, the method comprising the steps of:

receiving a request to enumerate the instances of the connection point interface;

sending to the sink object a reference to each instance of the connection point interface;

obtaining, from each referenced instance of the connection point interface, an indication of the interface identifier associated with each instance of the connection point interface;

selecting an instance of the connection point interface of the source object, the selected instance having an associated interface identifier that corresponds to a selected one of the obtained indications of interface identifiers;

selecting, from among the plurality of notification interfaces, a notification interface, the interface identifier associated with the selected notification interface corresponding to the interface identifier associated with the selected connection point interface instance;

using the selected connection point interface instance to request that the source object and the sink object be connected, wherein the request has a reference to an instance of the selected notification interface of the sink object; and

storing the reference to the instance of the selected notification interface, so that the sink object can be notified by the source object.

44. A computer system for notifying a sink object from a source object, the computer system having a plurality of sink objects and source objects, each sink object having a plurality of notification function members, each source object having a plurality of connection points for storing one or more notification function members, the system comprising:

means for selecting a notification function member from among the plurality of function members of the sink object;

means for selecting a corresponding connection point from among the plurality of connection points of the source object, the selection based upon the notification function member that is selected by the notification function member selection means;

means for connecting the connection point selected by the connection point selection means and the notification function member selected by the notification member selection means, wherein a reference to the selected notification function member is stored within the selected connection point; and

means for invoking the selected notification function member referred to by the stored reference to effect notification of the sink object.

45. The system of claim 44 wherein the plurality of connection points of each source object is stored within a connection point container, and wherein the means for selecting a connection point uses the connection point container to determine which connection point to select.

46. A computer-readable medium having computer-executable instructions for performing steps to generate an object connection between a source object and a sink object, the sink object implementing a plurality of notification interfaces for communicating with the source object, each notification interface having an associated interface identifier, and the source object having instances of a connection point interface identifier, each instance of the connection point interface having an associated interface identifier, the steps comprising:

selecting a notification interface from among the plurality of notification interfaces of the sink object;

selecting an instance of the connection point interface of the source object, the selected instance having an associated interface identifier that corresponds to the interface identifier associated with the selected notification interface of the sink object;

using the selected connection point interface instance to request that the source object and the sink object be connected, wherein the request has a reference to an instance of the selected notification interface of the sink object; and

storing the reference to the instance of the selected notification interface, so that the sink object can be notified by the source object.

47. A computer-readable medium having stored thereon computer-executable code for creating an object connection architecture, the computer-executable code comprising:

computer-executable code for instantiating a plurality of sink objects, each sink object having a notification function member for communicating with the sink object from a source object; and

computer-executable code for instantiating a plurality of source objects, each source object having a connection point object, each connection point object storing a notification function member and returning an identification of the notification function member upon request.

48. A computer-readable medium having computer-executable instructions for causing a computer system to dynamically connect source and sink objects by:

communicating with a sink object from the source object via a notification interface;

storing a plurality of notification interfaces referenced by a plurality of connection point objects wherein each source object is coupled to a connection point object; and

returning an identification of one of the notification interfaces from the stored plurality of notification interfaces upon request.

49. A computer-readable medium having computer-executable instructions stored thereon for causing a computer system to connect a source object and a sink object, the sink object having an instance of a notification interface for receiving communications from the source object, the notification interface having an associated interface identifier, the source object having instances of a connection point interface, each instance of the connection point interface having an associated interface identifier, the computer system directed by said instructions to perform the steps comprising:

receiving a request to identify instances of the connection point interface;

sending a reference to each instance of the connection point interface, wherein from each reference the sink object obtains an indication of the interface identifier associated with the instance;

receiving, through one of the instances of the connection point interface, a request to connect the source object and the sink object, the request having a reference to the notification interface instance of the sink object, wherein the interface identifier associated with the receiving connection point interface corresponds to the interface identifier associated with the notification interface of the sink object; and

storing the reference to the notification interface instance, wherein the source object communicates with the sink object using the stored reference to the notification interface instance.

50. A computer-readable medium having computer-executable instructions for causing a computer system to dynamically notify a sink object from a source object, each sink object having a notification interface, each source object having a connection point for referencing one or more notification interfaces, the computer system performing a method comprising:

selecting a notification interface of the sink object;

selecting a corresponding connection point of the source object, the selection based upon the notification interface that is selected;

connecting the connection point selected and the notification interface selected, wherein a reference to the selected notification interface is stored by the selected connection point; and

invoking the selected notification interface referred to by the stored reference to effect notification of the sink object.

51. A computer system for dynamically connecting objects, the system comprising:

a plurality of sink objects, each sink object having a notification interface for communicating with the sink object from the source object; and

a plurality of source objects, each source object having a connection point object, each connection point object storing a notification interface and returning an identification of the notification interface upon request.

52. A computer system for notifying a sink object from a source object, the computer system having a plurality of sink objects and source objects, each sink object having a notification interface, each source object having a connection point for storing one or more notification interfaces, the system comprising:

means for selecting a notification interface;

means for selecting a corresponding connection point, the selection based upon the notification interface that is selected by the notification interface selection means;

means for connecting the connection point selected by the connection point selection means and the notification interface selected by the notification interface selection means, wherein a reference to the selected notification interface is stored within the selected connection point; and

means for invoking the selected notification interface referred to by the stored reference to effect notification of the sink object.

53. A computer-readable medium having stored thereon computer-executable code for causing a computer system to dynamically connect objects, the computer-executable code comprising:

computer-executable code for instantiating a plurality of sink objects, each sink object having a notification interface for communicating with the sink object from the source object; and

computer-executable code for instantiating a plurality of source objects, each source object having a connection point object, each connection point object storing a notification interface and returning an identification of the notification interface upon request.

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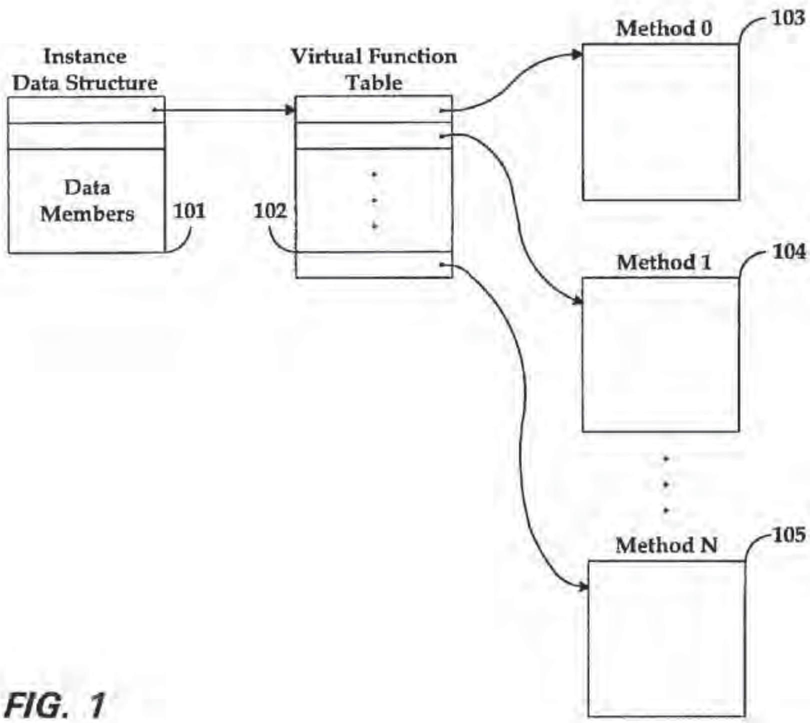

FIG. 1

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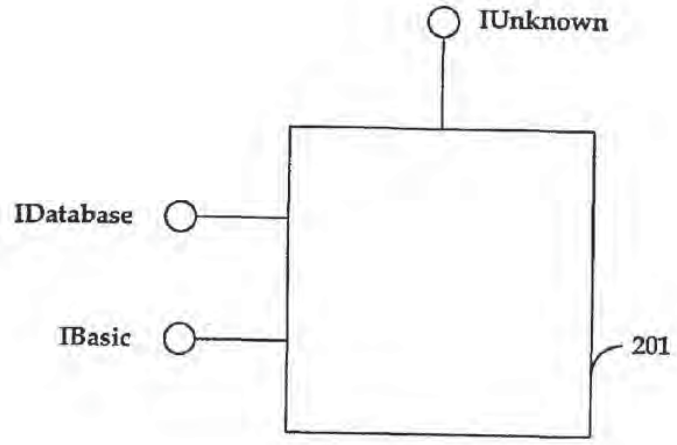

FIG. 2

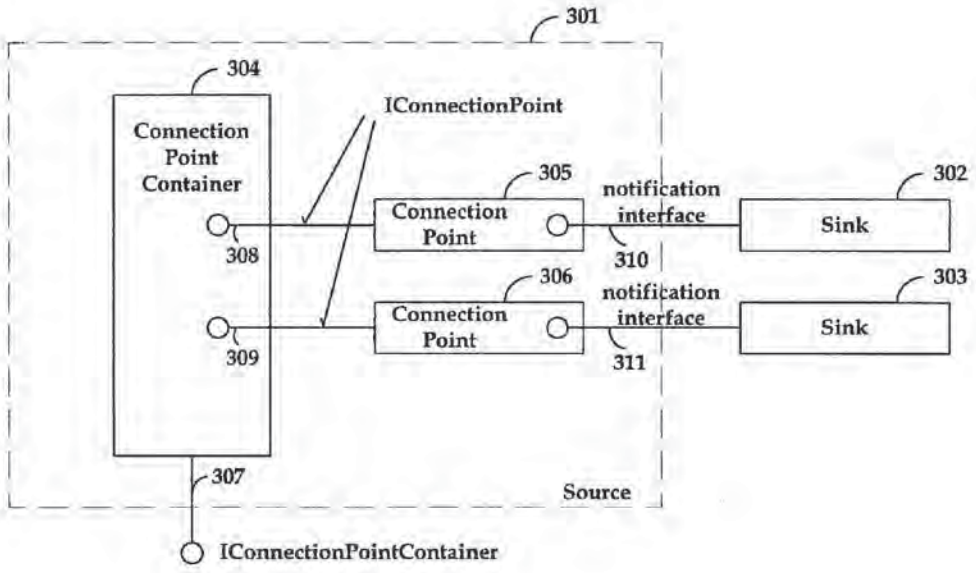

FIG. 3

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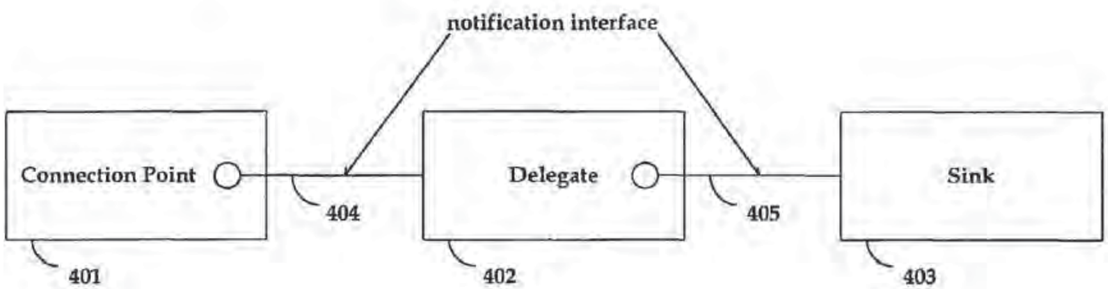

FIG. 4

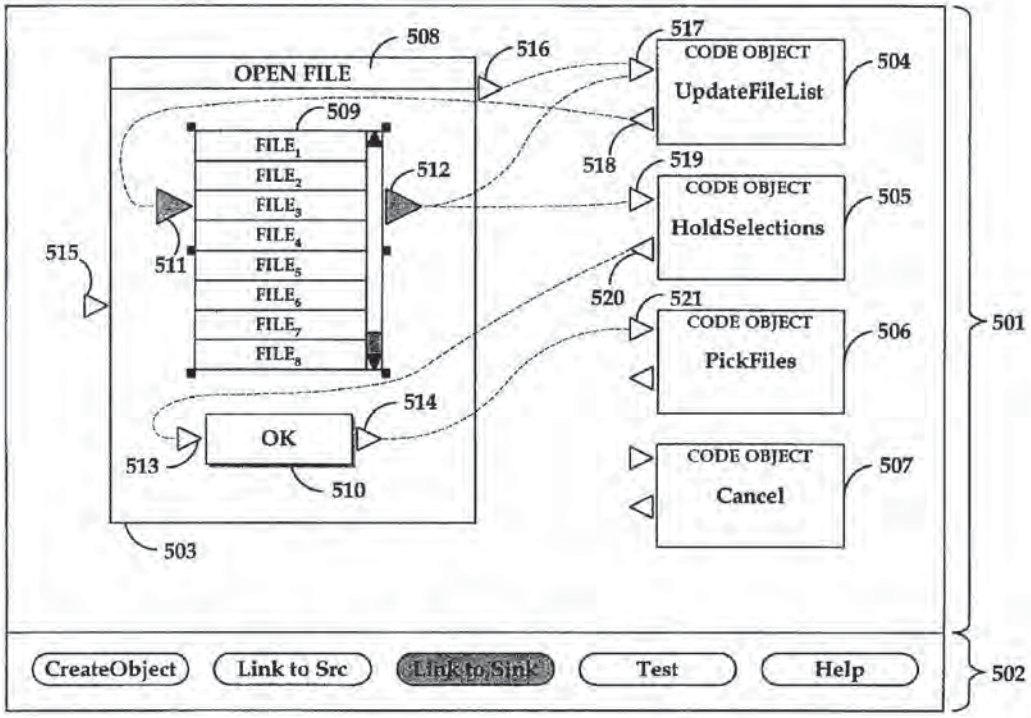

FIG. 5

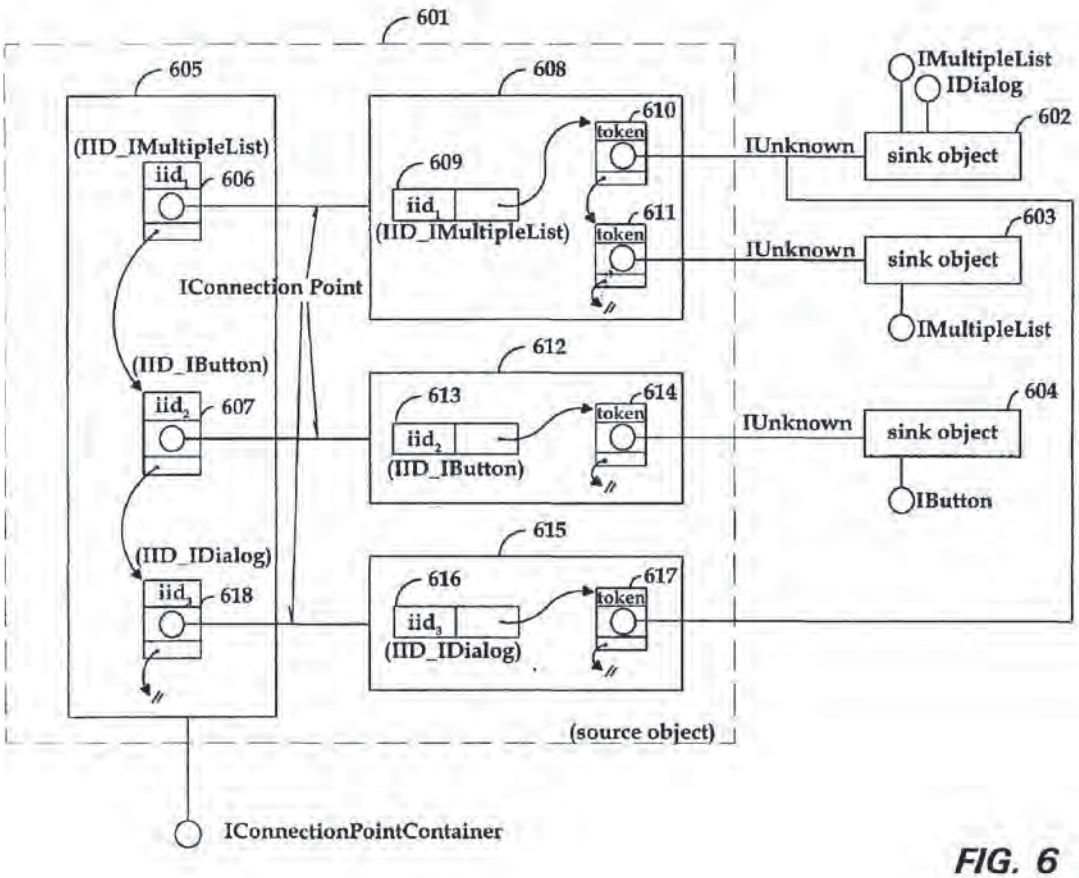

FIG. 6

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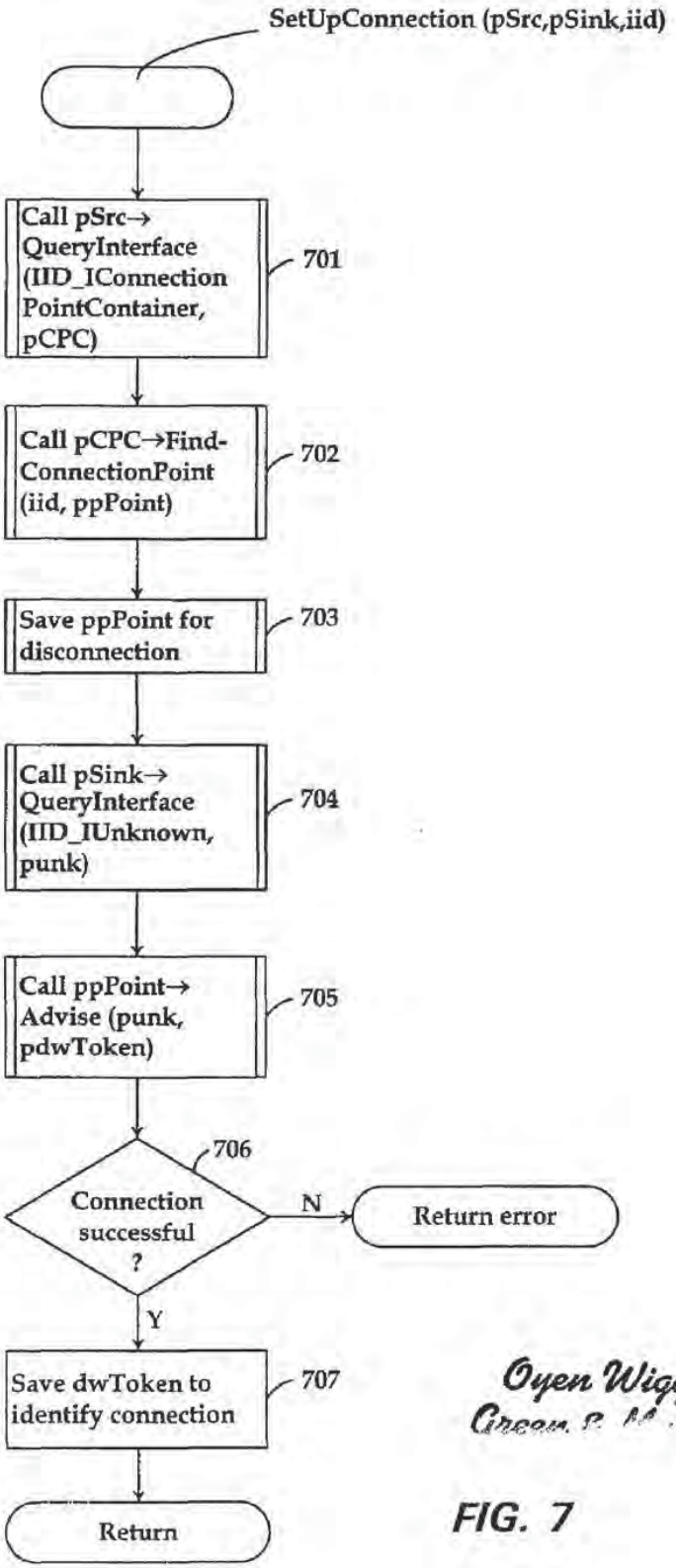
SetUpConnection (pSrc,pSink,iid)
Call pSrc→ QueryInterface (IID_IConnection PointContainer, pCPC)
701
Call pCPC→Find-ConnectionPoint (iid, ppPoint)
702
Save ppPoint for disconnection
703
Call pSink→ QueryInterface (IID_IUnknown, punk)
704
Call ppPoint→ Advise (punk, pdwToken)
705
706
Connection successful ?
N
Return error
Y
Save dwToken to identify connection
707
Return

FIG. 7

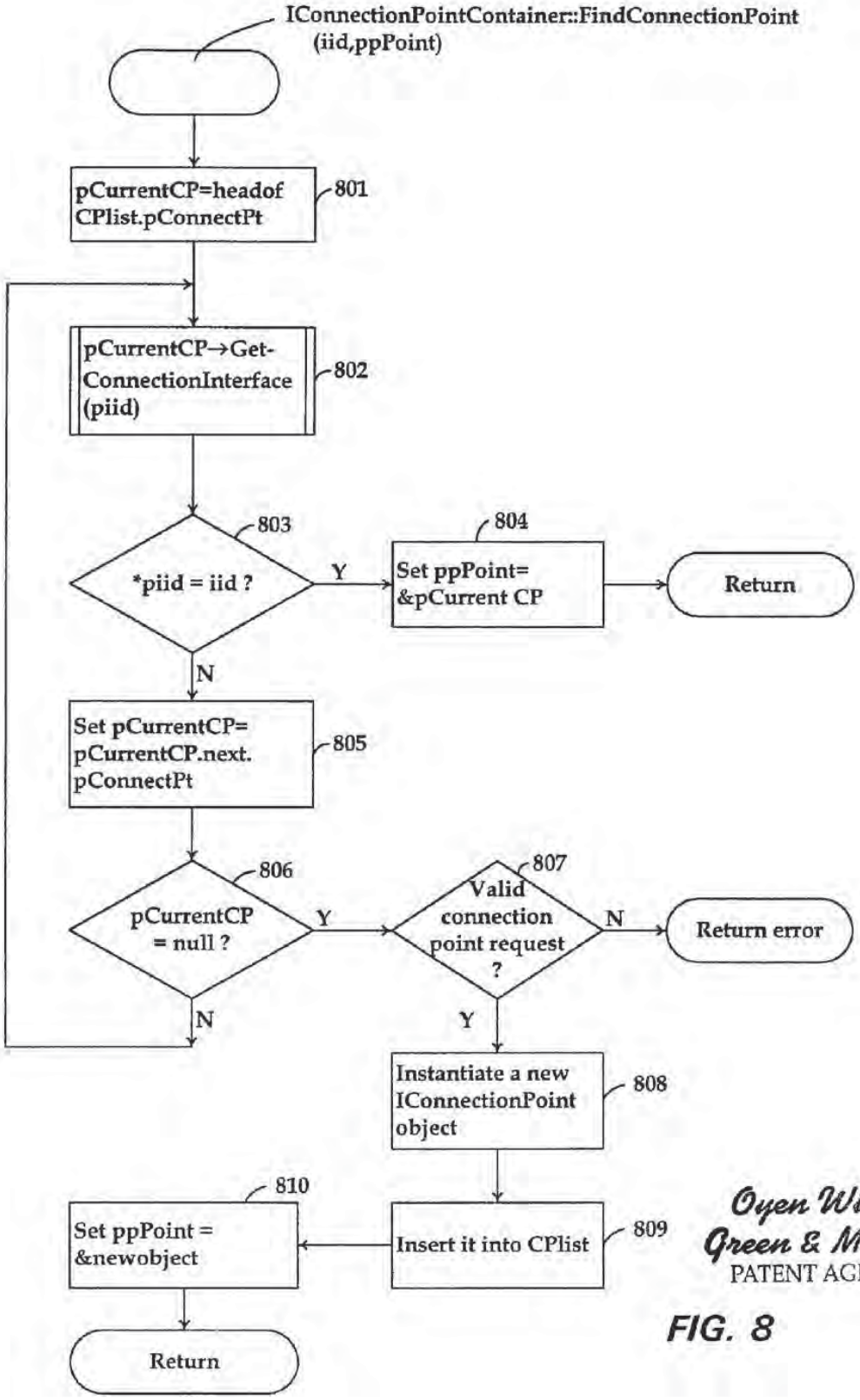

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FIG. 8

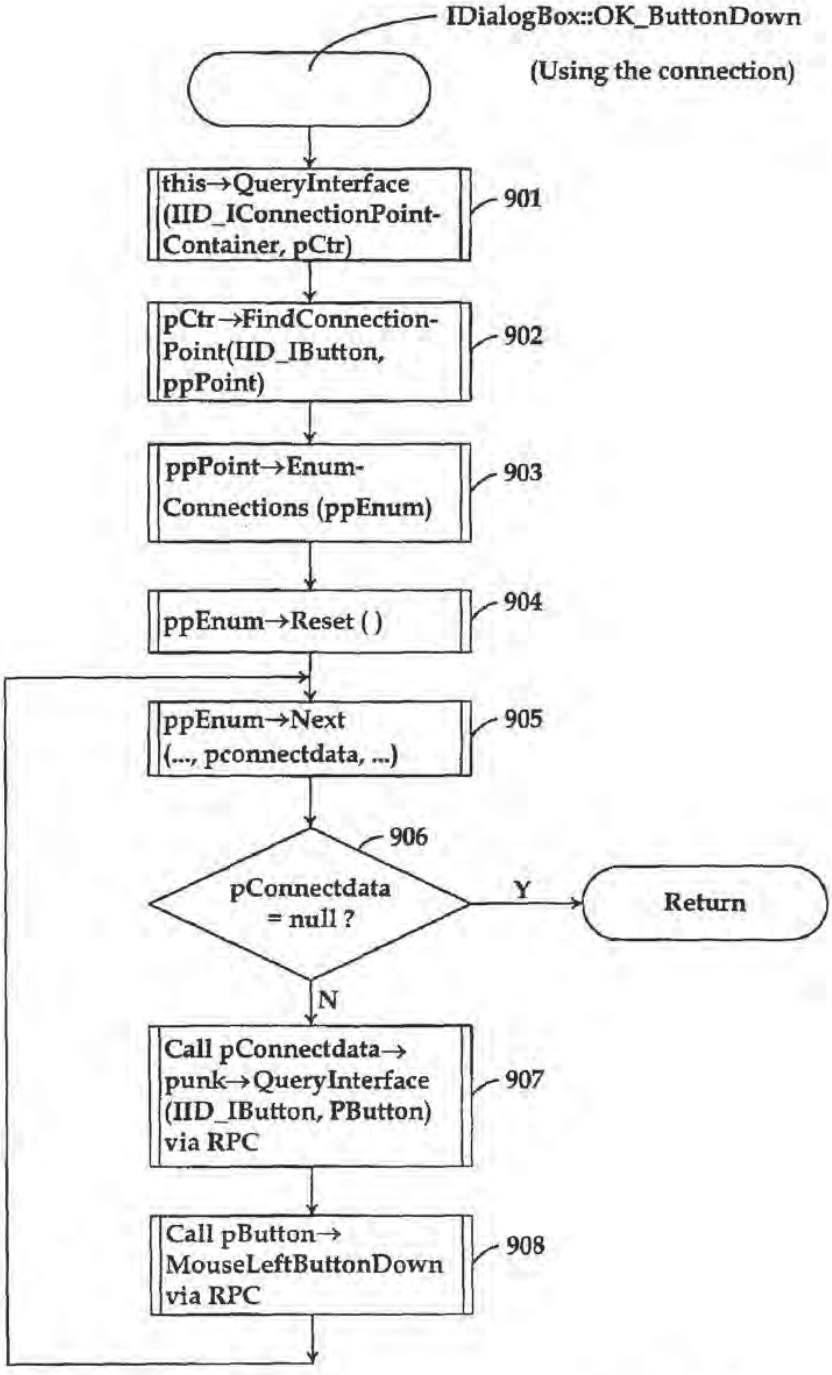

FIG. 9

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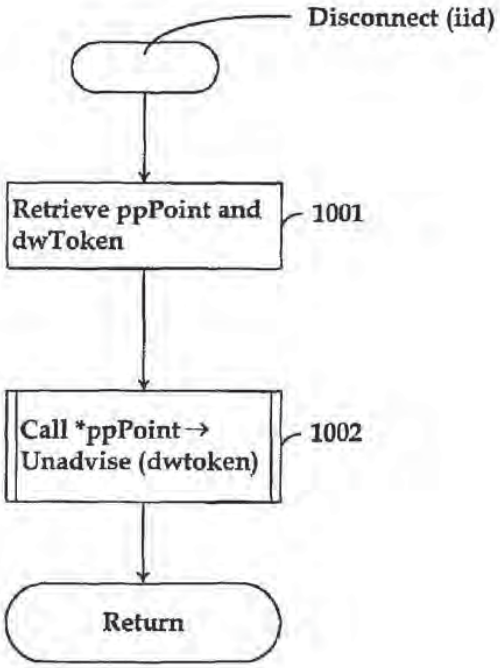

FIG. 10

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(54) Event architecture for system management in an operating system.

(57) An event system is provided within an object-oriented environment. The event system informs users and system functions of events within the system. Events may be modeled as objects that are visible within the global namespace. These objects include event source objects and event sink objects. Event source objects generate event reports and event sink objects are the objects that receive reports. Special objects may be incorporated in the system to direct event reports from an event source object to an event sink object.

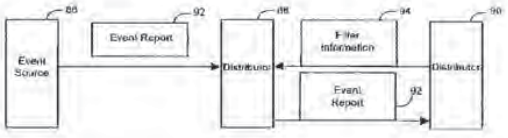

Figure 8

EP 0 651 328 A1

Technical Field

The present invention relates generally to data processing systems and, more particularly, to an event system for reporting system management events in a data processing system.

Background of the Invention

Many distributed operating systems have difficulty in monitoring events. In particular, these operating systems have difficulty determining where events occur and obtaining useful information about the events. Such systems do not provide a convenient architecture for raising and sending events.

Summary of the Invention

In accordance with an aspect of the present invention, a method is practiced in a data processing system in which a global namespace of objects is provided and stored in the memory means. Event source objects are provided for generating event report objects in response to events at the event source objects. An event sink object is provided for receiving event report objects and a distributor object is also provided for distributing event report objects from the event source objects to the event sink objects. The event source objects, the event sink object, the distributor object and the event report objects are all visible in the global namespace. An event is triggered at one of the event source objects and an event report is generated in response to the event. The event report is generated at the event source object where the event was triggered. The event report object is forwarded to the distributor object. The distributor object forwards the event report object to the event sink object to inform the event sink object of the triggered event. The distributor object may be provided with a filter that is examined to determine where the report object should be forwarded.

In accordance with an additional aspect of the present invention, a plurality of event source objects are provided along with a plurality of event sink objects and a distributor object. The event sink objects are registered with the distributor object to be informed of events at the event source objects. Event report objects are generated at the event source objects in response to events. The event report objects are forwarded to the distributor object, and the distributor object determines which event sink object should receive the event report objects. Once this determination is made, the event report objects are forwarded to the determined event sink objects.

In accordance with a further aspect of the present invention, a method is practiced in a data processing system having a storage device. In this method an event source object is stored in the storage device. The event source object then raises events and generates event reports that report the generated events. Event sink objects are also stored in the storage device. An event source holder object is stored in the storage device. The event source holder object maintains a register of registrations by event source objects that are registered to receive an event report upon occurrence of an event at the event source object. An event is triggered at the event source object, and event reports are sent to event sink objects that are registered with the event source holder object.

In accordance with a still further aspect of the present invention, a method is practiced wherein an event source object is stored in the storage device. The event source object is capable of raising a set of events. Type information is stored about the event source object in the storage device. The type information specifies the set of events that the event source object may raise.

In accordance with a further aspect of the present invention, a method is practiced wherein at least one event source object is provided in the memory means for generating an event report in response to an event at the event source object. In addition, a first distributor object and a second distributor object are provided in the memory means. The first distributor object serves to distribute the event report then generated by the event source object to the second distributor object. An event is triggered at the event source object and the event report is generated at the event source object. The event report is forwarded to the first distributor object. Filtering information is provided from the second distributor object to the first distributor object. The filtering information specifies a type of event report that the second distributor object wishes to receive. Where the filtering information indicates that the second distributor object wishes to receive the event report, the event report is forwarded from the first distributor object to the second distributor object.

In accordance with a further aspect of the present invention, a method is practiced wherein an event source object for generating an event report in response to an event is provided along with an event sink object for receiving the event report. In this method, the event sink object is registered to receive the event

report from the event source object. As part of the registration, an instance of a function in an interface to be called by the event report as received by the event sink object is specified.

Brief Description of the Drawings

Figure 1 is a block diagram of a data processing system that is suitable for practicing a preferred embodiment of the present invention.

Figure 2A is a block diagram illustrating an instance of the preferred embodiment in which a single event report is sent from a single event source to a single event sink.

Figure 2B is a block diagram illustrating an instance of the preferred embodiment in which a single event report is sent from a single event source to multiple event sinks.

Figure 2C is a block diagram illustrating an instance of the preferred embodiment in which multiple event sources send multiple event reports to a single event sink.

Figure 2D is a block diagram illustrating an instance of the preferred embodiment in which a single event source sends multiple event reports to multiple event sinks.

Figure 3 is a diagram of the run time data structures used for interfaces by the preferred embodiment to the present invention.

Figure 4 is a diagram of objects that play a role in the preferred embodiment of the present invention to register an event sink object with an event source object to receive event reports.

Figure 5 is a flowchart illustrating the steps performed by the preferred embodiment to register an event sink object with an event source object to receive event reports.

Figure 6 is a flowchart illustrating steps performed by the preferred embodiment of the present invention in generating and processing event reports.

Figure 7 is a block diagram of a preferred embodiment of the present invention when a distributor object is employed.

Figure 8 is a block diagram illustrating propagation of an event rePort from a first distributor object to a second distributor object in accordance with a preferred embodiment of the present invention.

Detailed Description of the Invention

A preferred embodiment of the present invention provides an event system architecture for generating system management events. The architecture is designed to be easily used and to require minimal overhead. The system management events notify processes of certain states.

Figure 1 shows an illustrative data processing system 10 for practicing a preferred embodiment of the present invention. Those skilled in the art will appreciate that other types of data processing systems may be used for practicing the present invention. The data processing system 10 includes a central processing unit (CPU) 12 that oversees activities of the system. The CPU 12 communicates with a memory 14, a keyboard 16, a video display 18, a printer 19 and a mouse 24. The memory 14 holds an object-oriented operating system 20 that includes an event system 22. Although the operating system 20 of the preferred embodiment is an object-oriented operating system, those skilled in the art will appreciate that the present invention is not limited to such an object-oriented environment. The keyboard 16 and mouse 24 are conventional input devices, and the video display 18 and printer 19 are conventional output devices.

The event system 22 is responsible for overseeing the generation and transmission of event reports that report the occurrence of particular events in the system 10. An "event," in this context, is an asynchronously arising condition relative to a destination process that wishes to be informed of the event. The process in which the condition arises is the "event source," whereas the process to which the event is reported is the "event sink." An "event report" reports an event and is transmitted from the event source to the event sink (as will be described in more detail below). The event source and event sink are objects that are visible in a distributed namespace of the system 10. The distributed namespace is a logical organization of the "names of objects" (described in more detail below) that are stored in the system 10.

The preferred embodiment of the present invention allows application programs run on the system 10 (Figure 1) to generate and receive information about external events without possessing knowledge about the events or the sources of the events. It provides a means for an event sink 27 (Figure 2A) to register with an event source 23 to receive an event report 25. The event sink 27 may then invoke an event handler to respond to the occurrence of the event. The design of the preferred embodiment leverages the distributed namespace of the system to provide places for event sinks to register. The preferred embodiment also provides a means to send the event report from the event source to the event sink.

It should be noted that an event report 25 need not be generated from a single event source 23 for transmission to a single event sink 27 as shown in Figure 2A. In many instances, a single event report 25 may be sent from a single event source 23 to multiple event sinks 27, 27' or 27", as shown in Figure 2B. Moreover, a single event sink 27 may receive different event reports 25 and 25' from different event sources 23 and 23', respectively, as shown in Figure 2C. Still further, a single event source 23 may generate different event reports 25 and 25' (Figure 2D) that are destined to different event sinks 27 and 27', respectively. In general, an event source may generate multiple or single event reports that are destined to one or many event sinks.

In order to understand how the preferred embodiment of the present invention operates, it is necessary to first understand certain programming concepts that are employed therein. One of the concepts employed by the preferred embodiment of the present invention is the notion of an "object." An "object" is an entity that may be a combination of two things: data that specifies an internal state of the object and functions that act upon the data.

The preferred embodiment of the present invention is designed far use in the object-oriented operating system 20 (Figure 1). The operating system 20 supports an underlying object model. As such, many components in the system are modeled as objects. For example, event sources 23 (Figure 2a) and event sinks 27 are modeled as objects. Event reports may be objects having properties. Other objects of interest will be described in more detail below. All of these objects are visible in the distributed namespace and thus their properties are easily accessible.

A closely related concept is the concept of an "interface." An "interface" is a group of semantically related functions that are organized into a named unit (the name being the identifier of the interface). Interfaces, by definition, have no instantiation (i.e., a definition of an interface does not include code for implementing the functions that are identified in the interface); rather, interfaces specify a set of signatures for functions. "Instantiation" refers to the process of creating in-memory structures that represent an object so that operations can be invoked on the object. When an object "supports" an interface, the object provides code for the functions specified by the interface. Thus, the object that supports the interface is responsible for providing the code for implementing the functions of the interface. The code that is provided must comply with the signatures of the functions specified by the interface (i.e., the code must have the same parameters and functionality as are specified in the interface). Accordingly, an interface may be viewed as a standard with which objects must comply.

Interfaces support extensiblity by allowing new interfaces to be developed in a fashion that does not affect existing applications. Interfaces are also consistent with the client/server model that is adopted by the operating system 20. In particular, interfaces are used to provide services to a client object. A server object is defined to support the interface, and the interface defines the functions that provide the services of the server object. For instance, the event source 23 (Figure 2a) may be viewed as a server object, and the event sink 27 may be viewed as a client object.

The run time manifestation of an interface instance is a data structure that provides access to the functions defined for the interface. Interface instances are referenced by clients using pointers. As shown in Figure 3, an interface pointer 28 points to an entry in the object data 29 of the object that supports the instance of the interface. In particular, the interface pointer points to an entry in the object data 29 that holds a pointer to a virtual table (i.e., a vtable, such as commonly used in C + + programming). The vtable 31 holds a series of pointers to instances of functions 33 that are supported by the object. Pointers to the functions included in the interface are among those provided in the vtable 31.

Each object in the distributed namespace 28, by definition, must support the IUnknown interface (i.e., all objects support interfaces that inherit the IUnknown interface). The IUnknown interface is a standardized interface provided by the operating system that includes a function, QueryInterface(), for querying whether an object supports a particular interface. The QueryInterface() function returns a pointer to an instance of an interface that is specified in the parameters of the function. In general, whenever a function is called that is part of an instance of an interface, the QueryInterface() function must first be called.

An interface pointer, such as returned by the QueryInterface() function, may serve as a connection between an object and a client. It is difficult, however, for external entities to discover interface pointers that an object has dispensed, and it is difficult for external entities to discover interface pointers to other object objects that an object holds. To overcome these difficulties, the operating system 20 provides software connectors. Software connectors are standardized interfaces for connecting objects together and for advertising the interfaces of an object that are accessible by events. In general, a connection between objects in the preferred embodiment of the present invention is realized by passing an interface pointer from one object directly to another object in order to establish a meaningful connection between the objects. Both objects must share at least one connecting interface. Software connectors are utilized in the

preferred embodiment of the present invention to establish connections between an event source and an event sink. This process will be described below as "registration".

Before discussing how an event sink registers with an event source to receive event reports, it is helpful to consider how events are defined relative to the objects that may generate them. In general, an object specifies an event set of events that it is capable of generating. The event set is part of the object's definition and is described in type information provided for the object. The type information may be stored in a storage structure that is separate from the object. The type information specifies which events are provided in the objects of that set. Consider as an example as object that supports an event set known as the DiskEventSet. This event set is identified as follows:

```
{
        DiskSpaceLow(DiskSpaceEvent psEvent);
        DiskFull(DiskSpaceEvent psEvent);
        DiskError(DiskErrorEvent psEvent)
}
```

DiskSpaceEvent is a property set that may be defined as follows:

```
propset DiskSpaceEvent : public DiskEvent
    {
        LARGE_INTEGER       DiskSpaceAvailable;
        LARGE_INTEGER       TotalDiskSpace;
    }
propset DiskEvent : public ISystemEvent
    {
        ULONG               ulVolumeID;
        WCHAR *             pwzVolumeName;
    }
propset ISystemEvent
    {
    mandatory:
        SYSTIME             timeEventCreationTime;
        UUID                uuidClassId;
        ULONG               sevSeverity;
        UUID                uuidCategoryID;
        ULONG               ulEventCode;
        ULONG               ulHopCount;
    }
```

Before discussing the registration process in more detail, it is useful to first introduce the objects which play a role within this registration process. Figure 4 is a diagram illustrating an example situation wherein the objects that play a role in registration are used. Figure 4 illustrates an instance wherein a printer 46

generates an event report that it is jammed and forwards this event report to a sink pop-up object 44 that generates a pop-up message on the video display 18 (Figure 1) that is viewed by the user. As discussed above, an event source object 42 is an object which generates event reports. The event source object 42 supports the IConnectionContainer interface which is a standardized interface having functions for storing a connector in a container object. An event source holder object 50 is an object that maintains a list of registered event sinks for an event source object. The event source holder object 50 is responsible for the multi-casting of event reports to each registered event sink object. In the example of Figure 4, the event source holder object 50 includes a list of all event sinks that are registered to receive event reports from the printer 46. An event source interface holder 54 object is an object that is a connection object (i.e., it holds an interface pointer to an event sink object) and holds the state associated with the connection to the event sink object. In Figure 4, the event source interface holder object 50 holds a single event sink registration (i.e., it holds one entry from the register of event sink objects).

Figure 5 is a flowchart of the steps performed to obtain a registration of an event sink object so that it receives event reports from an event source. C++ code for implementing these steps in a separate connection tool is as follows:

```
pconSink->QueryInterface(IID_ISystemEventSink, &pesnkSink);

//Setup the source side of the registration
pSource->QueryInterface(IID_IConnectionContainer, &piccSource);
piccSource->NewConnection(IID_IEventSet, &pconSource);


//Actually perform the connection.
pconSource->Connect( pesnkSink, IID_ISystemEventSink, CONNECTFLAGS_PERSIST)
```

Initially, a pointer to the event sink object (i.e., "pSink" in Figure 4) is obtained (step 56 in Figure 5). Next, a pointer to the event source object is obtained (step 62 in Figure 5). Specifically, the QueryInterface() function is called in the second instruction in the above code segment to determine whether the event source object 42 (pointed to by "pSource" in Figure 4) supports the IConnectionContainer interface and stores the resulting pointer to the instance of IConnectionContainer interface in "piccSource". A connector to the event source object (i.e., a pointer to an interface that facilitates a connection to the object) is then acquired (step 64 in Figure 5). The call to the NewConnection method provided within the IConnectionContainer interface of the event source object is used to store the connector in "pconSource".

The connect function is then called to create a connection (step 66 in Figure 5) . In the code segment given above, the connect function within the ISystemEventSink interface supported by the event sink object 40 is called to connect the event sink object 40 to the event source object 42.

An event report in the preferred embodiment of the present invention is largely represented as an array of variants. A variant is a data structure that can hold any fundamental data type, including character data, integer data and floating point data. Property sets that contain context information describing an event are loaded into the variants. This array of variants is passed as an event report type. Each event report may be encapsulated into an event report object that is persistently stored and visible within the distributed namespace. One of the properties held within the variant array is a class I.D. The class I.D. may be utilized to manufacture an event report object.

Figure 6 is a high level flow chart of the steps performed to pass an event report from an event source object to event sink objects. Initially the event report is created by the event source object (step 70) . The event source holder filters the output of the event report using the register stored therein and sends the report to the registered event sinks (step 72). The event sink receives the event report and calls an event handler to respond to the event report (step 74). The event handler then executes (step 78). The event handler may generate activity in response to the event report or may simply ignore the event report. A wide variety of options as to how to respond to an event report are available to an event handler.

A system may also include special objects, known as "distributor objects." A distributor object is an object which exists in the global namespace to route event reports to event sinks. Figure 7 depicts a distributor object 82 that receives event reports from event sources 80, 80' and 80". The distributor object 82 provides both event source and event sink functionalities. The distributor object 82 routes the event reports received from the event sources 80, 80' and 80" to event sinks 84, 84' and 84". Distributor objects 82 are useful in grouping event sources and sinks as sets. For example, a distributor may be used to represent all administrators on a given domain.

A distributor object may also be configured to propagate event reports to other distributor objects. Figure 8 shows an example of a situation in which a distributor object 88 receives an event report 92 from an event source 86 and propagates the event report to a second distributor object 90. The difference between this type of propagation and the propagation that occurs with normal registration is that filtering information 94 stored on the second distributor object 90 is forwarded to the first distributor object 88. This filtering information specifies which type of event report the distributor object 90 is interested in obtaining. The first distributor object 88 filters the incoming event reports 92 to determine whether the second distributor object 90 wishes to receive the event report. The filtering information 94 is stored on the second distributor object in such a way that it is available to any distributor object that is registered to propagate event reports to the second distributor object.

The operating system 20 provides a number of dispatch interfaces. A dispatch interface, in this context, is as defined in the Microsoft Object Linking and Embedding (OLE) 2.0 protocol, established by Microsoft Corporation of Redmond, Washington. Dispatch interfaces allow access to methods, properties and data members of objects whose interface is not known. Each dispatch interface has functions that allow a caller to retrieve and send property values. The event distributor objects have the ability to call any dispatchable interface. Parameter information is stored with the registration information for the event sink object. Properties are set on the software connector to the event sink in the event source such that each registration can have its own interface to be called. As an example, this capability allows a system event to trigger the printing of a word processing document through the call to the unique interface associated with the registration of an event sink.

It should be appreciated that registrations may be maintained over a period of time. Registrations are not strictly a one-time phenomena. The registration need not be deleted after a single event occurs. Maintaining the registration is helpful in performing functions such as logging. Logging involves recording event reports in a file to create a log. The log may be later viewed to provide a historical record of activity of a part of the system.

A preferred embodiment of the present invention enhances the ability of system administration functions to become aware of relevant events within the system. This capability stems, in large part, from segregating the occurrence of an event from the response to the event. The preferred embodiment also facilitates segregation by event type so that the system administrator may be aware of the different types of events and respond accordingly.

Since event reports are objects in the global namespace, both users and system components have access to the event reports. The event reports include important state information that may be used by users and system components alike. The user has the ability to discover what events a program is capable of generating and can register to receive notice of any such events.

While the present invention has been described with reference to a preferred embodiment thereof, those skilled in the art will appreciate that various changes in form and scope may be made without departing from the present invention as defined in the appended claims. For instance, the present invention need not be practiced in a single processor system like that shown in Figure 1; rather the present invention may also be practiced in a distributed system.

Claims

1. In a data processing system having memory means and processing means, a method comprising the steps of:

   storing a global namespace of objects in the memory means;

   providing event source objects for generating event reports in response to events at the event source objects, an event sink object for receiving event reports and a distributor object for distributing event reports from the event source objects to the event sink object;

   triggering an event at one of the event source objects;

   generating an event report at the event source object where the event was triggered;

   forwarding the event report to the distributor object; and

forwarding the event report from the distributor object to the event sink object to inform the event sink object of the triggered event.

2. The method as recited in claim 1, further comprising the step of registering the event sink with the distributor object to receive the event report.

3. The method as recited in claim 1, further comprising the step of providing at least one additional event sink object that is visible in the global namespace.

4. The method as recited in claim 3, further comprising the step of registering the additional event sink object with the distributor object to receive the event report.

5. The method as recited in claim 1, further comprising the step of providing the distributor object with a filter that is examined to determine where the event report should be forwarded.

6. The method of claim 1 wherein the event report is an object that is visible in the global namespace.

7. In a distributed system having processors running an object-oriented operating system, a method comprising the steps of:
providing a plurality of event source objects;
providing a plurality of event sink objects;
providing a distributor object;
registering the event sink objects with the distributor object to be informed of events at the event source objects;
generating event reports at the event source objects in response to events at the event source objects;
forwarding the event reports to the distributor object; and
determining which event sink objects should receive the event reports and forwarding the event reports to the determined event sink objects.

8. The method of claim 7 wherein the event report is an object that is visible in the global namespace.

9. In a data processing system having a storage device, a method comprising the steps of:
storing an event source object in the storage device, said event source object generating events and event reports that report the events;
storing event sink objects in the storage device;
storing an event source holder object in the storage device, said event source holder object maintaining a register of registrations by event sink objects that are registered to receive an event report upon occurrence of an event at the event source object;
triggering an event at the event source object; and
sending event reports to event sink objects that are registered with the event source holder object.

10. The method recited in claim 9, further comprising the step of registering an event sink object with the event source holder to receive an event report after an event is triggered at the event source.

11. The method recited in claim 9 wherein the step of sending event reports further comprises the step of sending a data structure holding property information about the triggered event to event sink objects that are registered with the event source holder object.

12. The method recited in claim 9, further comprising the step of storing each registration in an object in the storage device.

13. In a data processing system having a storage device, a method comprising the steps of:
storing an event source object in the storage device, said event source object being capable of raising a set of events; and
storing type information about the event source object in the storage device, said type information specifying the set of events that the event source object may raise.

14. In a data processing system having memory means and processing means, a method comprising the steps of:

providing at least one event source object in the memory means for generating an event report in response to an event at the event source object;

providing a first distributor object and a second distributor object in the memory means, said first distributor object serving to distribute the event report when generated by the event source object to the second distributor object;

triggering the event at the event source object;

generating an event report at the event source object;

forwarding the event report to the first distributor object;

providing filtering information from the second distributor object to the first distributor object, said filtering information specifying a type of event report that the second distributor object wishes to receive; and

where the filtering information indicates that the second distributor object wishes to receive the event report, forwarding the event report from the first distributor object to the second distributor object.

15. In a data processing system having processing means and memory means, a method comprising the steps of:

providing an event source object for generating an event report in response to an event and an event sink object for receiving the event report; and

registering the event sink object to receive the event report from the event source object, wherein as part of the registration specifying an instance of a function in an interface to be called when the event report is received by the event sink object.

16. The method of claim 15, further comprising the steps of:

triggering the event at the event source object;

generating the event report at the event source object and forwarding the event report to the event sink object; and

in response to receiving the event report at the event sink object, invoking the function of the instance of the interface specified in the registration.

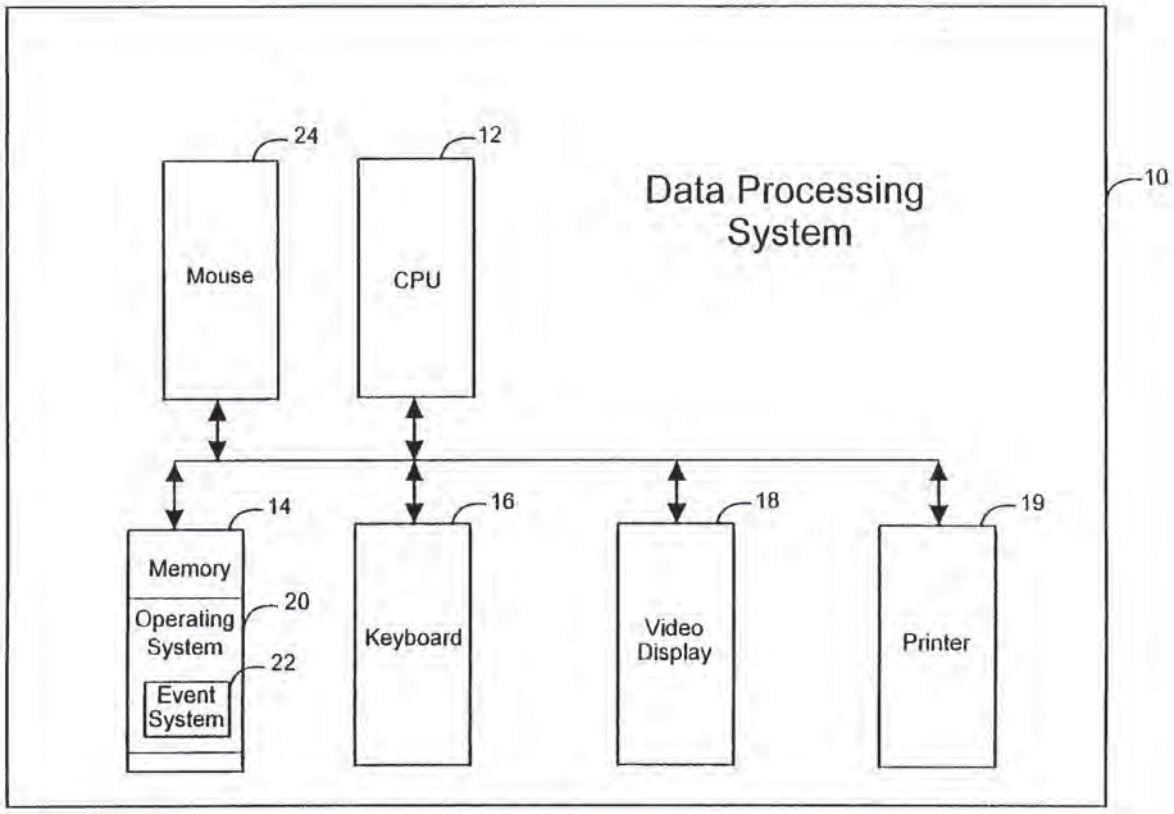
Data Processing System
10
24
Mouse
12
CPU
14
Memory
Operating System
20
22
Event System
16
Keyboard
18
Video Display
19
Printer

Figure 1

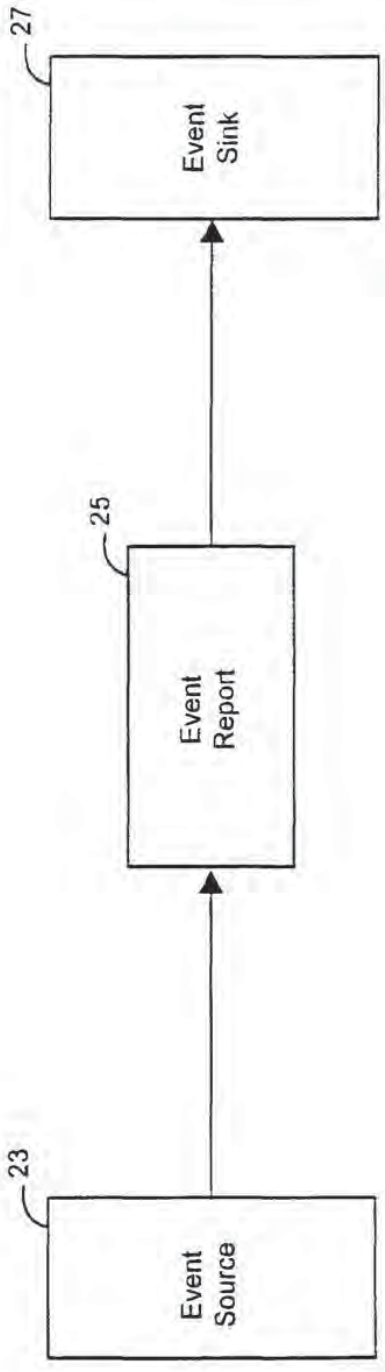

Figure 2A

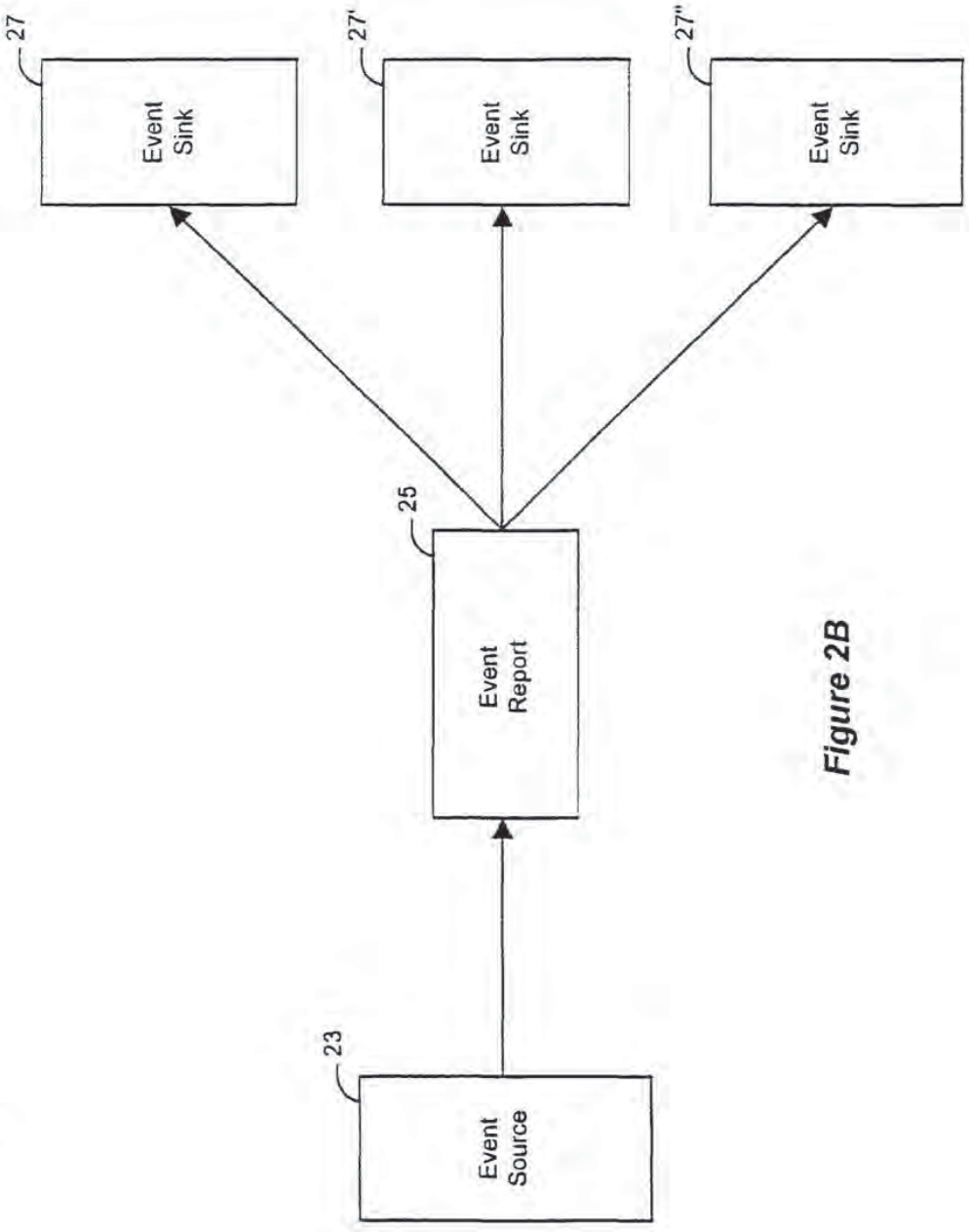
27
Event Sink
27'
Event Sink
27"
Event Sink
25
Event Report
23
Event Source

Figure 2B

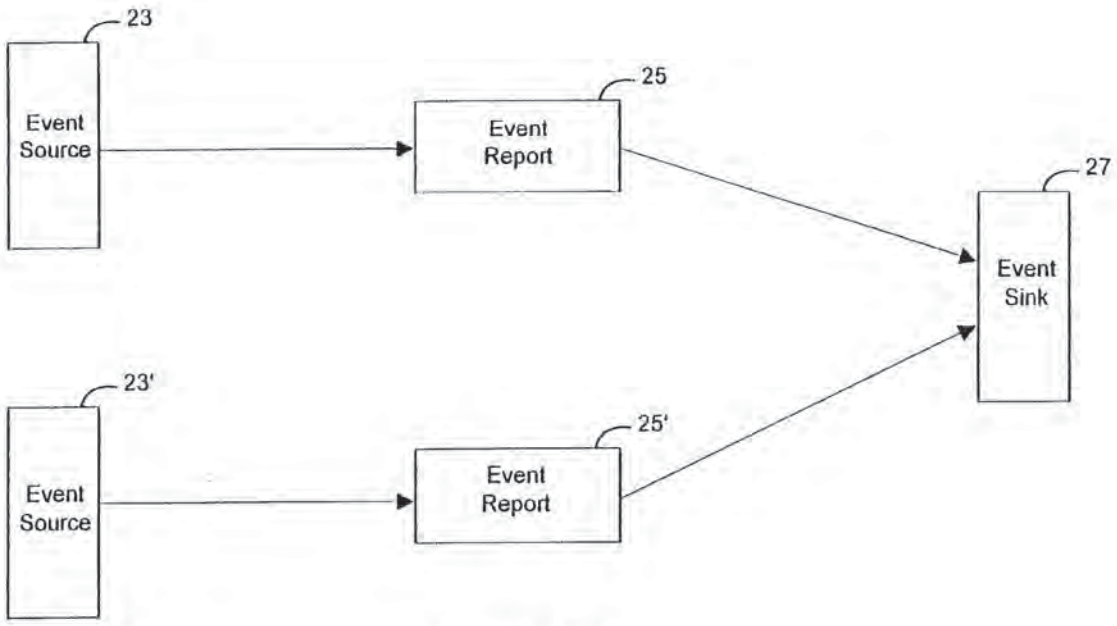
23
Event Source
25
Event Report
27
Event Sink
23'
Event Source
25'
Event Report

Figure 2C

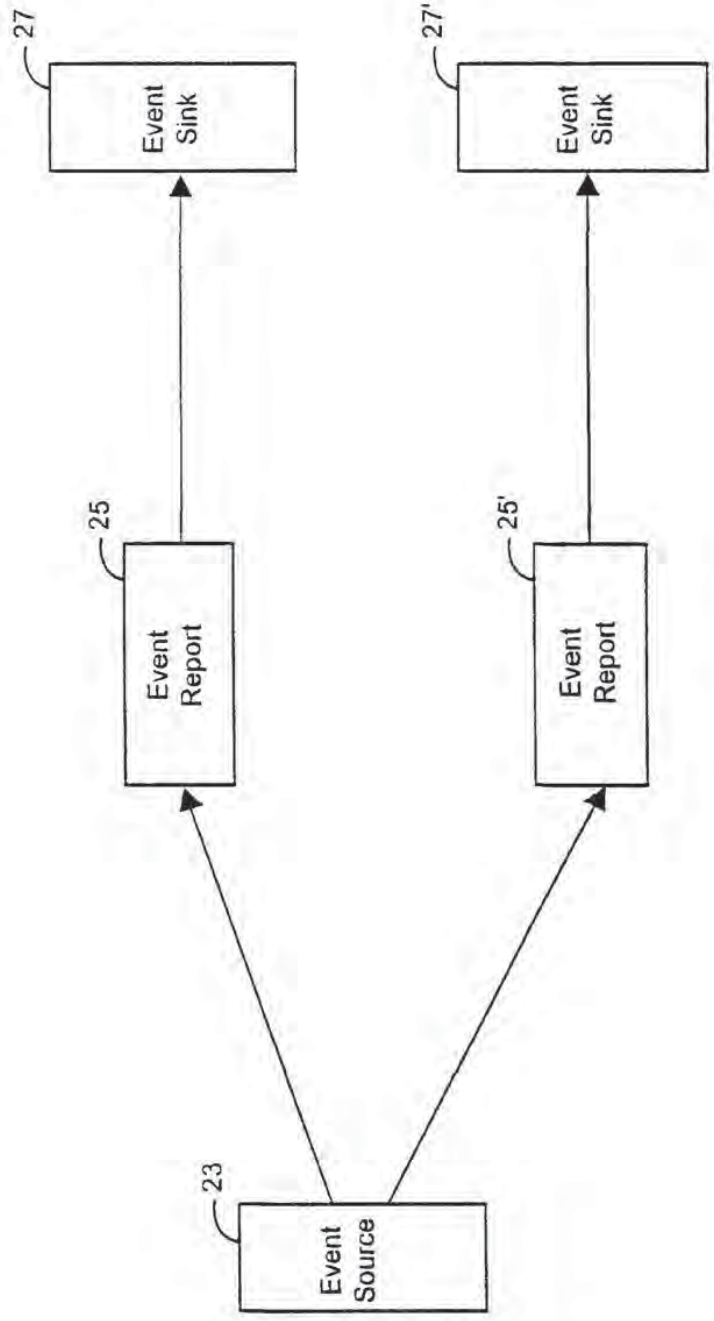
27
Event Sink
27'
Event Sink
25
Event Report
25'
Event Report
23
Event Source

Figure 2D

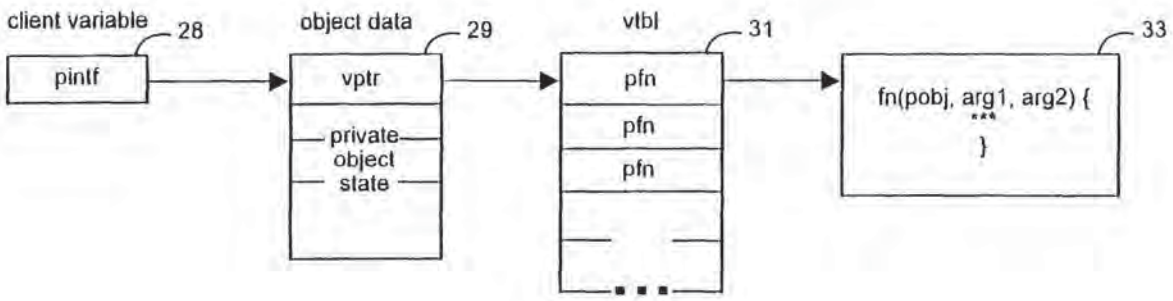
client variable
28
pintf
object data
29
vptr
private
object
state
vtbl
31
pfn
pfn
pfn
33
fn(pobj, arg1, arg2) {
***
}

Figure 3

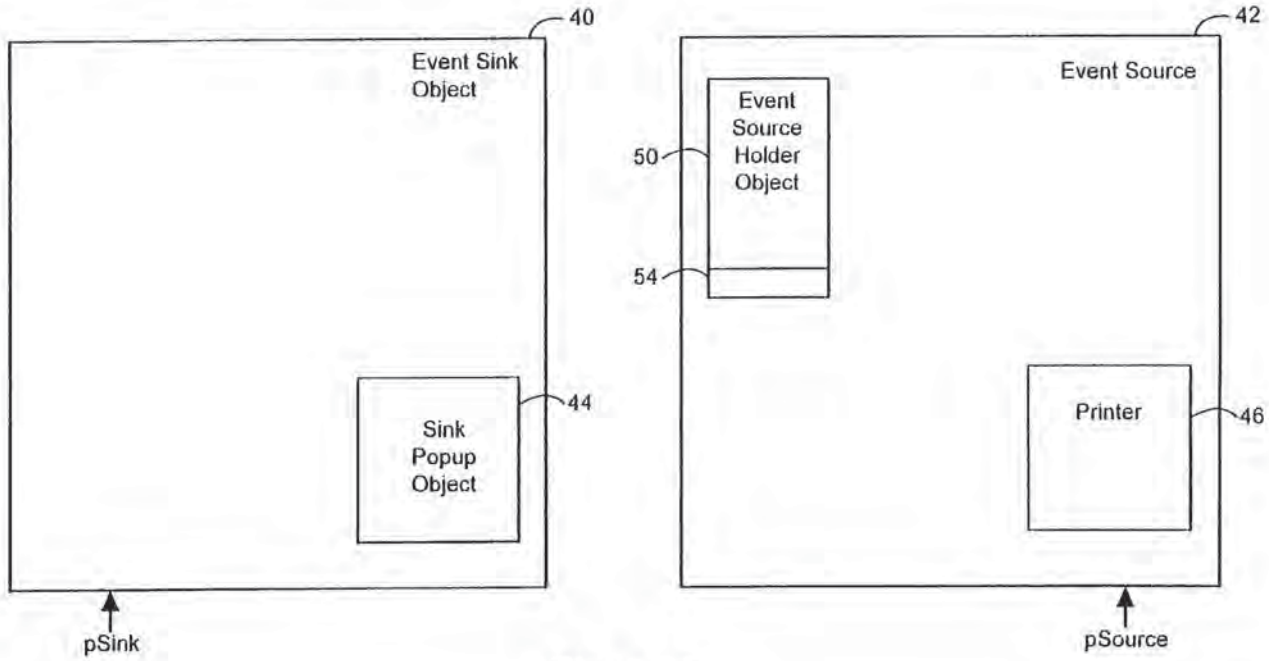
40
Event Sink Object
Sink Popup Object
44
pSink
42
Event Source
Event Source Holder Object
50
54
Printer
46
pSource

Figure 4

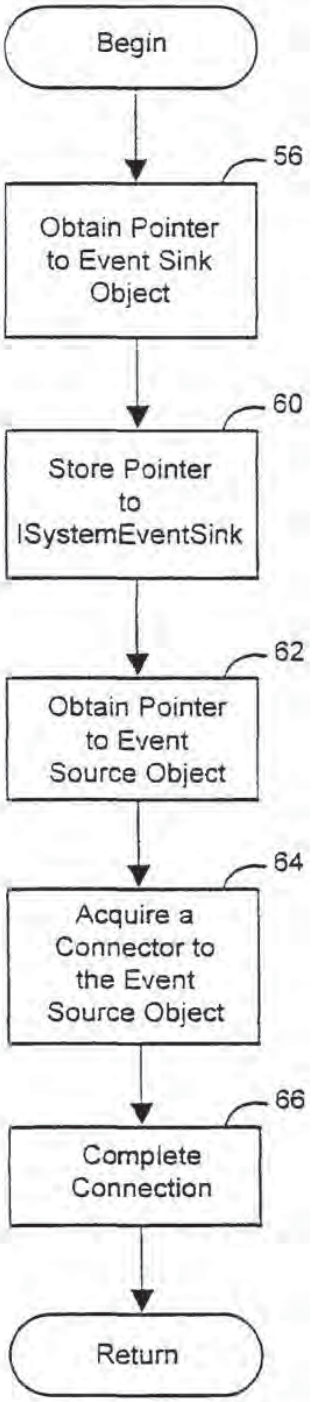
Begin
56
Obtain Pointer to Event Sink Object
60
Store Pointer to ISystemEventSink
62
Obtain Pointer to Event Source Object
64
Acquire a Connector to the Event Source Object
66
Complete Connection
Return

Figure 5

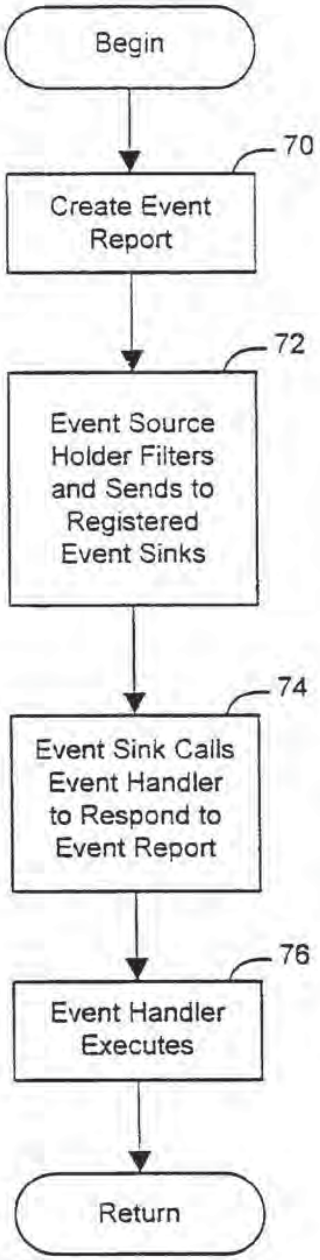
Begin
70
Create Event Report
72
Event Source Holder Filters and Sends to Registered Event Sinks
74
Event Sink Calls Event Handler to Respond to Event Report
76
Event Handler Executes
Return

Figure 6

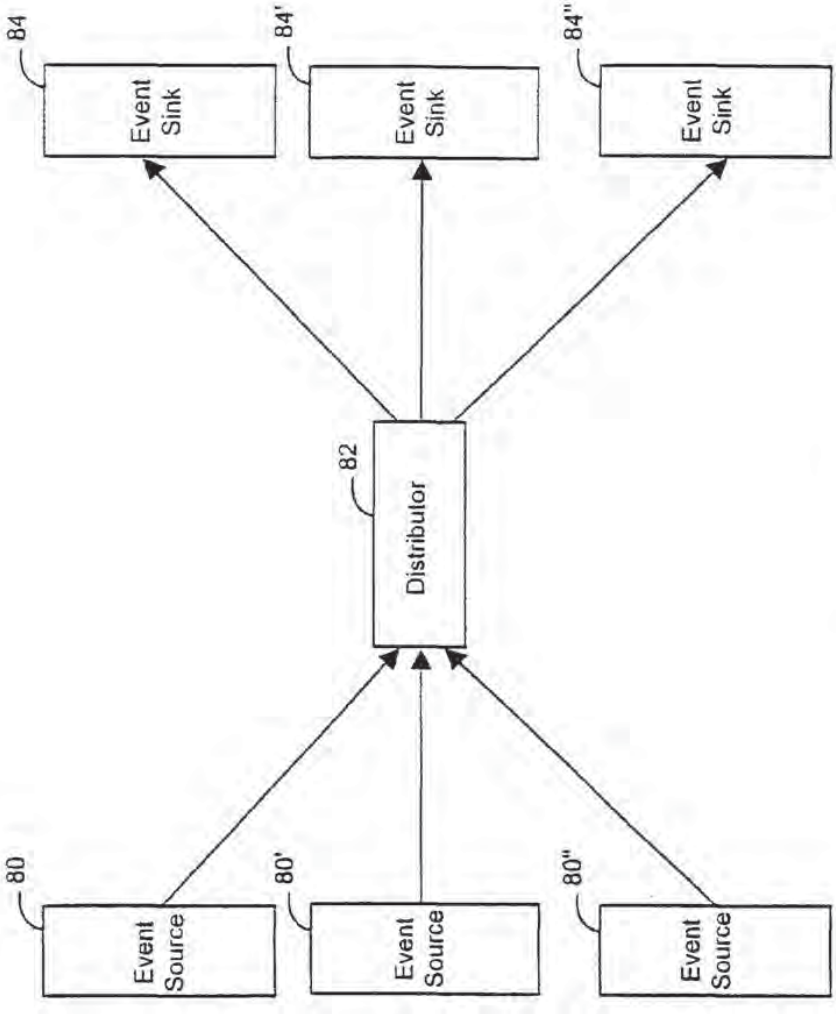
84
Event Sink
84'
Event Sink
84"
Event Sink
82
Distributor
80
Event Source
80'
Event Source
80"
Event Source

Figure 7

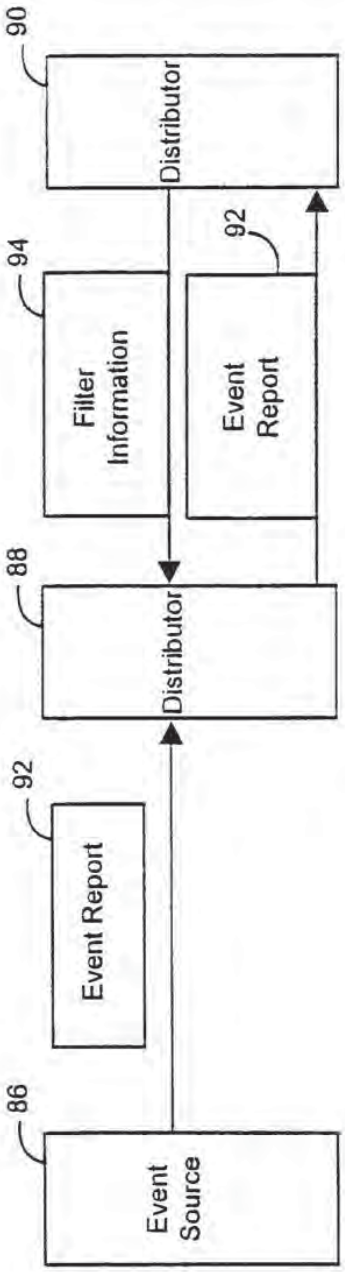
90
Distributor
92
94
Filter Information
Event Report
88
Distributor
92
Event Report
86
Event Source

Figure 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 6832

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO-A-91 03017 (MICROSOFT CORPORATION) * page 2, line 35 - page 3, line 29; figure 1 * ---	1-16	G06F9/46
A	IBM TECHNICAL DISCLOSURE BULLETIN, vol.34, no.4A, September 1991, NEW YORK US page 193 'Event handlers for an object-oriented OfficeVision' -----	5,14	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 February 1995	Corremans, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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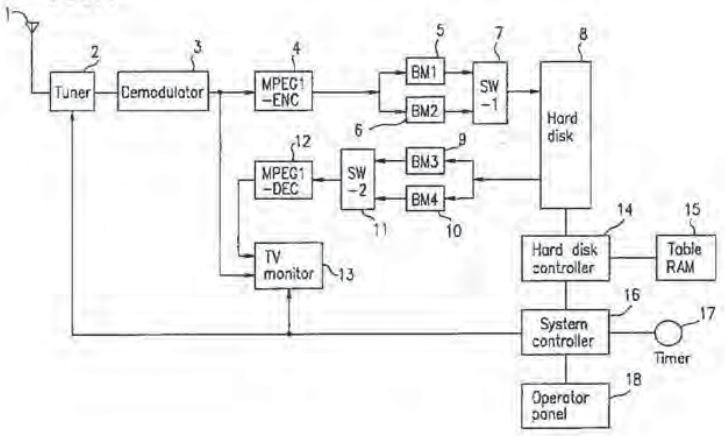
(54) Video signal recording and reproducing apparatus

(57) The video signal recording and reproducing apparatus of the invention includes: a receiving section (1-3) for receiving a television signal; an image compression section (4-7) for compressing an amount of information per unit time of the received continuous video signal; a writing section (8) for intermittently writing a compressed video signal, obtained as an output of the image compression section, onto a hard disk apparatus via a magnetic head; a reading section (8) for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; a decoding section (9-12) for restoring the read compressed video signal into an original video signal; a display section (13) for displaying the restored video signal; and a control section (14-18) for controlling the writing section and the reading section such that writing the video signal onto the hard disk apparatus and reading an arbitrary video signal, which was previously written onto the hard disk apparatus, from the hard disk apparatus are performed apparently simultaneously and continuously.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a video signal recording and reproducing apparatus which can simultaneously record and reproduce a video by using a disk apparatus.

2. Description of the Related Art:

A video tape recorder (VTR) has heretofore been used as a home-use video recording apparatus. As is well known, a VTR receives a broadcast program transmitted by a broadcasting station via an antenna, records the program and then reproduces the program. That is to say, having once finished the recording operation of a predetermined program, the VTR rewinds the tape on which the program has been recorded and then reproduces the received and recorded program to be watched.

A currently available VTR cannot record and reproduce a video simultaneously. For example, assuming that a broadcast program which starts at 10 o'clock and ends at 12 o'clock is now being received and recorded by a single VTR, it is impossible to reproduce and watch the broadcast program from the beginning from 11 o'clock on, while continuing receiving and recording the program. It is much less impossible to perform a trick play reproducing operation (e.g., a fast-forward reproducing operation or a backward reproducing operation) of a recorded video of a program which is now being received and recorded. On the other hand, a technique which is called "following reproducing operation" is currently utilized for a live broadcast relayed by a broadcasting station. In accordance with this technique, a video which has been transmitted to a broadcasting station is slightly delayed and then delivered substantially in real time. However, in such a case, it is necessary to use either a plurality of VTRs or an optical disk apparatus of a special type in which a recording head and a reproducing head are separately provided, for simultaneously performing the recording and the reproducing operations. If a plurality of VTRs are simultaneously used, then it becomes adversely complicated to operate these apparatuses. On the other hand, the use of such an optical disk apparatus of a special type disadvantageously increases the costs.

SUMMARY OF THE INVENTION

According to the present invention, a video signal recording and reproducing apparatus is provided. The video signal recording and reproducing apparatus of the invention includes: receiving means for receiving a television signal; image compression means for compressing an amount of information per unit time of the received continuous video signal; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; display means for displaying the restored video signal; and control means for controlling the writing means and the reading means such that writing the video signal onto the hard disk apparatus and reading an arbitrary video signal, which was previously written onto the hard disk apparatus, from the hard disk apparatus are performed apparently simultaneously and continuously.

In one embodiment, a compressed video signal which was recorded at an earliest time is sequentially updated by a newly received and obtained compressed video signal.

In another embodiment, an audio signal, as well as a compressed video signal, is recorded onto the hard disk apparatus.

In still another embodiment, the video signal recording and reproducing apparatus further includes instruction means for starting and/or finishing recording a compressed video signal onto the hard disk apparatus.

In still another embodiment, the video signal recording and reproducing apparatus further includes instruction means for starting and/or finishing reproducing a compressed video signal from the hard disk apparatus.

In still another embodiment, the instruction means for starting recording a compressed video signal onto the hard disk apparatus is instantaneously driven manually.

In still another embodiment, the instruction means for starting recording a compressed video signal onto the hard disk apparatus is driven by timer means.

In still another embodiment, the instruction means for finishing recording a compressed video signal onto the hard disk apparatus is driven by timer means.

In still another embodiment, the instruction means for starting reproducing a compressed video signal from the hard disk apparatus is instantaneously driven manually.

In still another embodiment, the display means displays at least a time difference between a time at which a video

signal which is being reproduced was recorded and a current time, in addition to a video.

In still another embodiment, the display means displays at least a current time and a time at which a video signal which is being reproduced was recorded, in addition to a video.

In still another embodiment, the video signal recording and reproducing apparatus includes operation means for setting a normal reproduction, a fast forward reproduction, a backward reproduction or a slow reproduction as a reproduction mode.

In still another embodiment, the display means simultaneously displays a received video signal and an output of the decoding means which was previously recorded, reproduced and decoded.

In still another embodiment, the video signal recording and reproducing apparatus further includes television signal detection means for determining whether or not the receiving means has received a normal television signal and writing onto the hard disk apparatus is enabled only when the television signal detection means has detected a normal television signal.

According to another aspect of the present invention, a video signal recording and reproducing apparatus is provided. The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal, thereby reading out predetermined video and audio signals at a predetermined time.

According to still another aspect of the present invention, a video signal recording and reproducing apparatus is provided. The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; display means for displaying the restored video signal; and sound recognition means for recognizing an audio signal. In the video signal recording and reproducing apparatus, predetermined video and audio signals are read out at a point of time when the sound recognition means recognizes a predetermined sound.

According to still another aspect of the present invention, a video signal recording and reproducing apparatus is provided. The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal. In the video signal recording and reproducing apparatus, a video signal at an arbitrary point of time is retrieved for an arbitrary time period by an operation of a viewer from video signals which are being received or video signals which were previously recorded, and information for prohibiting overwriting data of the retrieved video signal is added to the retrieved video signal so as to be stored into the hard disk apparatus.

In one embodiment, when a video signal retrieved by an operation of a viewer is saved, search information required for the viewer to search for a desired video signal later is added to the video signal to be saved, and after the video signal which was previously retrieved and saved has been searched for and read out based on the search information, the read compressed video signal is decoded to be displayed on the display means.

In another embodiment, the video signal recording and reproducing apparatus includes at least an output terminal for outputting digital data which has been recorded onto the hard disk apparatus to the outside of the apparatus. In the video signal recording and reproducing apparatus, a video signal retrieved by a viewer is transferred to another recording apparatus through the output terminal.

According to still another aspect of the present invention, a video signal recording and reproducing apparatus is provided. The video signal recording and reproducing apparatus includes: image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal. In the video signal recording and reproducing apparatus, while compressing a video signal which is being received and writing the compressed video signal onto the hard disk apparatus, a video signal which was previously recorded is read out and decoded into an original video signal, and after an amount of data of the decoded video signal has been reduced, the video signal is subjected to an image compression again and written onto the hard disk apparatus.

According to still another aspect of the present invention, a video signal recording and reproducing apparatus is provided. The video signal recording and reproducing apparatus includes: receiving means for simultaneously receiving television signals from a plurality of channels; image compression means for compressing an amount of information per unit time of the received continuous video signals from the plurality of channels; writing means for intermittently writing each compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal. In the video signal recording and reproducing apparatus, while compressing video signals from the plurality of channels which are being received and writing the compressed video signals onto the hard disk apparatus, a video signal which was previously recorded from a particular channel is read out.

According to still another aspect of the present invention, a video signal recording and reproducing apparatus is provided. The video signal recording and reproducing apparatus includes: receiving means for simultaneously receiving television signals from a plurality of channels; synthesis means for synthesizing the received television signals from the plurality of channels into one screen; image compression means for compressing an amount of information per unit time of the continuous video signal which has been synthesized by the synthesis means; writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head; reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head; decoding means for restoring the read compressed video signal into an original video signal; and display means for displaying the restored video signal. In the video signal recording and reproducing apparatus, a plurality of video signals are synthesized into one screen, subjected to an image compression and then written onto the hard disk apparatus.

By utilizing the above-described configurations, it is possible to provide an apparatus which can independently perform a trick play reproducing operation (e.g., a fast-forward reproducing operation or a backward reproducing operation) of a recorded part of a broadcast program which is now being received, while compression encoding and recording the broadcast program. As a result, it is possible to start watching a recorded part of a program without waiting for the program to end as is done in the recording and reproducing operations performed by a conventional single VTR. In addition, even when a viewer initially starts watching a program at a time much later than the broadcast start time of the program, the viewer can finish watching the program substantially at the same time as the broadcast end time by additionally utilizing a fast-forward reproducing function in the middle of the reproducing operation.

According to the present invention, it is possible to provide an apparatus which can perform a normal reproducing operation or a trick play reproducing operation (e.g., a fast-forward reproducing operation or a backward reproducing operation) of a recorded part of a broadcast program which is now being received, while recording the broadcast program by using a universal hard disk apparatus without using a plurality of VTRs or an expensive optical disk apparatus for which a recording head and a reproducing head are separately provided. As a result, it is possible to start watching a recorded part of a program without waiting for the program to end, as is necessary in the recording and reproducing operations performed by a conventional single VTR. In addition, even when a viewer initially starts watching a program at a time much later than the broadcast start time of the program, the viewer can finish watching the program substantially at the same time as the broadcast end time by additionally utilizing a fast-forward reproducing function in the middle of the reproducing operation, so that a considerable amount of time can be saved. Moreover, in the case where a viewer cannot help stopping watching a program in the middle of the program, even if the program still continues when the viewer resumes watching the program, the viewer can reproduce and watch the program from the scene which was broadcast when the viewer left, while continuing recording the program. Furthermore, in the case where a viewer watches a first program while recording a second program on a different channel, it is possible to instantaneously start watching the second program from the beginning thereof at a time after the first program ends and before the second program ends.

Thus, the invention described herein makes possible the advantage of providing a video signal recording and reproducing apparatus which can simultaneously record and reproduce a television signal.

This and other advantages of the present invention will become apparent to those skilled in the art upon reading and understanding the following detailed description with reference to the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure **1** is a block diagram illustrating a configuration for a video signal recording and reproducing apparatus in a first example of the present invention.

Figure **2** is a diagram illustrating an operational concept in the first example.

Figure **3** is a diagram illustrating the contents of a table RAM.

Figure **4** is a detailed timing chart of peripheral hardware for a hard disk apparatus.

Figure **5** is a block diagram illustrating a configuration for a video signal recording and reproducing apparatus in a

fourth example of the present invention.

Figure **6** is a block diagram illustrating a configuration for a video signal recording and reproducing apparatus in a sixth example of the present invention.

Figure **7** is a diagram illustrating a screen synthesis in the sixth example of the present invention.

Figure **8** is a diagram illustrating a screen separation in the sixth example of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the embodiments of the present invention will be described with reference to the accompanying drawings.

Example 1

Figure **1** is a block diagram illustrating a configuration for a video signal recording and reproducing apparatus in a first example of the present invention. In Figure **1**, the reference numeral **1** denotes an antenna; **2** denotes a tuner; **3** denotes a demodulator; **4** denotes an MPEG1 encoder; **5** and **6** denote recording buffer memories; **7** denotes a first switch; **8** denotes a hard disk apparatus; **9** and **10** denote reproducing buffer memories; **11** denotes a second switch; **12** denotes an MPEG1 decoder; **13** denotes a TV monitor; **14** denotes a hard disk controller; **15** denotes a table RAM; **16** denotes a system controller; **17** denotes a timer; and **18** denotes an operator panel.

First, before describing the operation of the apparatus in the first example with reference to Figure **1**, the operational concepts will be described with reference to Figure **2**. In this example, it is assumed that a viewer wants to watch a program which is to be broadcast from 10 p.m. to 12 p.m. (as shown in portion **(a)** of Figure **2**) but that it is only after 11 p.m. that the viewer can watch the program because of some inconvenience. In such a case, in accordance with the method of this example, while recording the program from 10 p.m. to 12 p.m. (as shown in portion **(b)** of Figure **2**), the viewer can start reproducing the program from the beginning thereof from 11 p.m. (as shown in portion **(c)** of Figure **2**). When a normal reproducing mode is selected, the reproducing operation ends at 1 a.m. which is two hours later than the time when the viewer started watching the program. On the other hand, since a fast-forward reproducing operation can also be performed on a part of the program which has already been recorded as shown in portion **(d)** of Figure **2**, it is also possible to reproduce all of the program at a time slightly later than 12 p.m., that is the time when the broadcasting of the program actually ends.

Hereinafter, a detailed operation of the video signal recording and reproducing apparatus of the first example will be described with reference to Figure **1**. First, a viewer pre-sets a TV channel, a recording start time and a recording end time of a program to be watched on the operator panel **18**. For example, it is assumed that the viewer sets a program on channel # 6 starting at 10 p.m. In such a case, when it is 10 p.m., the system controller **16** sets the tuner **2** to channel # 6 in accordance with the information supplied from the timer **17** such that the electric waves for the channel # 6 are selected from the electric waves received by the antenna **1**, and the demodulator **3** demodulates the received waves into signals.

The received signals can be monitored on the TV monitor **13**. The received signals are converted by the MPEG1 encoder **4** into compressed video signals so as to be bit streams having a bit rate of 1.5 Mbps. These signals are transmitted via the first and the second recording buffer memories **5** and **6** having a capacity of 200 Kbytes, for example, and the first switch **7** so as to be written onto the hard disk apparatus **8**.

This operation will be described in detail later with reference to Figure **3**. The sector information indicating the physical positions of the compressed video signals written on the hard disk and the time information of the written signals are stored in the table RAM **15** so as to correspond to each other. Such a state is maintained until 11 p.m., when the viewer starts watching the program. When it is 11 p.m., the viewer starts watching the program on the TV monitor **13**. In this case, if the viewer wants to watch the program starting at 10 p.m. (i.e., reserved recording start time) from the beginning thereof, then the viewer has only to push the reproducing button (not shown) on the operator panel **18**.

In this case, the program starting at 10 p.m. is reproduced from the beginning thereof from 11 p.m. at a normal reproducing speed as shown in portion **(c)** of Figure **2**. The hard disk controller **14** controls the hard disk apparatus **8** in accordance with the information supplied from the table RAM **15**, so that the compressed video signals recorded on the hard disk apparatus **8** are reproduced via the reproducing buffer memories **9** and **10** and the second switch **11**. This operation will be described in detail later with reference to Figure **3**. The reproduced compressed video signals are decoded by the MPEG1 decoder **12** so as to be video signals which are displayed on the TV monitor **13**.

It is noted that, in this example, the video signals compressed by the MPEG1 encoder **4** are being transmitted via the recording buffer memories **5** and **6** and the first switch **7** so as to be continuously written onto the hard disk apparatus **8** until 12 p.m. during the reproduction of the video signals. When it is 12 p.m., the system controller **16** finishes recording the compressed video signals onto the hard disk apparatus **8** in accordance with the information supplied from the timer **17**. In this case, it is possible to monitor on the TV monitor **13**, the video signals which are being written in parallel with the video signals which are being reproduced by using a technique such as a screen division.

On the other hand, in performing the reproducing operation, the viewer can reproduce a part of a program to be watched in detail at a slower speed and can reproduce an unnecessary part of the program at a higher speed in accordance with the instructions supplied from the system controller **16** by operating the operator panel **18**. The correspondence between the sector information of the compressed video signals recorded on the hard disk, and the time information of the signals, has been stored in the table RAM **15** for performing these operations.

The format of this table is shown in Figure **3**. In Figure **3**, the reference numeral **19** denotes the time information represented as a time code and **20** denotes a sector number on the hard disk. In this example, since each of a plurality of successive sectors corresponds to one second, sector addresses are indicated every other second in Figure **3**. In accordance with the operation of the viewer, the hard disk controller **14** reproduces required video signals based on this time information.

In the case of the MPEG1 standard, an image is generally compressed based on a unit consisting of a plurality of frames. A concept "GOP (group of pictures)" is used as the unit. For example, in the case where 1 GOP = 15 frames, 1 GOP covers a video corresponding to 0.5 second. Thus, in the case of performing a fast forward reproducing operation or a slow reproducing operation, if a decimation or an interpolation is performed on a GOP basis with respect to a video which has been decoded on a GOP basis, the resulting motion of the image is no longer smooth. In order to make the motion smooth, the decimation or the interpolation is required to be performed on a frame basis.

That is to say, a 10x fast-forward reproducing operation (or a fast-forward reproducing operation performed at a speed ten times as high as a normal reproducing speed) is realized by reproducing one frame out of ten frames. On the other hand, a 1/10x slow reproducing operation is realized by displaying one and the same frame 10 times in succession.

A time difference between the time when the video which is now being reproduced was recorded (hereinafter, such a time will be referred to as a "video recording time") and the current time, can be calculated by subtracting the video recording time, obtained by using the time information supplied from the table RAM **15**, from the current time. If the time difference is displayed on the TV monitor **13**, the time difference can be monitored. Before this time difference becomes zero, any arbitrary part of the video which has already been recorded can be reproduced. In addition, it is also possible to simultaneously display on the TV monitor **13** both the time corresponding to the output of the demodulator **3** and the time corresponding to the output of the MPEG1 decoder **12** by dividing the screen into two parts. Then, a video which is now being broadcast (and corresponds to the output of the demodulator **3**) and a video which is now being reproduced (and corresponds to the output of the MPEG1 decoder **12**) can be simultaneously watched on the same screen.

Assuming that the hard disk apparatus has a capacity large enough to record compressed video signals corresponding to two hours, if the viewer does not start watching a program within two hours after the recording start time, the recorded signals are updated from the point of time two hours later than the recording start time, whereby a program corresponding to two hours preceding the time when the viewer starts watching the recorded program can always be covered. On the other hand, an update halt mode may also be selected. In such a case, a video can only be recorded for two hours in the same way as a commonly used VTR.

Hereinafter, detailed timings of peripheral hardware of the hard disk apparatus **8** will be described with reference to Figure **4**.

The detailed configuration of the hard disk apparatus **8** is omitted in Figure **1**. A hard disk apparatus which is universally used as a peripheral device for a computer system can be used as the hard disk apparatus **8**. The hard disk apparatus **8** may include either one disk medium or a plurality of disk media and includes a recording and reproducing head, not a head exclusively used for a recording operation or a reproducing operation.

Portion **(a)** of Figure **4** represents an output of the MPEG1 encoder **4** and **A1**, **A2**, **A3**, ... **A6** indicate the signals obtained by dividing the output by every 1.5 Mbits. Portion **(b)** of Figure **4** represents the operational modes of the recording buffer memory **5** having a capacity of 200 Kbytes and **W** indicates writing a signal onto the memory and **R** indicates reading out a signal from the memory. Thus, **A1-W** means writing a signal **A1** onto the buffer memory and **A1-R** means reading out the signal **A1** from the buffer memory, for example. A signal is written onto the buffer memory in real time simultaneously with the video signals, while the signal is read out from the buffer memory at a high rate in accordance with the transfer rate at which the signal is transferred to the hard disk apparatus **8**.

Portion **(c)** of Figure **4** represents the operational modes of the recording buffer memory **6** having a capacity of 200 Kbytes and **W** and **R** indicate the same operations as those in portion **(b)**. The buffer memories **5** and **6** operate in pairs. More specifically, while one of the buffer memories **5** or **6** transfers data to the hard disk apparatus **8** via the first switch **7**, the other buffer memory **6** or **5** stores therein a compressed video signal supplied from the MPEG1 encoder **4**.

Portion **(d)** of Figure **4** represents the seek timings for writing data onto the hard disk apparatus **8**. Portion **(e)** of Figure **4** represents the timings at which data is transferred from the buffer memories **5** and **6** to the hard disk apparatus **8** so as to be written thereon. **A1-W** means writing the signal **A1** onto the hard disk apparatus **8**. Though the time sequence is not specifically shown in Figure **4**, portions **(b)** and **(c)** always precede portion **(e)**. For example, the signal **A1** read out by **A1-R** in portion **(b)** is written by **A1-W** in portion **(e)**.

Portion **(f)** of Figure **4** represents the seek timings for reading out data from the hard disk apparatus **8**. Portion **(g)** of Figure **4** represents the timings at which data is read out from the hard disk apparatus **8** and **B1-R** means reading

out a signal **B1** from the hard disk apparatus **8**, for example. Portion **(h)** of Figure **4** represents the operational modes of the reproducing buffer memory **9** having a capacity of 200 Kbytes and **B1-W** means writing the signal **B1** onto the buffer memory **9**.

Portion **(i)** of Figure **4** represents the operational modes of the reproducing buffer memory **10** having a capacity of 200 Kbytes and **W** and **R** indicate the same operations as those described above. The buffer memories **9** and **10** operate in pairs. More specifically, while a signal read out from the hard disk apparatus **8** is written onto one of the buffer memories **9** or **10**, the other buffer memory **10** or **9** reads out a signal, which has been supplied from the hard disk apparatus **8** and stored in the buffer memory **10** or **9**, at a rate of the video signal and then supplies the signal to the MPEG1 decoder **12** via the second switch **11**.

Portion **(j)** of Figure **4** represents an input to the MPEG1 decoder **12**. As shown in Figure **4**, the input has been extended so as to have the same period as that of the output in portion **(a)** and is continuously reproduced.

As shown in Figure **4**, for recording and reproducing a video signal simultaneously and continuously, the period of each of the signals **A1**, **A2**, **A3**, ... is set to be longer than the following time **T**:

T = (seek time for preparing to record data onto the hard disk)
+ (time required for writing the data having the period onto the hard disk)
+ (seek time for preparing to reproduce the data from the hard disk)
+ (time required for reading out the data having the period from the hard disk)

If the total of these times becomes longer than the period of **A1**, **A2**, **A3**, ..., then the video cannot be recorded but overflows. Thus, the period is required to be sufficiently longer than the total time. Since the seek time of the hard disk, in particular, largely varies depending upon situations, a maximum seek time is required to be estimated and included in the sum.

In this case, the period of **A1**, **A2**, **A3**, ... is a time during which an MPEG bit stream having a bit rate of 1.5 Mbps is occupied by a buffer memory having a capacity of 200 Kbytes: 200 k ÷ (1.5 M ÷ 8) = about 1 second . Assuming that the data transfer rate of the hard disk is 1 Mbyte per second, the time required for transferring the data is: 200 k ÷ 1 M = 0.2 second . Even when the maximum seek time is estimated to be 100 milliseconds,

$$T = 0.1 + 0.2 + 0.1 + 0.2 = 0.6 \text{ second} < 1 \text{ second}$$

Thus, a sufficient margin time can be obtained.

As described above, the video signal recording and reproducing apparatus according to the present invention is a video signal recording and reproducing apparatus using a hard disk which can simultaneously perform the recording and reproducing operations in different portions of the same hard disk. Thus, it is possible to provide an apparatus which can perform a trick play reproducing operation (e.g., a fast-forward reproducing operation or a backward reproducing operation) of a recorded part of a broadcast program which is now being recorded, while recording the broadcast program.

As a result, it is possible to start watching the recorded part of a program without waiting for the program to end, as is necessary in the recording and reproducing operations performed by a conventional single VTR. In addition, even when a viewer initially starts watching a program at a time much later than the broadcast start time of the program, the viewer can finish watching the program substantially at the same time as the broadcast end time by additionally utilizing a fast-forward reproducing function in the middle of the reproducing operation, so that a considerable amount of time can be saved.

Furthermore, though audio signal recording and reproducing sections are not shown in Figure **1**, a sound accompanied with a video can be processed completely in the same way as the video. Therefore, the same description as applied to a "video" in this example is applicable to "video and sound".

It is noted that it is possible to perform the writing operation onto a hard disk only when it is necessary while a viewer watches a TV program for using the hard disk as long as possible. In such a case, a viewer starts a video recording operation by pushing an instruction button. A recording start button and a reproducing start button are provided for the operator panel **18** or a single button can be used for these two purposes. This function is effectively applicable to a case where a viewer cannot help stopping watching a TV program in the middle of the program for some unavoidable reason. For example, in the case where it becomes necessary to stop watching a TV program in the middle for receiving a visitor, responding to a telephone call, taking a bath or having a meal or the like, the viewer pushes the recording start button for recording the program from that point of time, settles his business and then pushes the reproducing start button. Thus, the recorded program is reproduced and the viewer can watch the program from the point of time when he started recording the program without missing any scene of the program. In addition, by providing an end setting button for allowing a viewer to set a recording end time easily, even if the viewer must go out suddenly and does not know exactly when he will be able to come home, the viewer can record a video for as long as he wants. Thus, the viewer can comfortably leave after he sets the hard disk in a writing state. In this case, if the end setting button is configured such

that the recording time can be set depending upon how many times the viewer pushes the button (for example, one push of the button allows the program which is now being watched to be recorded for 30 minutes and two pushes of the button allows the program to be recorded for 1 hour), then the viewer can advantageously operate this apparatus very easily.

Since the program is continuously recorded during the reproduction of the program, the viewer can naturally watch the part of the program which is being broadcast during the reproduction.

In addition, a TV signal detector (not shown in Figure **1**) for determining whether or not a TV broadcast is available or not is incorporated in the demodulator **3** shown in Figure **1**. A synchronizing signal detector which is commonly provided for an existing TV receiver can be used as the TV signal detector and it is not necessary to additionally provide a novel circuit. Hereinafter, a case where a synchronizing signal detector is used as the TV signal detector will be specifically described.

First, it is determined whether or not a synchronizing signal exists in the demodulated video signal. If a synchronizing signal is absent in the demodulated video signal, then it is determined to be out of a broadcasting time, thereby protecting the hard disk apparatus from the writing operation. If the writing operation has already been started on the hard disk apparatus, the writing operation onto the hard disk apparatus is temporarily suspended at a point of time when the synchronizing signal is no longer detected and is resumed when the synchronizing signal is detected again. As a result, it is possible to avoid performing a recording operation in an undesired time period (e.g., a midnight time or the like when no broadcast is available), so that the lifetime of the hard disk apparatus can be lengthened. This function will be effective for avoiding performing an unnecessary recording operation at midnight when no broadcast is televised, supposing that a hard disk comes to have a recording capacity large enough to always record a televised video corresponding 24 hours preceding the current time in the near future. Since a synchronizing signal detector is commonly available well known circuit, the detailed description thereof will be omitted herein. A synchronizing signal detector of the type which integrates a synchronizing signal obtained from a well known synchronizing signal separator thereby determining whether or not the DC level thereof is a normalized value, or a synchronizing signal detector of the type which determines whether or not the frequency of the synchronizing signal is a predetermined value (e.g., the frequency of a horizontal synchronizing signal is 15.73 KHz in an NTSC standard) is used herein.

This example has been described while using a synchronizing signal detector as a TV signal detector. However, in the case where a digital broadcast is received, the TV signal can be detected by a method in which it is determined whether or not an error signal detected by an error signal detector, used for reproducing a clock for a PLL or the like, is at a predetermined level or by a method in which it is determined whether or not the amount of the error flag output from an error detector for correcting an error of a transmitted signal is at a predetermined level.

If a viewer continuously records a program and supplies a signal by the push of a button or the like for stopping watching the program such that the recording stop time, the address and the like are stored; then the viewer can naturally reproduce the program from the point of time when the viewer stopped watching the program by pushing the reproducing start button for resuming watching the program.

In addition, by additionally providing a second tuner and a second demodulator (though not shown in Figure **1**), a channel to be watched and a channel to be recorded can be independently designated. For example, a case where a second program to be watched by a viewer starts on another channel while the viewer is watching a first program to be recorded will be assumed. In such a case, if the viewer starts to record the second program on the second channel, the viewer can watch the second program from the beginning thereof from the point of time when the first program which the viewer is watching ends.

Example 2

Hereinafter, a second example of the present invention will be described. Since the fundamental configuration in the second example is substantially the same as that in the first example shown in Figure **1**, no drawings will be particularly referred to for describing the second example.

The video signal recording and reproducing apparatus of the second example is further provided with a circuit for inputting a video and/or a sound other than that of a broadcast (e.g., a reproduced signal of a VTR). If a part of a broadcast or desired video and/or sound input through the circuit is stored in the hard disk apparatus **8** for about 10 seconds and is automatically reproduced at a predetermined time every morning, the broadcast or the video and/or the sound can be used in place of an alarm clock so that a user can wake up comfortably.

It is noted that in such a case, the volume of the sound is required to be automatically adjusted to a sufficiently large volume, irrespective of a sound volume which was set the previous day. Furthermore, by additionally providing a speech recognition circuit for the apparatus shown in Figure **1**, the apparatus can reproduce a predetermined video by recognizing the audible alarm of an alarm clock other than the clock incorporated in the system. Alternatively, by recognizing not an alarm but a speech pattern such as "I'm home" when a user comes home, the apparatus can reproduce a predetermined video by reading the video from the hard disk apparatus **8**.

Furthermore, it is true that a user is required to perform complicated operations for designating his desired video

and/or sound. However, if compressed video and/or sound are/is recorded in an inexpensive medium such as a floppy disk or a CD-ROM and the medium is put on the market, then the user can record his desired video and/or the sound onto the hard disk by connecting a reader for reading the video and/or sound from the medium to this apparatus. If the user reproduces the video and/or the sound at a predetermined time every morning, the user can receive a morning call of his favorite actor or the like. Thus, this apparatus can also be used as an instrument for making a user's life comfortable.

Example 3

Hereinafter, a third example of the present invention will be described. In this third example, the hard disk apparatus shown in Figure **1** has at least two recording regions. The first recording region of the hard disk apparatus **8** is a recording region in which the video signal received by the tuner **2** is recorded for realizing the function described in the second example. The second recording region of the hard disk apparatus **8** is a recording region for saving therein the video data which has arbitrarily been retrieved by a viewer from the video data recorded in the first recording region. As a result, the viewer can selectively save arbitrary information from a televised program in the second recording region while the viewer is watching the program.

For example, if only a scene of a travel program frequently televised recently, in which the address, the telephone number and the like of a hotel are displayed on the screen or the contents of a dish, a service or the like are presented, is selectively saved in the second recording region, the viewer can save such information more exactly without any need for taking notes. In addition, if the viewer applies a file name to the video data retrieved by himself and then stored in a prescribed directory, the viewer will be able to search for his desired file later more easily.

A specific example will be described below. For example, the second recording region of the hard disk is divided beforehand into a plurality of directories for "restaurants", "travel spots", "hotels" and the like. The directory of "hotels" can be further divided into a plurality of sub-directories of "restaurant hotels", "hot-spring hotels" and the like. A viewer performs an operation for designating a start point and an end point of a video to be saved while the viewer is watching a program, and then selects a directory corresponding to the retrieved data. As a result, the video data is automatically saved in the selected directory. When the viewer searches for the video data later, the viewer will be able to find the video data by selecting his desired directory and the file name of the video data. If an external output terminal such as an SCSI interface is provided for the hard disk apparatus for storing the saved video data onto an external storage device such as a floppy disk drive or a PD drive, the viewer can produce his own database.

In this example, the hard disk apparatus is divided into two recording regions for simplifying the description. Alternatively, the same effects can also be attained by providing a circuit for designating whether the video data recorded on the hard disk is data which is to be automatically updated or data which is not updated unless the viewer commands the update. For example, the hard disk apparatus can be controlled by such a method that the type of recorded data, the sector information and the like are recorded in the table RAM **15** shown in Figure **1** and the hard disk controller **14** determines whether or not the respective sectors can be updated based on the information.

Example 4

Hereinafter, the fourth example of the present invention will be described with reference to Figure **5**. In Figure **5**, since the reference numerals **1** to **18** denote the same components as those having the same reference numerals in the first example, the description thereof will be omitted herein. In addition, since the reference numerals **9** to **26** correspond to and have the same configurations as the reference numerals **4** to **7** and **9** to **12** in Figure **5**, respectively, the description thereof will also be omitted herein. In Figure **5**, the reference numeral **27** denotes a frame decimator; **28** denotes a frame interpolator; and **29** denotes a third switch.

The hard disk apparatus **8** has at least two recording regions. The first recording region is a region in which the video signal received by the tuner **2** is recorded and which realizes the function described in the first example. Assuming that the first recording region has a capacity large enough to record compressed video signals corresponding to two hours, if the viewer does not start watching a program within two hours after the recording start time, the video data which was recorded previously is updated from the point of time, whereby a video corresponding to two hours preceding the time when the viewer starts watching the recorded video can always be watched as a normal video as already described in the first example.

In this example, when the video data is updated, the previously recorded video data is once read out; passed through the buffer memories **23** and **24**; and then decoded by the decoder **26** into the original video signals. Then, a frame decimator **27** performs frame decimation processing with respect to these decoded video signals, thereby reducing the amount of data. The output of the frame decimator **27** is compressed again by the encoder **19**. The compressed video signal, a part of the frames of which have been decimated in this way, are saved in the second recording region. The resulting recordable time is varied depending upon the method for decimating the frames. For example, assuming that the compression is performed by extracting one frame out of four frames, a recordable time four times as long as

the recordable time in the case of recording a normally compressed video signal can be secured by using the same recording capacity. That is to say, when a hard disk apparatus having a recording capacity large enough to record data corresponding to 2.5 hours by a normal recording operation is used, the viewer can watch a broadcast preceding the recording start time by about four hours (i.e., two hours in the first recording region and two hours in the second recording region) and check the contents of the broadcast. As a result, the viewer can confirm a larger amount of the contents of the programs while using a smaller recording capacity. In other words, while reducing the required minimum recording capacity of a hard disk apparatus, it is also possible to meet the viewer's demand for recording a video as long as possible.

It is natural that the audio signals recorded in the second recording region are normally recorded without performing a decimation operation on a frame basis. When the video signals recorded in the second recording region are read out to be displayed on the TV monitor **13**, the output of the decoder **12** shown in Figure **5** is once input to the frame interpolator **28**, where the decimated frames are interpolated by the same frames and the interpolated signals are passed through the third switch **29** so as to be displayed on the TV monitor **13**. In this example, a frame decimation method is used for reducing the amount of video data. Alternatively, various other methods such a sampling method and a color difference signal elimination method can also be used.

In this example, the hard disk apparatus is divided into two recording regions for simplifying the description. However, a circuit for applying information for identifying whether the video data recorded on the hard disk is data composed of normally recorded video signals, or data having a reduced amount of data by a frame decimation or the like to the video data recorded on the hard disk, and saving the data including the identifiers on the hard disk, may be provided. For example, it is possible to utilize a method in which the type of recorded data, the sector information and the like are recorded in the table RAM **15** shown in Figure **5** and the hard disk controller **14** controls the hard disk apparatus **8** based on the information.

In addition, the viewer can independently set a time period during which a video signal is normally recorded and a time period during which data is recorded after the amount of the data is reduced by a frame decimation or the like. As a result, the viewer can utilize the apparatus of the invention so as to satisfy his own preferences more completely.

Example 5

Hereinafter, the fifth example of the present invention will be described. Since the fundamental configuration used in this example is the same as that shown in Figure **1**, there are no drawings exclusively used for describing this example. If a plurality of (i.e., a number N of) tuners having the same configuration as the tuner **2** shown in Figure **1** are provided, a plurality of video signals can be simultaneously received. A number N of encoders **4** may be provided. Alternatively, if an encoder of the type operating at an encoding rate N times as high as a normal encoding rate is used, then it is possible to use the encoder by switching it depending upon the time.

If a number N of hard disk apparatuses having the same configuration as that of the hard disk apparatus **8** shown in Figure **1** are used in parallel; if the reading and writing rates from/onto the hard disk apparatus **8** are set to be higher while using a single hard disk apparatus 8 in the same way as in Figure **1**; or if the period **A1, A2, A3,** ... or the capacity of the buffer memories is increased such that the time $\mathbf{T_N}$ required for reading and writing in the N channels becomes shorter than the period, then it is possible to read out a video on a desired channel while simultaneously writing videos on the N channels. By realizing this function, a viewer can select his desired another TV channel after a TV program on a channel to be watched is finished without designating the another channel beforehand.

Example 6

Hereinafter, the sixth example of the present invention will be described with reference to Figure **6**. In Figure **6**, since the reference numerals **1** to **18** denote the same components as those having the same reference numerals in the first example, the description thereof will be omitted herein.

In Figure **6**, the reference numeral **30** denotes a screen synthesizer; **31** denotes a screen separator; and **32** denotes a pixel interpolator. In this example, by providing a plurality of (e.g., four in Figure **6**) tuners **2** and demodulators **3**, a plurality of video signals can be simultaneously received. The received video signals are input to the screen synthesizer **30**. The screen synthesizer **30** matches the phases of the synchronizing signals of the respective video signals by using frame memories (not shown) and then reduces the sizes of the screens corresponding to the respective video signals by performing a pixel decimation, a line decimation and the like, thereby synthesizing the screens having reduced sizes into one screen as shown in Figure **7**. A composite video signal obtained by synthesizing the video signals in the above-described manner is compressed by the encoder **4** and then recorded onto the hard disk apparatus **8** in the same way as in the first example. In performing a reproducing operation, the screen separator **31** extracts only the portion corresponding to the desired channel from the synthesized screen and the pixel interpolator **32** performs a pixel interpolation and a line interpolation on the extracted portion for enlarging the size of the portion to that of a normal screen and then displays the video on the TV monitor **13**, as shown in Figure **8**. Figure **8** is a diagram illustrating an

operation of retrieving only the video in the desired channel from the reproduced video. As a result, videos on a larger number of TV channels can be recorded in the hard disk apparatus **8** having the same recording capacity as that of a conventional one. In addition, by reading out a video on a desired channel while simultaneously writing videos on the N channels, a viewer can select his desired another TV channel after a TV program on a channel to be watched is finished without designating the another channel beforehand. Furthermore, in this sixth example, it is not necessary to use an N-times-larger recording capacity for recording the videos in the N channels, unlike the third example, so that it is effectively possible to save the recording capacity of the hard disk apparatus.

It is naturally possible to directly display the composite video signal output from the decoder **12** without performing a screen separation.

In the foregoing examples, a recording format (or a relationship between a GOP unit and a sector unit on the hard disk, in particular) has not been specifically described. However, in view of the case of performing a trick-play reproducing operation such as a fast-forward reproducing operation, it is preferable to utilize a format in which a simple relationship is established between a GOP and a sector. For example, a format in which one GOP consists of a number K of sectors; a format in which one sector consists of a number M (where K and M are integers) of GOPs; a format in which a number K of sectors correspond to a number M of GOPs; or the like can be used.

In addition, if the hard disk apparatus of the present invention is configured as a hard disk apparatus having a removable drive portion which is currently used as a peripheral device for a personal computer, then the hard disk apparatus of the present invention can be advantageously used for forming a backup file of video data, saving particular video data and the like.

Various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but rather that the claims be broadly construed.

Claims

1. A video signal recording and reproducing apparatus comprising:

   receiving means for receiving a television signal;
   image compression means for compressing an amount of information per unit time of the received continuous video signal;
   writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head;
   reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head;
   decoding means for restoring the read compressed video signal into an original video signal;
   display means for displaying the restored video signal; and
   control means for controlling the writing means and the reading means such that writing the video signal onto the hard disk apparatus and reading an arbitrary video signal, which was previously written onto the hard disk apparatus, from the hard disk apparatus are performed apparently simultaneously and continuously.

2. A video signal recording and reproducing apparatus according to claim 1, wherein a compressed video signal which was recorded at an earliest time is sequentially updated by a newly received and obtained compressed video signal.

3. A video signal recording and reproducing apparatus according to claim 1, wherein an audio signal, as well as a compressed video signal, is recorded onto the hard disk apparatus.

4. A video signal recording and reproducing apparatus according to claim 1, further comprising instruction means for starting and/or finishing recording a compressed video signal onto the hard disk apparatus.

5. A video signal recording and reproducing apparatus according to claim 1, further comprising instruction means for starting and/or finishing reproducing a compressed video signal from the hard disk apparatus.

6. A video signal recording and reproducing apparatus according to claim 4, wherein the instruction means for starting recording a compressed video signal onto the hard disk apparatus is instantaneously driven manually.

7. A video signal recording and reproducing apparatus according to claim 4, wherein the instruction means for starting recording a compressed video signal onto the hard disk apparatus is driven by timer means.

8. A video signal recording and reproducing apparatus according to claim 4, wherein the instruction means for finishing recording a compressed video signal onto the hard disk apparatus is driven by timer means.

9. A video signal recording and reproducing apparatus according to claim 5, wherein the instruction means for starting reproducing a compressed video signal from the hard disk apparatus is instantaneously driven manually.

10. A video signal recording and reproducing apparatus according to claim 1, wherein the display means displays at least a time difference between a time at which a video signal which is being reproduced was recorded and a current time, in addition to a video.

11. A video signal recording and reproducing apparatus according to claim 1, wherein the display means displays at least a current time and a time at which a video signal which is being reproduced was recorded, in addition to a video.

12. A video signal recording and reproducing apparatus according to claim 1, comprising operation means for setting a normal reproduction, a fast forward reproduction, a backward reproduction or a slow reproduction as a reproduction mode.

13. A video signal recording and reproducing apparatus according to claim 1, wherein the display means simultaneously displays a received video signal and an output of the decoding means which was previously recorded, reproduced and decoded.

14. A video signal recording and reproducing apparatus according to claim 1, further comprising television signal detection means for determining whether or not the receiving means has received a normal television signal, wherein writing onto the hard disk apparatus is enabled only when the television signal detection means has detected a normal television signal.

15. A video signal recording and reproducing apparatus comprising:

image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time;
writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head;
reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head;
decoding means for restoring the read compressed video signal into an original video signal; and
display means for displaying the restored video signal,

thereby reading out predetermined video and audio signals at a predetermined time.

16. A video signal recording and reproducing apparatus comprising:

image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time;
writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head;
reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head;
decoding means for restoring the read compressed video signal into an original video signal;
display means for displaying the restored video signal; and
sound recognition means for recognizing an audio signal,

wherein predetermined video and audio signals are read out at a point of time when the sound recognition means recognizes a predetermined sound.

17. A video signal recording and reproducing apparatus comprising:

image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time;

writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head;
reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head;
decoding means for restoring the read compressed video signal into an original video signal; and
display means for displaying the restored video signal,

wherein a video signal at an arbitrary point of time is retrieved for an arbitrary time period by an operation of a viewer from video signals which are being received or video signals which were previously recorded, and information for prohibiting overwriting data of the retrieved video signal is added to the retrieved video signal so as to be stored into the hard disk apparatus.

18. A video signal recording and reproducing apparatus according to claim 17, wherein, when a video signal retrieved by an operation of a viewer is saved, search information required for the viewer to search for a desired video signal later is added to the video signal to be saved, and after the video signal which was previously retrieved and saved has been searched for and read out based on the search information, the read compressed video signal is decoded to be displayed on the display means.

19. A video signal recording and reproducing apparatus according to claim 17, comprising at least an output terminal for outputting digital data which has been recorded onto the hard disk apparatus to the outside of the apparatus, wherein a video signal retrieved by a viewer is transferred to another recording apparatus through the output terminal.

20. A video signal recording and reproducing apparatus comprising:

image compression means for digitizing an input continuous video signal and audio signal, thereby compressing an amount of information per unit time;
writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head;
reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head;
decoding means for restoring the read compressed video signal into an original video signal; and
display means for displaying the restored video signal,

wherein, while compressing a video signal which is being received and writing the compressed video signal onto the hard disk apparatus, a video signal which was previously recorded is read out and decoded into an original video signal, and wherein, after an amount of data of the decoded video signal has been reduced, the video signal is subjected to an image compression again and written onto the hard disk apparatus.

21. A video signal recording and reproducing apparatus comprising:

receiving means for simultaneously receiving television signals from a plurality of channels;
image compression means for compressing an amount of information per unit time of the received continuous video signals from the plurality of channels;
writing means for intermittently writing each compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head;
reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head;
decoding means for restoring the read compressed video signal into an original video signal; and
display means for displaying the restored video signal,

wherein, while compressing video signals from the plurality of channels which are being received and writing the compressed video signals onto the hard disk apparatus, a video signal which was previously recorded from a particular channel is read out.

22. A video signal recording and reproducing apparatus comprising:

receiving means for simultaneously receiving television signals from a plurality of channels;
synthesis means for synthesizing the received television signals from the plurality of channels into one screen;

image compression means for compressing an amount of information per unit time of the continuous video signal which has been synthesized by the synthesis means;

writing means for intermittently writing a compressed video signal, obtained as an output of the image compression means, onto a hard disk apparatus via a magnetic head;

reading means for intermittently reading out the written compressed video signal from the hard disk apparatus via the magnetic head;

decoding means for restoring the read compressed video signal into an original video signal; and

display means for displaying the restored video signal,

wherein a plurality of video signals are synthesized into one screen, subjected to an image compression and then written onto the hard disk apparatus.

FIG. 1

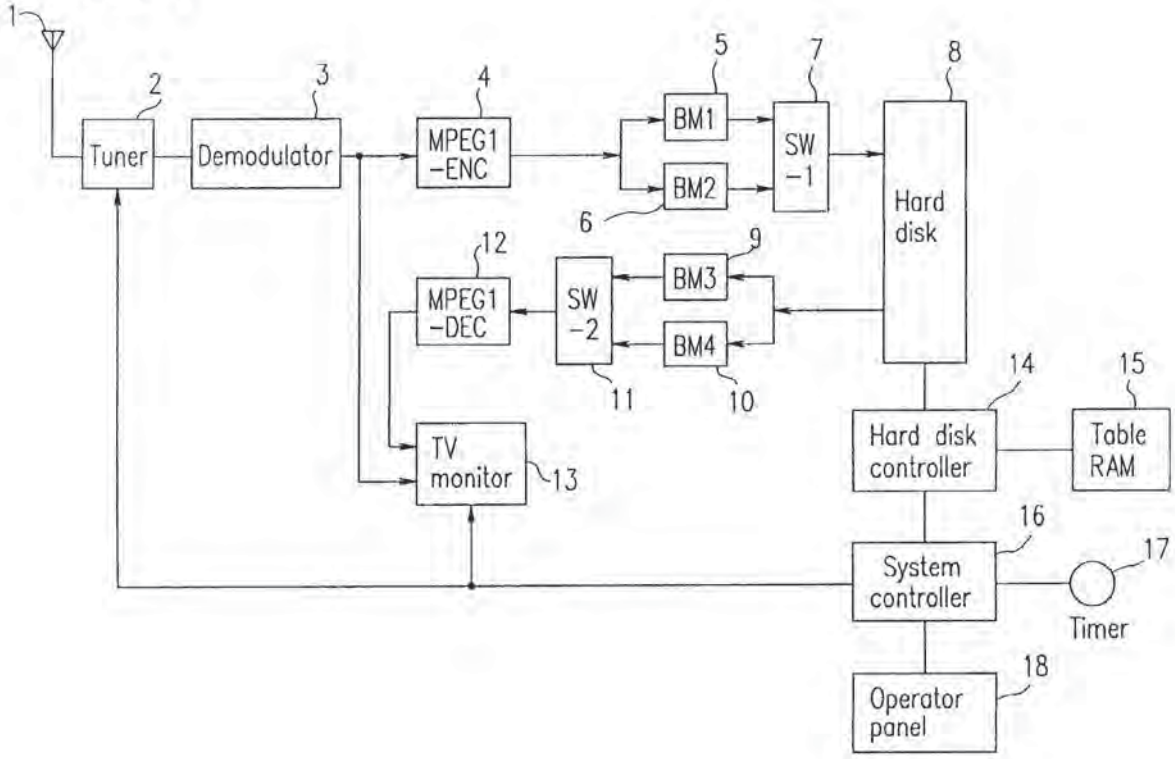
1
2
Tuner
3
Demodulator
4
MPEG1 -ENC
5
BM1
BM2
6
7
SW -1
8
Hard disk
9
BM3
BM4
10
11
SW -2
12
MPEG1 -DEC
TV monitor
13
14
Hard disk controller
15
Table RAM
16
System controller
17
Timer
18
Operator panel

FIG. 2

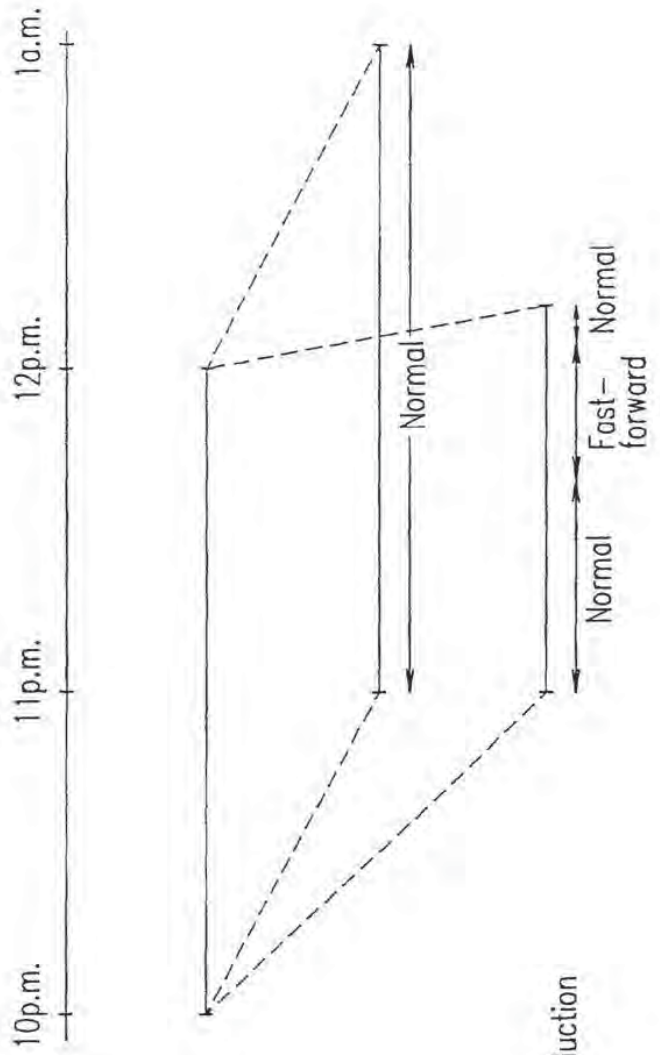
10p.m.
11p.m.
12p.m.
1a.m.
(a)Broadcast
(b)Recording
(c)Normal reproduction
(d)Normal reproduction and fast-forward reproduction
Normal
Normal
Fast-forward
Normal

FIG. 3

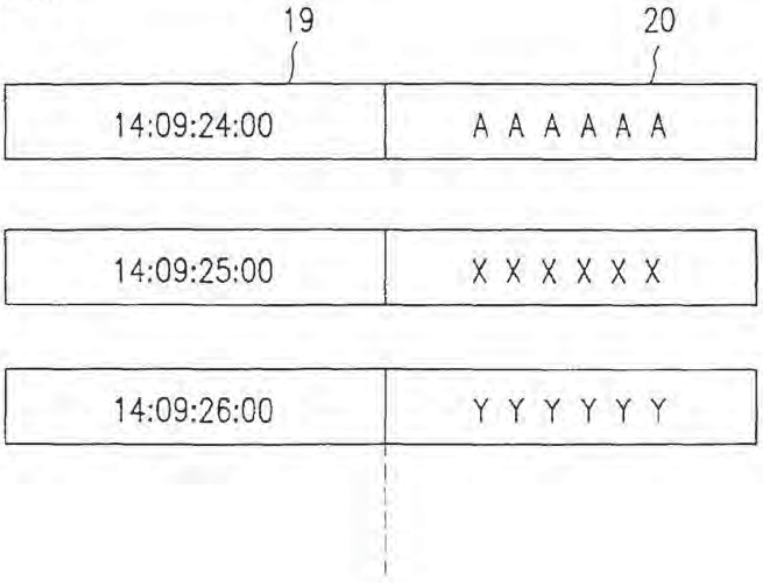

FIG. 4

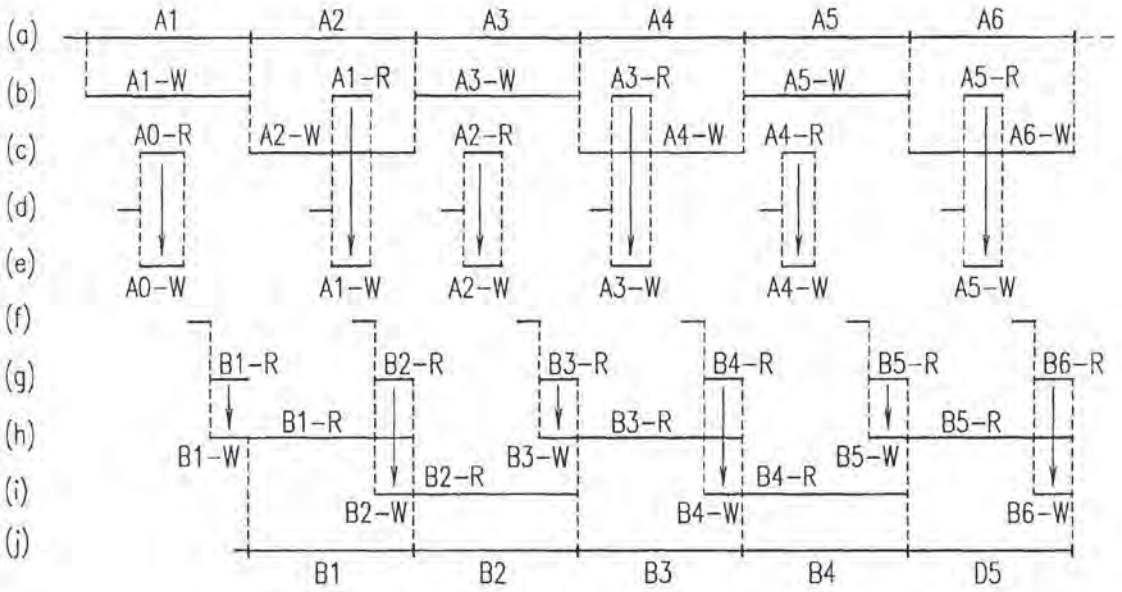
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
(j)
A1
A2
A3
A4
A5
A6
A1-W
A1-R
A3-W
A3-R
A5-W
A5-R
A0-R
A2-W
A2-R
A4-W
A4-R
A6-W
A0-W
A1-W
A2-W
A3-W
A4-W
A5-W
B1-R
B2-R
B3-R
B4-R
B5-R
B6-R
B1-R
B3-R
B5-R
B1-W
B3-W
B5-W
B2-R
B4-R
B2-W
B4-W
B6-W
B1
B2
B3
B4
D5

FIG. 5

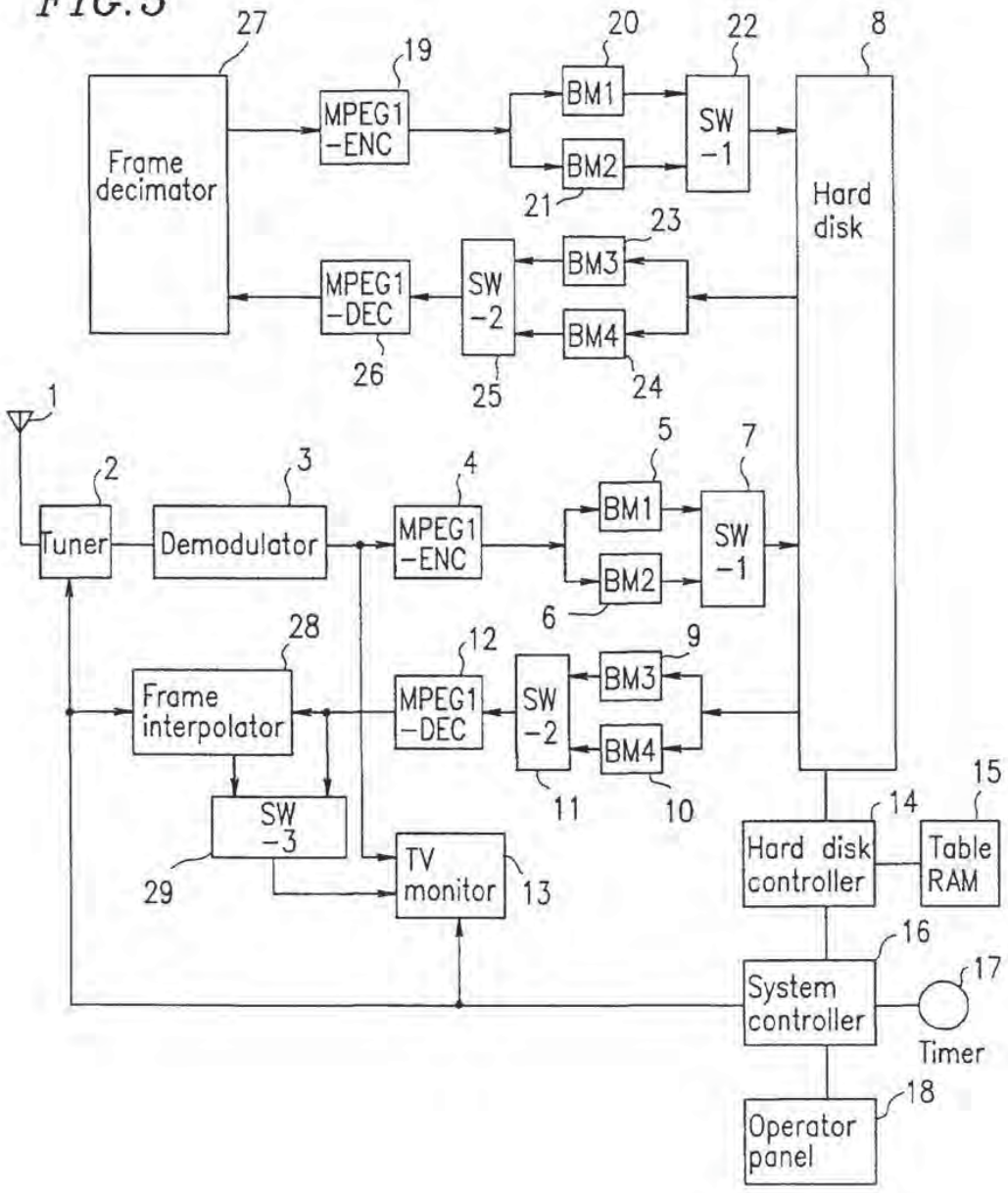
27
19
20
22
8
Frame decimator
MPEG1 -ENC
BM1
BM2
SW -1
Hard disk
21
23
BM3
MPEG1 -DEC
SW -2
BM4
26
25
24
1
5
7
2
3
4
Tuner
Demodulator
MPEG1 -ENC
BM1
SW -1
BM2
6
28
12
9
Frame interpolator
MPEG1 -DEC
SW -2
BM3
BM4
11
10
15
14
SW -3
Hard disk controller
Table RAM
29
TV monitor
13
16
17
System controller
Timer
18
Operator panel

FIG. 6

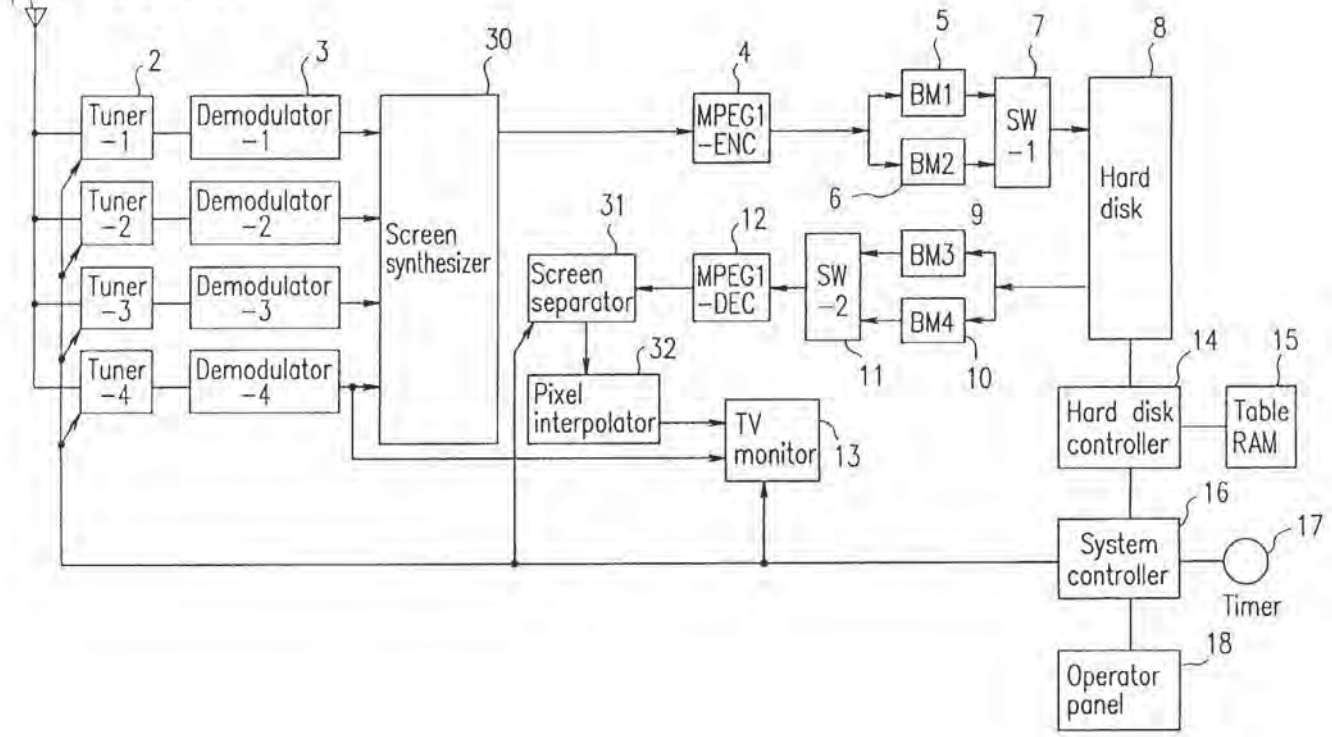

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FIG. 7

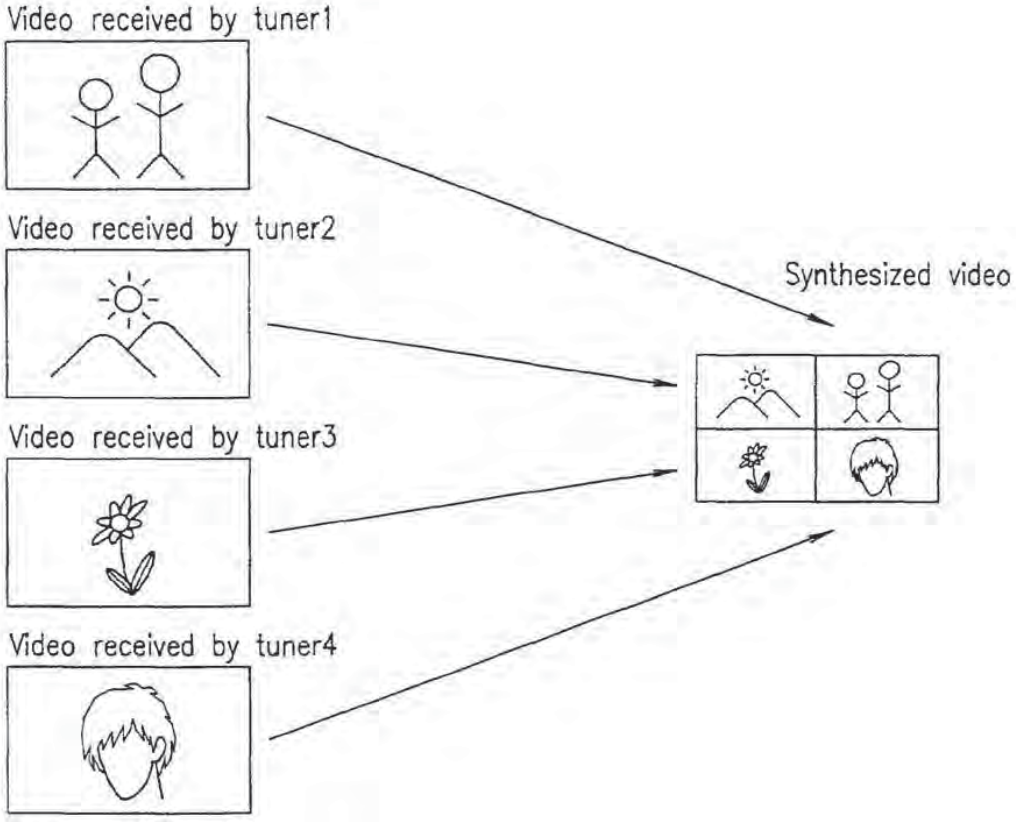
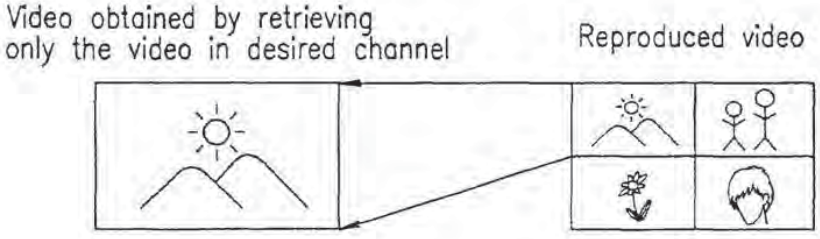

Video received by tuner1
Video received by tuner2
Video received by tuner3
Video received by tuner4
Synthesized video

FIG. 8


Video obtained by retrieving only the video in desired channel
Reproduced video

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(54) Multi-media communication system and method therefor

(57) A multi-media communication system has a data transmitter and communication terminals. Each communication terminal has a communication interface for communicating with the data transmitter via control signals, and a buffer for storing multi-media data. The control signals include a request for stopping data transmission, a request for restarting data transmission, and a request for transmission of a predetermined amount of data.

Fig.1.

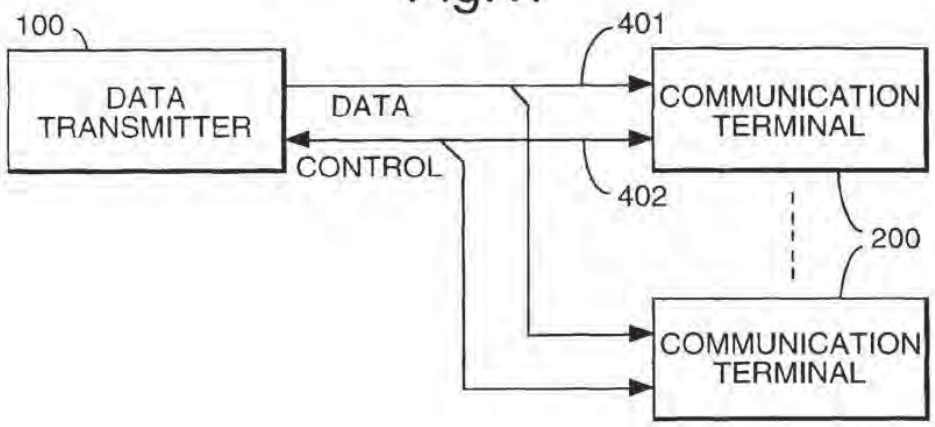

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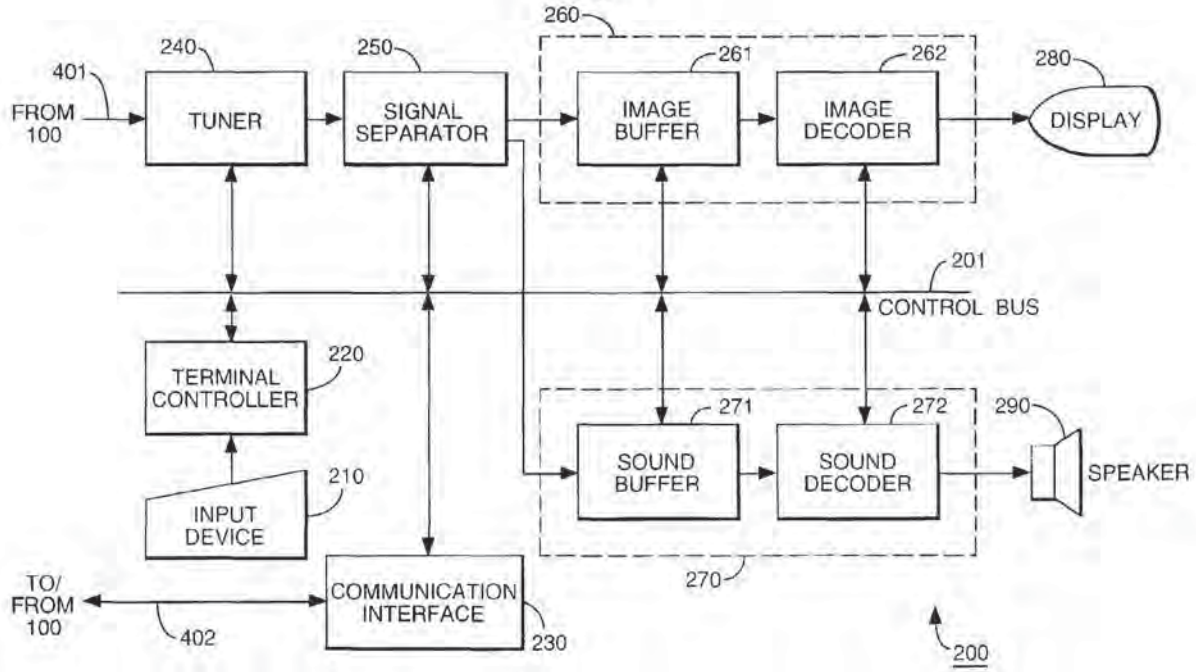
Fig.2.



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Description

The present invention relates to a multi-media communication system, and more particularly to a multi-media communication system having a data transmitter and a communication terminal.

There are many known multi-media communication systems. For one exemplary multi-media communication system, television services called VOD (Video-On-Demand) using communication lines such as cable television (CATV) lines have been developed. Such a conventional multi-media communication system has a head end unit and control terminal units. Each control terminal unit has a display unit connected thereto. The control terminal unit, typically disposed in an individual subscriber's home or office system, sends a control signal requesting a desired program to the head end unit (typically a data transmitter housed in or under the control of a remote broadcast program source). The control signal is sent in response to operation by the subscriber.

In response to the control signal, the head end unit sends the requested program to a predetermined channel in the form of multi-media data, and sends a channel information to the control terminal unit. The control terminal unit selectively receives the program on the channel specified by the channel information, and outputs the program to the subscriber's display unit. Thus, the subscriber can access (e.g., view) the desired program.

The conventional multi-media communication system stores in a separate recording medium an output mode control code for a special effect (e.g., slow-motion play) in addition to picture data and sound data.

This conventional multi-media communication system has a problem such that, since the special effect for the multi-media data on the control terminal units requires that the control code for special effects be separately stored in a recording medium, a medium capacity must be sufficient (e.g., large enough) for storing the control code. Moreover, the head end unit must have a controller for sending data while mutually synchronizing the data according to a request signal from the control terminal unit. As a result, the size of the head end unit is unnecessarily large.

In view of the foregoing problems of the conventional system, a feature of a multi-media communication system to be described below, by way of example, in illustration of the invention, is that it enables various special effects to be performed, without increasing the size of a data transmitter.

In a particular multi-media communication system to be described below, by way of example, in illustration of an aspect of the present invention, a data transmitter provides multi-media data. A communication terminal utilizes the multi-media data with a special effect. The communication terminal requests a next multi-media data from the data transmitter according to an amount of multi-media data utilized with the special effect.

With the unique and unobvious structure of the present invention, a multi-media communication system is enabled to provide various special effects, without increasing the data transmitter size.

The following description and drawings disclose, by means of an example, the invention which is characterised in the appended claims, whose terms determine the extent of the protection conferred hereby.

In the drawings:-

FIG. 1 is a block schematic diagram showing the configuration of a multi-media communication system.

FIG. 2 is a block schematic diagram showing the configuration of the communication terminal 200 used in the multi-media communication system of Fig. 1,

FIG. 3 is a block schematic diagram showing the configuration of the data transmitter 100 used in the multi-media communication system of Fig. 1,

FIG. 4 is a diagrammatic illustration of the configuration of one segment of multi-media data sent by the data transmitter 100,

FIG. 5 is a flowchart showing the normal operation in the communication terminal 200,

FIG. 6 is a flowchart showing an exemplary special effect (e.g., a slow-motion replay operation) in the communication terminal 200, and

FIG. 7 is a flowchart showing the operation of the data transmitter 100.

Referring to FIG. 1, a multi-media communication system has a data transmitter 100 and at least one communication terminal 200, and more typically, a plurality of communication terminals 200, for communicating with the data transmitter 100. The data transmitter 100 stores multi-media data, and sends the multi-media data to the communication terminals 200 at the request of the subscriber associated with the respective communication terminal 200. Each communication terminal 200 receives the multi-media data, and displays video and/or sound data accordingly.

Referring to FIG. 2, each of the communication terminals 200 has an input device 210, a terminal controller 220, a communication interface 230, a tuner 240, a signal separator 250, an image processor 260 including an image buffer and an image decoder 262, a sound processor 270 including a sound buffer 271 and a sound decoder 272, a display 280, and an audio output device (speaker) 290. The terminal controller 220, the communication interface 230, the tuner 240, the signal separator 250, the image processor 260, and the sound processor 270 are coupled together by a control bus 201.

The input device 210 (e.g., keyboard, infrared remote controller, touch screen/pad, joy-stick, track ball, voice input, or the like) is used to input instructions from a user (subscriber). The terminal controller 220 receives the instructions from the input device 210, and controls the multi-media communication system via the control

bus 201.

The tuner 240 receives multi-media data 401, which may include image and/or sound data, from the data transmitter 100, and selects a predetermined channel of the multi-media data 401: The signal separator 250 separates image data and sound data from the multi-media data 401. The image data are sent to the image processor 260. The sound data are sent to the sound processor 270.

The image processor 260 includes the image buffer 261 and the image decoder 262. The image buffer 261 stores the image data from the signal separator 250. The image decoder 262 decodes the image data stored in the image buffer 261.

The sound processor 270 includes the sound buffer 271 and the sound decoder 272. The sound buffer 271 stores the sound data from the signal separator 250. The sound decoder 272 decodes the sound data stored in the sound buffer 271.

The display 280 displays the image data decoded by the image decoder 262. The speaker 290 amplifies (typically using a variable gain) and outputs the sound data decoded by the sound decoder 272 in a synchronous manner with the image data with synchronization circuitry known in the art.

The communication interface 230 communicates with the data transmitter 100 via a control signal 402. The control signal 402 includes a request for stopping data transmission, a request for restarting data transmission, and a request for transmission of a predetermined amount of data.

Referring to FIG. 3, the data transmitter 100 has a data storage 110, a server 120, a server memory 130, a data controller 140, and a controller memory 150.

The data storage 110 stores multi-media data. The data storage 110 includes a high-capacity auxiliary storage (e.g., an optical disk unit or a magnetic tape for holding video and/or audio data). The server 120 reads out multi-media data from the data storage 110, and holds the read multi-media data in the server memory 130 so that a predetermined amount of multi-media data is held in the server memory 130 to supply the multi-media data for the communication terminal 200 without interruption.

The data controller 140 reads out multi-media data from the server 120, and sends out the multi-media data to the communication terminal 200 via the signal line 401.

Referring to FIG. 4, the multi-media data stored in the data storage 110 is formed from a plurality of segments 500. Each segment has at least one Group-Of-Pictures (GOP). In this case, the segment 500 has two GOPs 510 and 520. One GOP 510 has a header field 511 and a data field 512. The data controller 140 recognizes the header fields as boundaries of video and/or audio data.

For example, if one segment 500 is assumed to have 30 pictures, each of data fields 512 and 522 includes 15 pictures. Hence, each of the data fields is assumed to have a number of pictures equal to the other. Thus, if 30 frames are displayed per second during normal playback, then data for one second is stored in one segment and data for 0.5 seconds is stored in each GOP. The multi-media data is sent from the data controller 140 according to this display speed.

Hereinbelow and referring to FIGs. 2, 3, 5, 6, and 7, the operation of the multi-media communication system in accordance with the above-mentioned embodiment of the present invention will be described.

Referring to FIG. 5, the communication terminal 200 receives multi-media data from the data transmitter 100 via the signal line 401 (step S501). The tuner 240 selects the predetermined channel of the multi-media data on signal line 401 (step S502). The signal separator 250 separates image data and sound data from the multi-media data on signal line 401 (step S503).

If the separated data is image data (step S504), then the separated data is stored in the image buffer 261 (step S505). If the separated data is sound data (step S504), then the separated data is stored in the sound buffer 261 (step S508). The image data in the image buffer 261 is decoded by the image decoder 262 (step S506), and is displayed by the display 280 (step S507). The sound data in the sound buffer 271 is decoded by the sound decoder 272 (step S509), and is amplified and output by the speaker 290 (step S510). As mentioned above, image and sound reproduction are performed in a synchronous manner with known circuitry.

If a request for a special effect (e.g., a slow-motion play) is inputted from the input device 210 (step S511), then the communication terminal operates in a slow-motion play mode as illustrated in the flowchart in FIG. 6 (step S512). Otherwise, operations from step S501 are repeated for the remaining multi-media data in the program or broadcast.

Referring to FIG. 6 and the special effect mode (e.g., slow-motion play mode) operation, the terminal controller 220 sends a request for stopping data transmission to the communication interface 230 via the control bus 201. In response to the request, the communication interface 230 sends the control signal 402, indicating the request for stopping the data transmission, to the data transmitter 100 (step S601). This request to stop the data transmission is received by the data transmitter 100, and the output of the multi-media data via the signal line 401 is temporarily stopped according to a process described below.

Specifically, the terminal controller 220 sends a request for slow-motion play to the image decoder 262 via the control bus 201. In response to the request, slow-motion play is performed by the image decoder 262 based on the picture data held in the image buffer 261. In this case, the slow-motion play is carried out by repetitively playing (e.g., outputting) the same frame (picture) "N" (where N is an integer greater than 1) times (step 602).

For example, by repetitively playing the same frame (picture) twice (e.g., N=2), slow-motion play can be performed at 1/2 of the normal playback speed (e.g., 15 frames per second if the normal playback speed is assumed to be 30 frames per second), and by repetitively playing the same frame (picture) three times (e.g., N=3), slow-motion play can be performed at 1/3 of the normal playback speed (e.g., 10 frames per second if the normal playback speed is assumed to be 30 frames per second).

The image buffer 261 continually checks the amount of the data remaining in the image buffer 261 (step S603). If the remaining data is under the reference value (e.g., (capacity of the image buffer 261) - (1 GOP)), then the image buffer 261 outputs a signal to the communication interface 230 which in turn sends a request for transmission of a predetermined amount of multi-media data to the data transmitter 100 via the control signal line 402 (step S605).

The predetermined amount corresponds to the capacity of the image buffer 261 for holding data which was newly received in response to the request.

The terminal controller 220 checks whether the input device 210 has inputted a request for restarting the data transmission by a user (step S606). If the input device 210 has not inputted the request for restarting the data transmission, then operations from the step S602 are repeated (step S607).

If the input device 210 has inputted the request for restarting the data transmission, then the communication interface 230 sends a request for restarting the data transmission to the data transmitter 100 via the signal line 402 (step S608).

Thereafter, the slow-motion play mode is reset (e.g., terminated) the output of the multi-media data via the signal line 401 at the normal playback speed (e.g., 30 frames per second) is resumed by the data transmitter 100 (step S609).

Next, the operation of the data transmitter 100 is described.

In the normal playback operation, the data controller 140 receives multi-media data from the server 120 on a segment basis according to the normal playback speed on the multi-media communication terminal 200 and holds the multi-media data in the controller memory 150, and sends the multi-media data via the signal line 401.

If the data transmitter 100 receives from communication interface 230 the request for stopping the data transmission via the control signal line 402, the output of the multi-media data via the signal line 401 is stopped immediately after the completion of the unfinished transmission of the GOP.

If the data transmitter 100 receives the request for data transmission of a predetermined amount via the control signal line 402, the special playback operations in FIG. 7 are started.

Referring to FIG. 7, it is determined whether the preceding transmitted data is a GOP positioned in the second half of a segment (e.g., end of a segment) (step S701). If the preceding transmitted data is the second half GOP, then the data controller 140 divides the segment stored in the controller memory 150 in half according to the header field to produce first and second half-segments (step S702). Thus, each half-segment includes a header field and a data field. The data controller 140 sends the first half-segment to the communication terminal 200 via the signal line 401 (step S703). The data controller 140 stores the second half-segment in the controller memory 150 (step S704).

On the other hand, in step S701, if the preceding transmitted data is the first GOP, then the GOP held in the controller memory 150 is read-out and sent to the communication terminal 200 (step S705). The data controller 140 receives one segment from the server 120 as the next data and stores it in the controller memory 150 (step S706).

Further, if the control signal on signal line 402 from the communication terminal 200 indicates a request for starting the normal transmission, the process returns to the above-described operation for the normal playback.

Although an example has been described in which the image buffer 261 and the sound buffer 271 in the communication terminal 200 have a storage capacity for holding multi-media data for one to two GOPs, the present invention is not limited to this configuration.

For example, it may be configured such that, in response to a request for sending a predetermined amount of data from the communication terminal 200, a plurality of GOPs are sent from the data controller 140 corresponding to the amount of data that can be held in the image buffer 261 in the communication terminal 200.

The above description of an embodiment illustrative of the invention shows that, since the communication interface 230 requests the control of the data transmission from the data transmission 100, no medium (or its size and capacity) for storing control codes for special effects is required. Thus, it is not necessary for there to be an increase in the size of the data transmitter.

Although slow-motion playback has been described above, this special effect is but one exemplary special effect, and the protection sought is not limited to this specific special effect. Indeed, the present invention can be equally applied to any special effects presently known in the industry. For example, by making the playback speed slower, a frame advance play or pause may be performed, and by reversing the playback sequence of image data, a reverse play or reverse slow-motion play may be performed. Likewise, fast-motion advance play or reverse play may be performed. Further, by using the image data within the image buffer 261 to perform a playback with a timing or sequence different from the normal playback, various special effects are possible.

In addition, similar special effects for playback can be performed for not only image data but also for sound data.

It will be understood that, although a particular embodiment illustrative of the invention has been described by way of example, variations and modifications thereof, as well as other embodiments may be made within the scope of the protection sought by the appended claims.

Claims

1. A multi-media communication system, comprising:

   a data transmitter for providing a multi-media data; and
   a communication terminal for selectively utilizing the multi-media data with a special effect, wherein said communication terminal requests a next multi-media data from said data transmitter according to an amount of the multi-media data with the special effect having been utilized.

2. The multi-media communication system according to claim 1, said communication terminal comprising:

   a multi-media data processor for storing and decoding the multi-media data; and
   a communication interface for requesting the next multi-media data from said data transmitter.

3. The multi-media communication system according to claim 2, said multi-media data processor comprising:

   a multi-media data buffer for storing the multi-media data; and
   a multi-media data decoder for decoding the multi-media data stored in said multi-media data buffer.

4. The multi-media communication system according to claim 3, wherein said multi-media data buffer informs said communication interface of an amount of the multi-media data remaining in said multi-media data buffer to be utilized, and

   wherein said communication interface requests the next multi-media data from said data transmitter according to the amount of the image data remaining in said multi-media data buffer.

5. The multi-media communication system according to claim 4, said communication terminal further comprising:

   an input device for inputting to said multi-media data processor a request for the special effect.

6. The multi-media communication system according to claim 4, said communication terminal further comprising:

   a tuner for selecting a predetermined channel of the multi-media data for said multi-media data processor.

7. The multi-media communication system according to claim 2, said communication terminal further comprising:

   a signal separator for separating the multi-media data into an image data and a sound data, and
   said multi-media data processor comprising:

   an image processor for processing the image data; and
   a sound processor for processing the sound data.

8. The multi-media communication system according to claim 7, said image processor comprising:

   an image buffer for storing the image data; and
   an image decoder for decoding the image data stored in said image buffer,
   wherein said image buffer informs said communication interface of an amount of the image data remaining in the image buffer to be decoded, and wherein said communication interface requests the next multi-media data from said data transmitter according to the amount of the image data remaining in said image buffer.

9. The multi-media communication system according to claim 7, said sound processor comprising:

   a sound buffer for storing the sound data; and
   a sound decoder for decoding the sound data stored in said sound buffer,
   wherein said sound buffer informs said communication interface of an amount of the sound data remaining in sid sound buffer to be decoded, and wherein said communication interface requests the next multi-media data from said data transmitter according to the amount of the sound data remaining in said sound buffer.

10. The multi-media communication system according to claim 1, said data transmitter comprising:

    a data storage for storing the multi-media data; and
    a data controller for sending the multi-media data to said communication terminal.

11. The multi-media communication system according to claim 10, wherein the multi-media data includes at least one segment, said at least one segment

comprising at least one group of pictures, and wherein said data controller divides said at least one segment into first and second group-of-pictures portions.

12. A communication terminal for utilizing a multi-media data with a special effect, comprising:

a multi-media data processor for storing and decoding the multi-media data; and
a communication interface for requesting a next multi-media data according to an amount of the multi-media data having been utilized with the special effect by said communication terminal.

13. The communication terminal according to claim 12, said multi-media data processor comprising:

a multi-media data buffer for storing the multi-media data; and
a multi-media data decoder for decoding the multi-media data stored in said multi-media data buffer.

14. The communication terminal according to claim 13, wherein said multi-media data buffer informs said communication interface of an amount of the multi-media data remaining in said multi-media buffer to be utilized, and wherein said communication interface requests the next multi-media data according to the amount of said multi-media data remaining in said multi-media data buffer.

15. The communication terminal according to claim 14, further comprising:

an input device for inputting a request for the special effect to said multi-media data processor; and
a tuner for selecting a predetermined channel of the multi-media data for said multi-media data processor.

16. The communication terminal according to claim 12, further comprising:

a signal separator for separating the multi-media data into an image data and a sound data, and
said multi-media data processor comprising:

an image processor for processing the image data; and
a sound processor for processing the sound data.

17. A data transmitter, comprising:

a data storage for storing a multi-media data; and
a data controller for outputting the multi-media data, wherein the multi-media data includes at least one segment, said at least one segment including at least one group of pictures, and wherein said data controller divides said at least one segment into first and second group-of-pictures portions.

18. A method for utilizing a multi-media data in a communication terminal having a buffer, said method comprising steps of:

requesting termination of a transmission of the multi-media data;
processing the multi-media data with a special effect;
judging whether an amount of said multi-media data remaining in said buffer to be processed is less than a reference value; and
based on said judging step, requesting transmission of a predetermined amount of a multi-media data, if the amount of said multi-media data remaining in said buffer to be processed is less than the reference value.

19. The method for utilizing the multi-media data in the communication terminal according to claim 18, said processing step comprising a step of:

playing a same picture of an image data in the multi-media data a plurality of times.

20. A method for transmitting a multi-media data by a data transmitter, said method comprising steps of:

dividing a segment of the multi-media data into a plurality of groups of pictures;
outputting a first group of pictures;
storing remaining ones of said groups of pictures; and
outputting a second group of pictures of said remaining ones of said groups of pictures.

Fig.1.

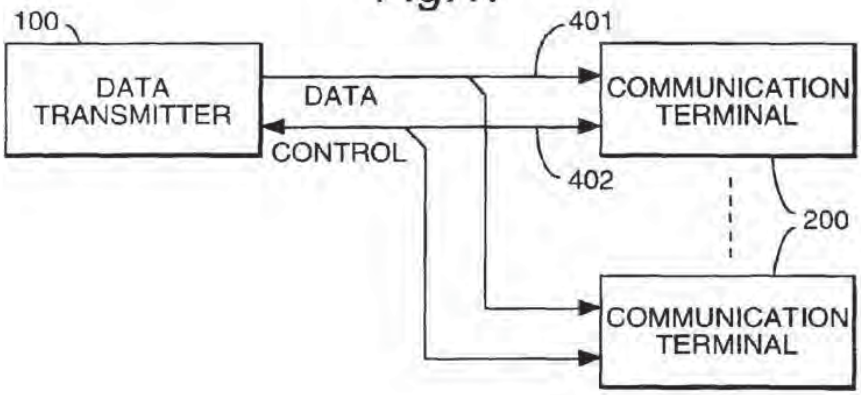


Fig.3.

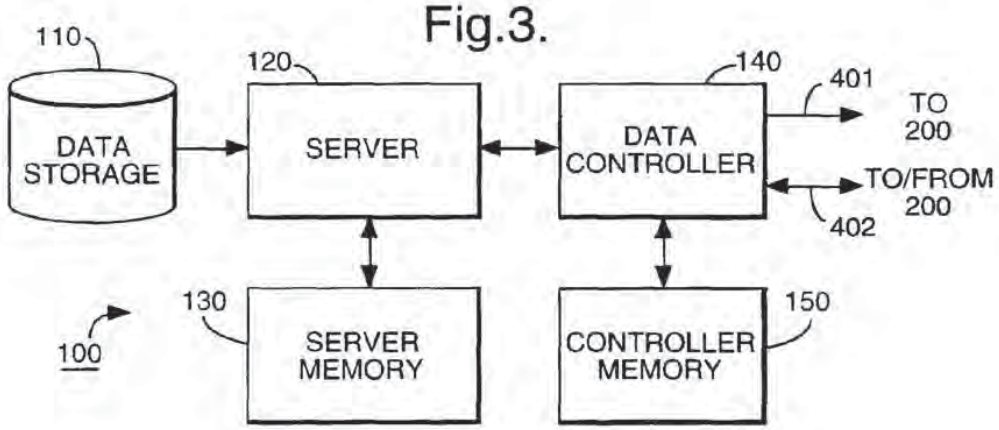


Fig.4.

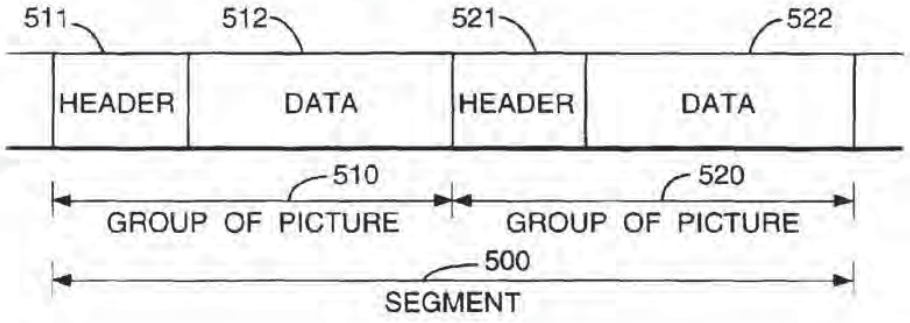
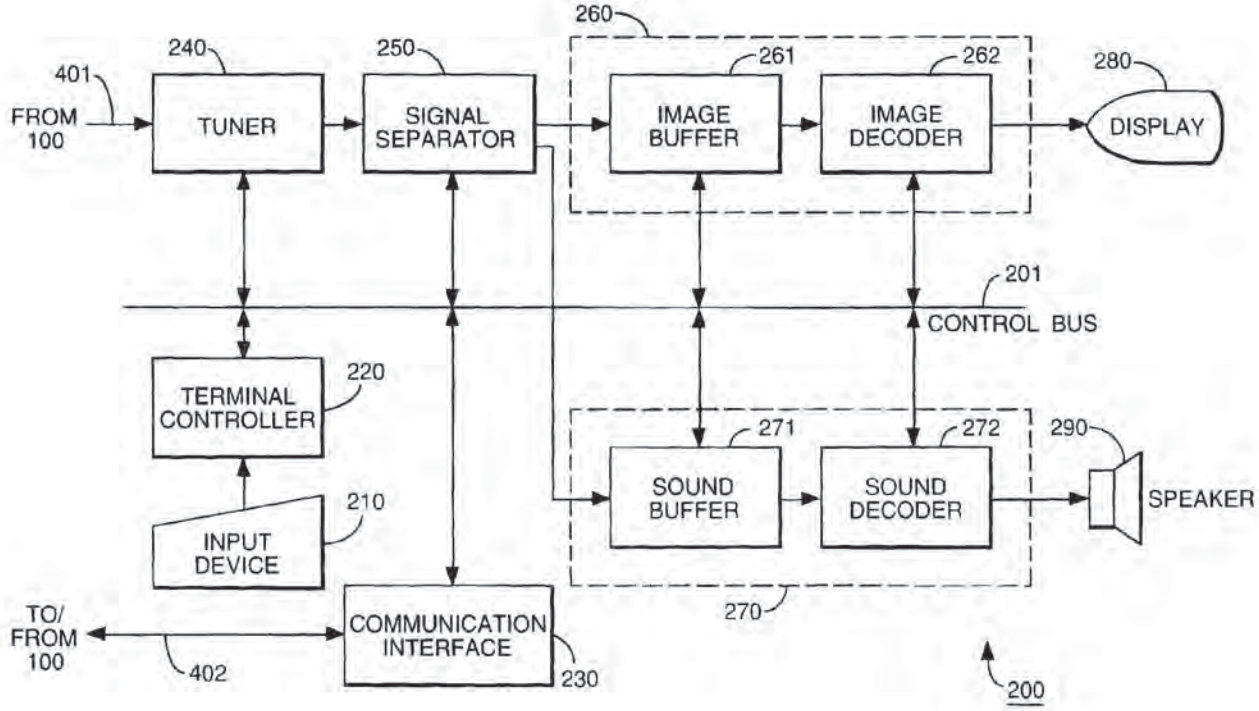


Fig.2.



EP 0 766 476 A2

Fig.5.

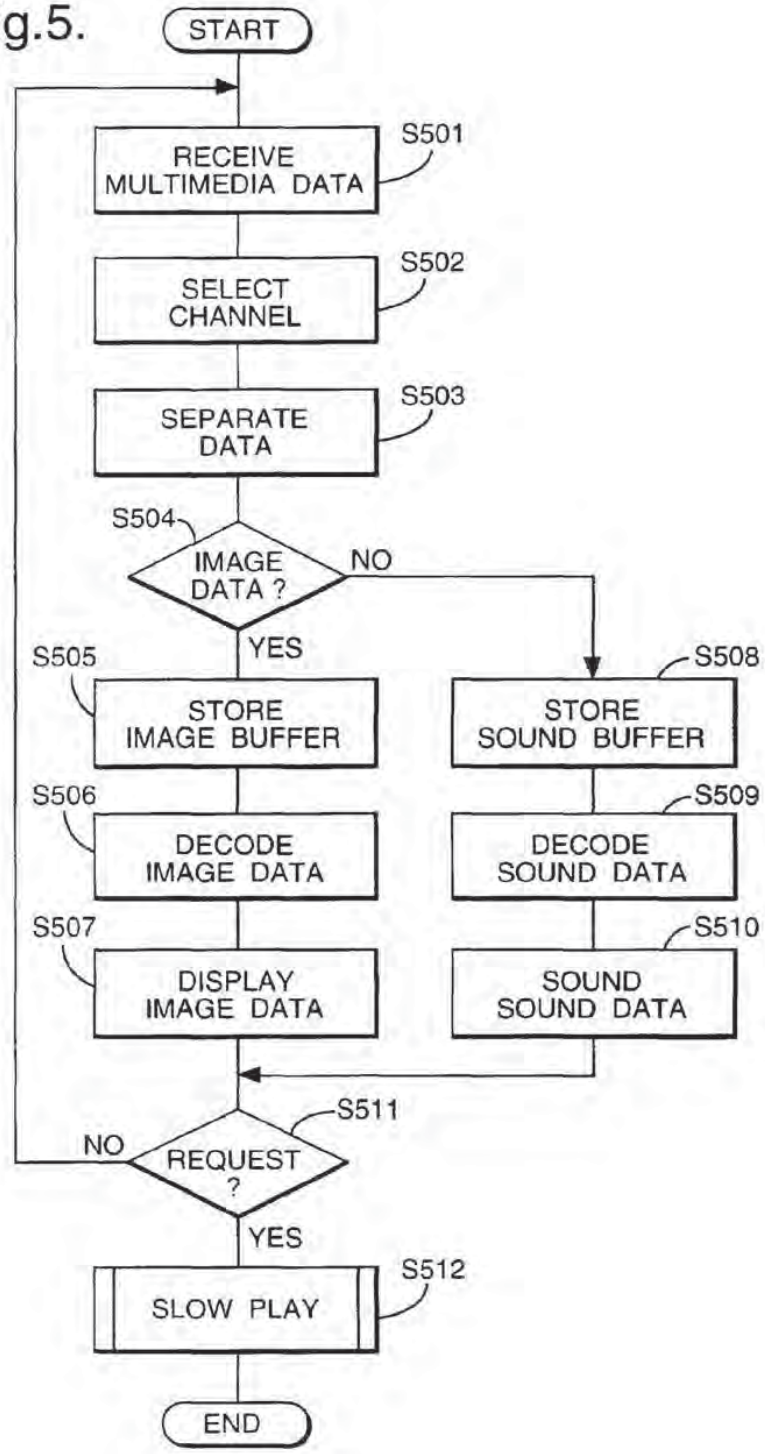

START
RECEIVE MULTIMEDIA DATA
S501
SELECT CHANNEL
S502
SEPARATE DATA
S503
S504
IMAGE DATA ?
NO
YES
S505
STORE IMAGE BUFFER
S506
DECODE IMAGE DATA
S507
DISPLAY IMAGE DATA
S508
STORE SOUND BUFFER
S509
DECODE SOUND DATA
S510
SOUND SOUND DATA
S511
NO
REQUEST ?
YES
S512
SLOW PLAY
END

Fig.6.

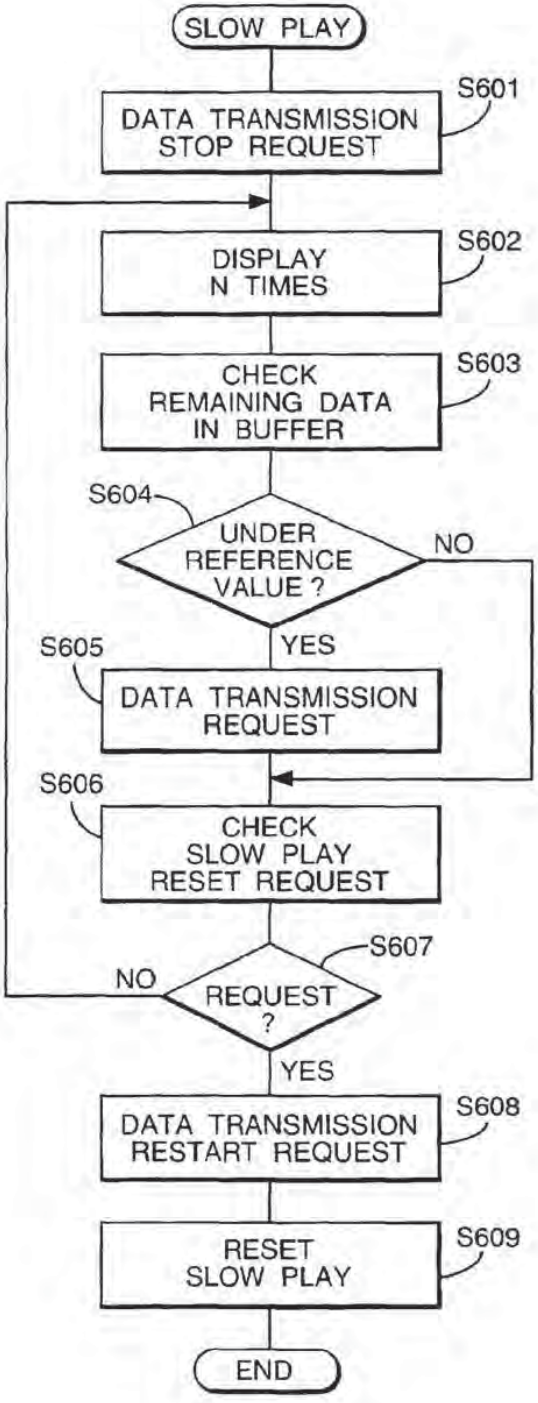
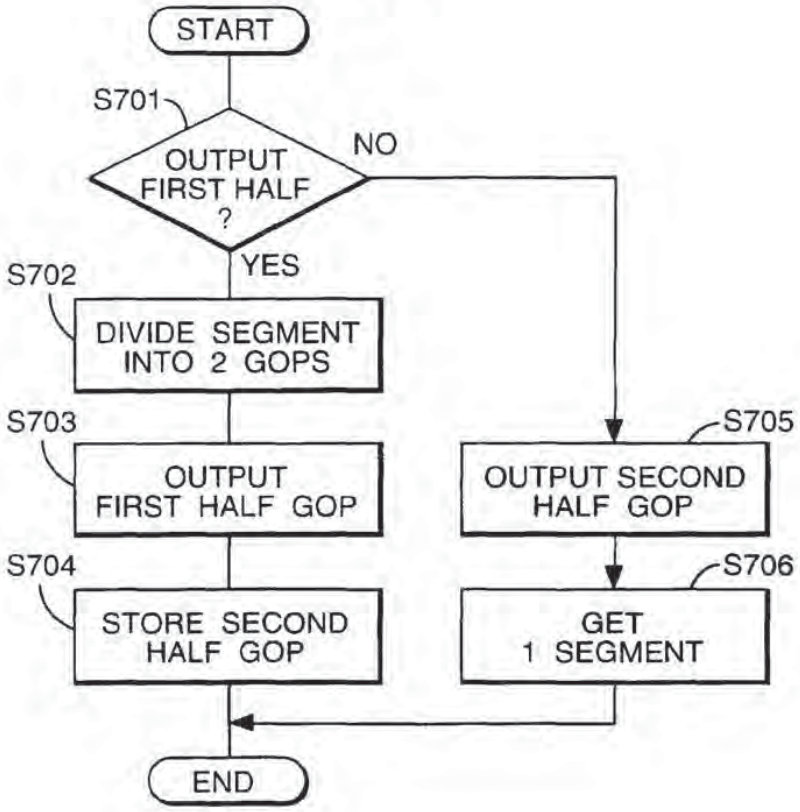

SLOW PLAY
S601
DATA TRANSMISSION STOP REQUEST
S602
DISPLAY N TIMES
S603
CHECK REMAINING DATA IN BUFFER
S604
UNDER REFERENCE VALUE ?
NO
YES
S605
DATA TRANSMISSION REQUEST
S606
CHECK SLOW PLAY RESET REQUEST
S607
REQUEST ?
NO
YES
S608
DATA TRANSMISSION RESTART REQUEST
S609
RESET SLOW PLAY
END

Fig.7.


START
S701
OUTPUT FIRST HALF ?
NO
YES
S702
DIVIDE SEGMENT INTO 2 GOPS
S703
OUTPUT FIRST HALF GOP
S704
STORE SECOND HALF GOP
S705
OUTPUT SECOND HALF GOP
S706
GET 1 SEGMENT
END

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None

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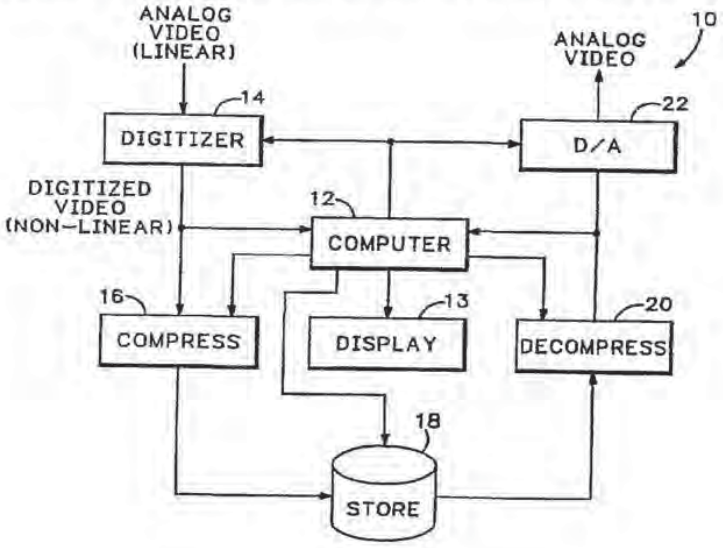
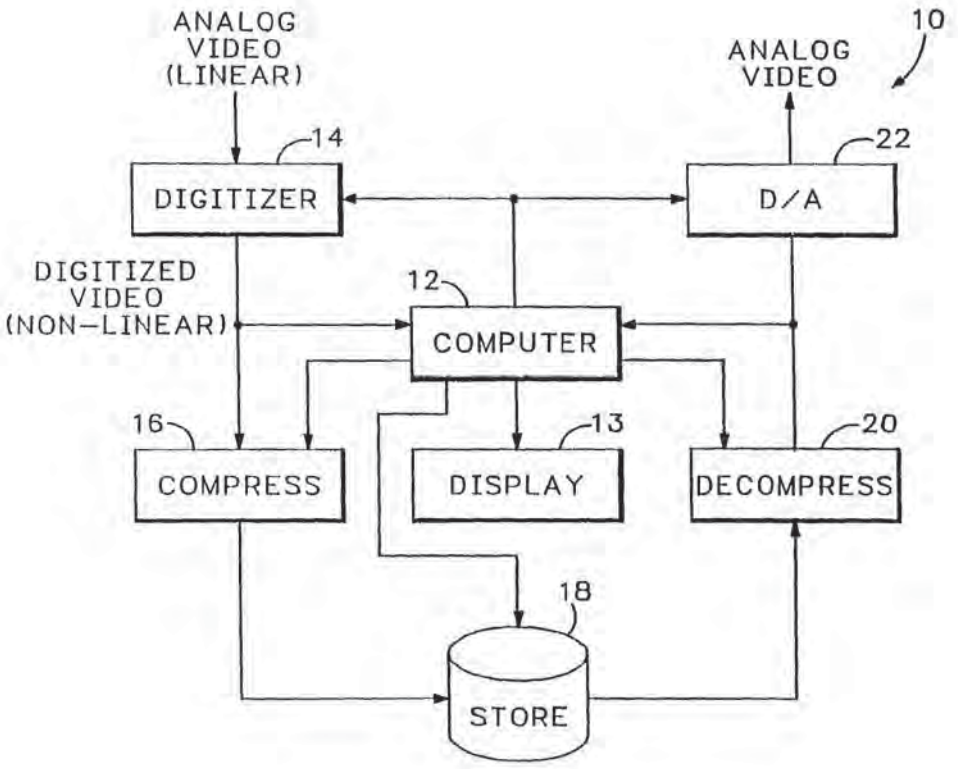
(54) A non-linear video editing apparatus

(57) A spiral buffer for a non-linear editing system digitizes and stores an input video signal as it is simultaneously being cataloged by an operator. The digitized video signal is stored in a circular buffer of a random access non-linear storage device, 18 such as a disk recorder, wherein the old video data is overwritten by new incoming video data when the buffer is full so long as the old video data has not been marked by the cataloging process to be retained. The video data is further edited which results in a spiral shrinking of the buffer.



GB 2 286 282 A


ANALOG
VIDEO
(LINEAR)
10
ANALOG
VIDEO
14
22
DIGITIZER
D/A
DIGITIZED
VIDEO
(NON-LINEAR)
12
COMPUTER
16
13
20
COMPRESS
DISPLAY
DECOMPRESS
18
STORE

1/1

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SPIRAL BUFFER FOR NON-LINEAR EDITING

Background of the Invention

The present invention relates to video editing, and more particularly to a spiral buffer for non-linear editing where a video signal is simultaneously converted from a linear to a non-linear format while being cataloged by an operator.

A linear editing system uses a linear video source, such as a camera or video tape recorder. As the video is played from the linear video source, an operator, either with manual annotations and/or computer assisted annotations, catalogs the material presented by the video. Cataloging is a process by which the operator identifies segments of the video that are to be kept or discarded. After the video has been cataloged, then the editing process is used to sort, order, crop and otherwise alter the video that has been kept by the cataloging process. In this manner a large amount of video may be reduced to a desired time frame, for example, reducing five hours of video to a twenty-four minute situation comedy episode.

Since the video source is linear, it has to be played sequentially to arrive at a particular segment of interest. This is time consuming, as it takes time to position video tape through shuttling and jogging operations. With the advent of non-linear storage medium, such as random access video disks, the time to access any particular segment is reduced. However another step in the editing process is added, namely converting the video from a linear form to a non-linear form, also called video capture. This conversion step is added either before or after the cataloging step, which requires the video to be played twice prior to the editing

step, once for cataloging and once for capturing for storage. Pictorially the conventional nonlinear editing process may be modeled as follows:

CAPTURE >>> CATALOG >>> EDIT >>> OUTPUT

or

CATALOG >>> CAPTURE >>> EDIT >>> OUTPUT

The two approaches to capturing the video material involve either capturing all material prior to cataloging, which consumes large amounts of storage space, or capturing after cataloging, which consumes more of the operator's time. In the latter sequence the operator specifically must tell the system to capture the material when he finds a sequence which he may want to keep. The system must then replay the sequence to capture and save it for storage.

What is needed is a non-linear editing process that further reduces the editing time and minimizes the amount of storage space used.

Summary of the Invention

Accordingly the present invention provides a spiral buffer for non-linear editing that minimizes the amount of storage space required. As an operator performs a cataloging step for an input video source, everything is converted from a linear to a non-linear form automatically, commonly called video capture. A circular buffer of user configurable size on a random access video disk storage medium is used to store this material. The space in the circular buffer occupied by the least recently used video material is reclaimed as more space is needed. Any video material that the operator marks during the cataloging step as "in" is marked as not discardable and retained. In this way the circular buffer shrinks

as the editing production grows, "spiraling" into a smaller size. When the operator wants to view a part of the video that he has already seen, if it was viewed within a time frame less than the total time stored on the circular buffer, it is still available for viewing from the disk. Thus the video capture phase is folded into the cataloging phase of the editing process so that the process model becomes:

CATALOG >>> EDIT >>> OUTPUT

The objects, advantages and other novel features of the present invention are apparent from the following detailed description when read in conjunction with the appended claims and attached drawing.

Brief Description of the Drawing

The Figure is a block diagram view of a non-linear editing system using a spiral buffer according to the present invention.

Description of the Preferred Embodiment

Referring now to the Figure an editing system **10** includes a computer **12** that controls the editing process and with which an operator interfaces. Analog video from a linear source, such as a camera or video tape recorder, is processed by a digitizing circuit **14** to produce a digital signal while it is simultaneously viewed on a display **13** by an operator for cataloging and conversion into a non-linear form for storage, i.e., video capture. The digital signal is processed by the computer **12** for automatic annotations, such as scene changes and the like. The computer **12** also provides a mark for the digital signal in response to an operator

catalog input which indicates whether the particular segment is to be kept or discarded. The digital signal may be processed by a compression algorithm **16** and then stored on a random access non-linear storage device, such as a disk recorder **18**. The computer **12** maintains a list of the locations for each video segment together with the associated catalog mark, the list having a storage start address, length and catalog mark. Where the segment is broken into smaller pieces for storage, the list includes a point to the next piece of the segment.

On playback the computer **12** accesses the disk recorder **18** by directly retrieving a desired segment from the disk based upon the location(s) indicated by the list. If the video segment is compressed, then the digital signal is processed by a decompression algorithm **20**, and the decompressed digital signal is input to a digital to analog converter **22**. The analog video from the digital to analog converter **22** is then available for display and/or recording on a linear storage device, such as a video tape recorder. The decompressed digital signal may also be stored directly in the appropriate digital format on a digital tape recorder.

All of the incoming video material, whether analog or digital, is captured as it is being cataloged by the operator. A circular buffer, configurable in size by the operator, within the disk recorder **18** is used for storing the captured video signal as a nonlinear signal. As the circular buffer is filled up, the oldest video segments are subject to being overwritten by the newest video segments. However the computer **12** only overwrites the oldest video segments which are not marked during the cataloging process by a "save" indication. In this manner the circular buffer need not be so large as to store the entire video signal to be edited, but only the marked video segments. The operator may recall any

segment from the disk recorder 18 and further edit it by pruning it, breaking it up into lesser segments, some of which are kept, and the like. As the "weeding" continues the circular buffer shrinks in size to hold only those segments that are retained. At the conclusion of the editing process the segments are read from the disk recorder 18 in a sequence that produces a final linear video product that may be stored on a linear storage device.

Thus the present invention provides a spiral buffer for a non-linear editing system that is configurable in size, which size is less than the total amount of video to be processed, and while the video is simultaneously cataloged and captured for storage on a random access non-linear storage device, new video material overwrites the oldest video material in the spiral buffer so long as the video material has not been marked as being kept.

CLAIMS:

1. A method of processing a video signal in a non-linear editing system comprising the steps of:

simultaneously cataloging and capturing for storage the video signal as it is received, the cataloging indicating which segments of the video signal are to be kept;

storing the video signal from the cataloging and capturing step in a circular buffer of a random access non-linear storage device as it is received; and

overwriting old segments of the video signal in the circular buffer with new segments of the video signal during the storing step when the circular buffer is full and the old segments have not been indicated by the cataloging and capturing step to be kept.

2. The method as recited in claim 1 wherein the cataloging and capturing step comprises the steps of:

marking the segments of the video segment to be kept with a catalog mark; and

automatically listing a start location, a length and the catalog mark for each segment in the random access non-linear storage device as it is received.

3. A method of processing a video signal in a non-linear editing system substantially as herein described with reference to and as shown in the accompanying drawing.

7

Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(The Search report)**	Application number GB 9502072.3
Relevant Technical Fields (i) UK Cl (Ed.N) G5R (RB81) (ii) Int Cl (Ed.6) G11B	Search Examiner P R SLATER Date of completion of Search 6 APRIL 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI	Documents considered relevant following a search in respect of Claims :- 1-3

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	**P:**	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	**E:**	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	**&:**	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

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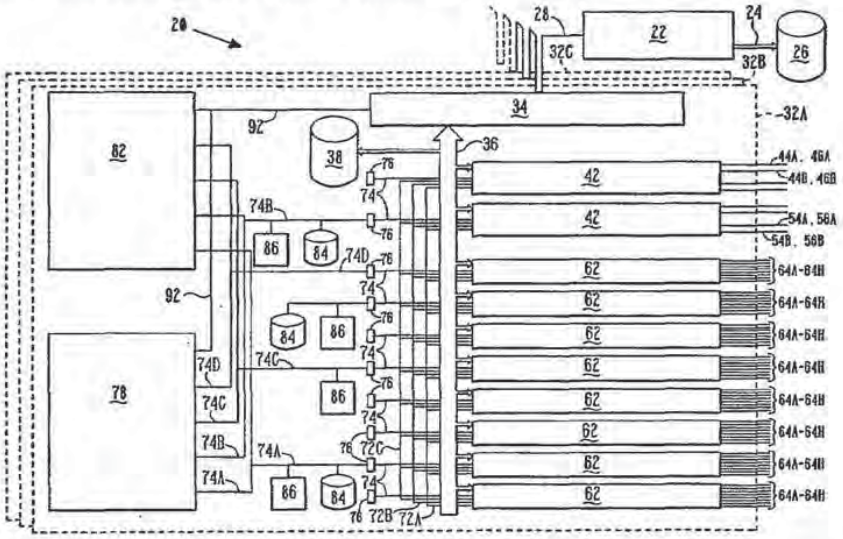

(57) Abstract

The technical field of the invention generally concerns systems for interactive access to stored video data. In particular, a video file server (20) includes both a random access data storage subsystem (78) and an archive data storage subsystem (82) for storing compressed video data. In response to commands from subscriber system (66), the video file server (20) transmits compressed video data to the subscriber systems (66) over lines (64A-64H), or receives compressed video data therefrom. Commands from the subscriber systems (66) may cause the video file server (20) to store compressed video data received from the subscriber systems (66) in the random access data storage subsystem (78) and/or archive data storage subsystem (82). Compression-decompression cards (42) included in the video file server (20) provide an authoring capability for storing compressed video and/or audio data in the random access data storage subsystem (78) and/or archive data storage subsystem (82), and for converting from one data compression standard to another.

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ADAPTIVE VIDEO FILE SERVER AND METHODS FOR ITS USE

Technical Field

The present invention relates generally to the technical field of electronic storage and transmission of video data and, more particularly, to the storage of such video data in a compressed digital format, and to transmission of compressed format video data over a comparatively narrow bandwidth communication channel such as that provided by an Integrated Services Digital Network ("ISDN") twisted pair communication channel.

Background Art

To deal rationally with the complexity of present communication systems and with the need to make different systems mutually compatible, the International Standards Organization ("ISO") developed a model for specifying such systems. Using this model, called the Open Systems Interconnect ("OSI") model, a communication system can be broken down into a hierarchial structure that permits standards to be defined at each level in the structure. The OSI model provides a hierarchy of seven different layers that can occur in a communication system. Each layer in the OSI model covers a different function performed by the communication system.

The lowest layer in the OSI model, called the physical layer, specifies the physical structure of interfaces in a particular communication system or network. Thus, a standard for the physical layer of a communication system specifies such things as the number of wires, their electrical characteristics, the characteristics of signals transmitted over the wires, connectors used for joining two sets of wires into a single longer set of wires, etc.

The next higher layer in the OSI model, called the data link layer, specifies how data is transmitted error free through the communication system. Thus, a standard for the second layer in the OSI model specifies how to detect errors in transmissions passing over the physical layer, and how to correct any errors that may occur during transmission.

The next higher layer in the OSI model, called the network layer, specifies the manner in which connections are formed between various places in the communication system for transmitting data between them. The standard for the third layer in the OSI model, therefore, specifies the signals transmitted over the data link layer that cause the communication system to transfer data between two places on the network.

A standard defined by an International Telegraph and Telephone Consultative Committee ("CCITT") for the ISDN communication channel specifies these three lowest levels in the OSI model. Under the CCITT standard, a basic ISDN access consists of two full-duplex 64 kilobits per second ("kbps") digital data channels, called channel B1 and channel B2, plus another full-duplex 16-kbps digital channel, called a D channel. Under the CCITT standard, using time division multiplexing, all three of these digital data channels may be transmitted over a single pair of twisted wires, or over two pairs of twisted wires. ISDN basic access, as specified by CCITT, was originally intended to provide a basic digital data transmission capability suitable for use by individuals such as in their homes or small businesses.

When ISDN basic access was initially specified, each of the B channels was intended to carry either:

1. digital data, such as that from a personal computer or from a computer terminal;
2. Pulse Code Modulation ("PCM") encoded digital voice communication; or
3. a mixture of lower data rate communications including digital data and digitized voice that were each encoded at a fraction of each B channel's full 64-kbps capacity.

Under the ISDN specification, the D channel serves two purposes. First, the D channel carries signaling information that controls the transmission of data over the two B channels. In addition, when the D channel is not carrying signaling information, it may be used to transmit packet-switching or low-speed telemetry. The combined data rate at which digital data may be transmitted over twisted pairs of wires in accord-

ance with the ISDN standard for basic access is 144-kbps, i.e. 128-kbps for the combined B1 and B2 channels plus 16-kbps for the D channel.

In addition to the ISDN basic access specified by CCITT, that organization has also specified a higher performance ISDN communication channel identified as ISDN primary access. An ISDN primary access provides twenty three 64-kbps B channels plus one 16-kbps D channel for a total capacity of approximately 1.5 megabits per second ("mbps"). CCITT envisions that the ISDN primary access can be used for communications between an ISDN local exchange and an ISDN Private Branch Exchange ("PBX").

Because the CCITT standard for the ISDN communication channel specifies the lowest three layers of the OSI model, the ISDN standard provides interfaces, both physical, e.g., the plug in a wall, and logical, e.g., electrical signals passing through the plug. In achieving this result, the ISDN standard specifies several different physical interfaces, the most widespread of which is called the S interface. The S interface of the ISDN standard specifies the interface between Terminal Equipment ("TE"), e.g., a telephone, and a Network Termination ("NT") of the ISDN communication channel.

In North America, the S interface is the four wires usually found in a home telephone installation. In this interface, two of the four wires transmit data from the Network Termination to the Terminal Equipment, and two wires transmit data back from the TE to the NT. That is, the NT uses one pair of the four wires to transmit the combined B1, B2 and D channels of ISDN basic access to the TE, while the TE simultaneously transmits a different combined B1, B2 and D channels back to the NT on a different pair of the four wires.

While ISDN basic access was originally intended to provide voice and slow speed data communication services such as those identified above, over the years developments in digital signal processing and compression techniques have advanced technology to the extent that compressed video data may now be transmitted using ISDN basic access. These techniques have progressed to such an extent that there now exist several alternative video

data compression techniques such as the CCITT H.261 picture phone standard, the Joint Photographic Experts Group ("JPEG") standard, and the Motion Picture Experts Group ("MPEG") standard.

United States Patent No. 5,027,400, that issued June 25, 1991, on an application filed in the names of Toru Baji et al. ("the Baji et al. patent"), discloses a multimedia bidirectional broadcasting system that distributes motion picture data using a broadband ISDN communication channel. In the system depicted in FIG. 3 of the Baji et al. patent, a motion picture program data base is maintained at a broadcasting station for transmission over broadband ISDN communication channels in response to requests received at the broadcasting system from subscriber systems. In the broadcasting station disclosed in the Baji et al. patent, an image encoder compresses a video signal prior to its transmission over the broadband ISDN communication channel to the subscriber system. The subscriber system includes a decoder for decoding the compressed video data and a television monitor for displaying them. Also included in the broadcasting station depicted in FIG. 3 is a cell disassembler that transfers control information received from the subscriber system over the ISDN communication channel to a main control unit of the broadcasting station.

In the broadcasting station depicted in FIG. 1-3 of the Baji et al. patent, a subscriber system submits a reservation to the broadcasting station to access a program stored there. A group of video buffers, also depicted in FIG. 1-3, permits the broadcasting system to simultaneously process data bases for a plurality of subscriber systems. A limitation of the broadcasting station disclosed in the Baji et al. patent occurs if the number of data bases available at the broadcasting station is insufficient for the number of subscriber systems requesting them. Under such circumstances, even though the subscriber system can communicate with the broadcasting system through an ISDN communication channel, the broadcasting system notifies the subscriber system attempting to make a reservation of how long it must wait before the data base will become available.

A playback control function, depicted in FIG.15 of the Baji et al. patent, permits a subscriber system to control a program being transmitted from the broadcasting station, such as fast forwarding it, rewinding it, temporarily stopping it, or displaying it slowly. FIG. 1-6 of the Baji et al. patent depicts a subscriber system that includes an image encoder for compressing a video signal from a video tape recorder, an optical disk or a real-time video camera prior to transmitting the compressed signal to the broadcasting station. At the broadcasting station, the compressed signal from the subscriber system apparently passes through the cell disassembler to be recorded in a video mail file from which other subscriber systems may retrieve it.

A limitation of the broadcasting system disclosed in the Baji et al. patent is that it lacks the ability to adapt compressed video data to the various different compression techniques such as CCITT H.261, MPEG or JPEG. The illustration of FIG. 1-6 depicts the video mail file for storing compressed video data transmitted to the broadcasting system from subscriber systems. The text of the Baji et al. patent states that the broadcasting system includes an interface for accessing the video mail file. The illustration of FIG. 1-6 shows that transmitted video mail file data passes directly from the video mail file to the broadcasting system's cell assembler, thus bypassing the broadcasting system's image encoder. Consequently, data stored in the video mail file of the broadcasting system can be viewed only on a subscriber system capable of decoding video data compressed according to the same standard, e.g., CCITT H.261, MPEG or JPEG, as that employed by the subscriber system in transmitting the compressed video data over the ISDN communication channel to the broadcasting system.

Furthermore, the broadcasting system disclosed in the Baji et al. patent cannot provide real-time communication between two subscriber systems. Using the broadcasting station disclosed in the Baji et al. patent, two subscriber systems can communicate only if one system first stores video data in the

broadcasting systems video mail file, after which the other subscriber system must retrieve the stored video data.

Yet another limitation of the broadcasting system disclosed in the Baji et al. patent is that it possesses the capability of transmitting only compressed video data. In addition to various alternative video data compression techniques identified previously, there now also exist a variety of different standards for compressing audio data, such as the CCITT standards G.711 and G.722, that adapt audio data for transmission over an ISDN communication channel.

Disclosure of Invention

An object of the present invention is to provide a video file server that, responsive to requests from a plurality of subscriber systems, can always immediately transmit video or audio data stored thereon.

Another object of the present invention is to provide a system that in real-time can convert video data compressed in accordance with one standard into video data compressed in accordance with a different standard that is incompatible with the first standard.

Another object of the present invention is to provide a file server that is capable of storing and transmitting both video and audio data.

Another objective of the present invention is to provide a video file server capable of providing real-time video communication between subscriber systems.

Another object of the present invention is to provide a video file server also capable of augmenting access to stored video or audio data with real-time video communication between subscriber systems.

Another object of the present invention is to provide a video file server capable of inserting compressed video data for a single stationary image between segments of compressed video data for moving images, and conversely.

Briefly, in a preferred embodiment, a video file server in accordance with the present invention includes a management operation center system for configuring and maintaining the

operations and services provided by the video file server. The video file server also includes one or more main units that provides all of the subscriber interface functions, e.g., ISDN Interface ("ISDN I/F"), sending selection menus to subscriber systems, interpreting subscriber requests and executing those requests, up-loading and down-loading of files, etc. Each main unit in the video file server includes a main unit controller for controlling transmission of compressed video data to subscriber systems. Each main unit also includes a random access data storage subsystem for storing compressed video data. Compressed video data stored in the random access data storage subsystem is randomly retrievable.

In addition to the items already described, each main unit controller also includes a plurality of communication subsystems. All of the communication subsystems operate under the control of main unit controller. Each communication subsystem receives control data from a particular one of the subscriber systems requesting that the communication subsystem transmit back to it specific video data stored in the random access data storage subsystem. In response to the control data received from the subscriber system, the communication subsystem transmits control data to the random access data storage subsystem that causes the random access data storage subsystem to retrieve the specific video data and to supply such data to the communication subsystem. Upon receiving the compressed video data from the random access data storage subsystem, the communication subsystem transmits it to the subscriber system.

A video file server in accordance with the present invention may also include compressed video data format conversion subsystems. Each compressed video data format conversion subsystem operates in response to control signals from the main unit controller, and is capable of exchanging compressed video data either with one of the communication subsystems or with the random access data storage subsystem. The compressed video data format conversion subsystem receives video data, either from one of the communication subsystems or from the random access data storage subsystem, that is compressed in accordance with a first compression standard. The compressed video data

format conversion subsystem converts the compressed video data into a format specified by a second compression standard that is different from the first compression standard. After the compressed video data format conversion subsystem has converted the video data into the format of the second standard, it transmits that compressed video data to either one of communication subsystems, or to the random access data storage subsystem.

A video file server in accordance with the present invention may also include video data compression subsystems. Each video data compression subsystem operates in response to control signals from the main unit controller, and is capable of exchanging compressed video data either with one of the communication subsystems or with the random access data storage subsystem. The video data compression subsystem receives a video signal, compresses the video signal in accordance with a compression standard specified by the main unit controller, and transmits the compressed video data either to the random access data storage subsystem or to one of the communication subsystems.

A video file server in accordance with the present invention may also include video data decompression subsystems. Each video data decompression subsystem operates in response to control signals from the main unit controller, and is capable of exchanging compressed video data either with one of the communication subsystems or with the random access data storage subsystem. The video data decompression subsystem receives compressed video data either from one of the communication subsystems or from the random access data storage subsystem, decompresses the video data to produce a video signal, and transmits the video signal thus generated.

A video file server in accordance with the present invention may also include audio compression-decompression subsystems. Each audio compression-decompression subsystem operates in response to control signals from the main unit controller, and is capable of exchanging compressed audio data either with one of the communication subsystems or with the random access data storage subsystem. The audio compression-decompression

subsystem may receive an audio signal, compress the audio signal in accordance with a compression standard, and transmit the compressed audio data to the random access data storage subsystem. The audio compression-decompression subsystem may also receive compressed audio data from the random access data storage subsystem, decompress the audio data to produce an audio signal, and transmit the audio signal thus obtained.

A video file server in accordance with the present invention may also include an archive data storage subsystem for storing compressed video data from which such data is sequentially retrievable. The archive data storage subsystem operates in response to control data transmitted from the communication subsystems to the archive storage subsystem. Such control data causes the archive data storage subsystem to retrieve compressed video data and to supply such data either to the communication subsystem, for immediate transmission to the subscriber system, or to the random access data storage subsystem.

An advantage of a video file server in accordance with the present invention is that all subscriber systems are able to concurrently request transmission, and all of the communication subsystems, together with the random access data storage subsystem, are capable of concurrently supplying all of the subscriber systems with the same specific video data.

Another advantage of the video file server in accordance with the present invention is that it can provide compressed video data to subscriber systems in a format that differs from the format in which compressed video data is stored in the random access data storage subsystem.

Another advantage of the video file server in accordance with the present invention is that the main unit controller can determine if video data stored in the random access data storage subsystem in accordance with one compression standard is being frequently converted into a second compression standard for transmission to subscriber systems. If particular compressed video data is being converted frequently, the main unit controller can cause that video data to also be stored in the random access data storage subsystem compressed in

accordance with the second compression standard so it need not be converted repetitively in responding to future requests from subscriber systems.

Another advantage of the video file server of the present invention is that it can receive compressed video data from one subscriber that is compressed in accordance with a first compression standard, convert that compressed video data into the format specified by a second compression standard, and then transmit the compressed video data in the second format to another subscriber system.

Another advantage of the video file server of the present invention is that it can receive a video signal, convert it into compressed video data, store the compressed video data in the random access data storage subsystem, and then subsequently retrieve the compressed video data for transmission to a subscriber system.

Another advantage of the video file server of the present invention is that it can take compressed video data stored in the random access data storage subsystem, convert it into a video signal, and then transmit the video signal thus produced.

Another advantage of the video file server of the present invention is that it can provide real-time, visually interactive game playing environment for individuals present at subscriber systems. During such game playing, each subscriber systems creates a visual image that is transmitted to other subscriber systems engaged in the game. Thus, for example, in playing such a game two combatants physically separated by a large distance could visually observe each other during combat. Furthermore, the main unit could function as a referee or umpire during such game playing to enforce and/or establish the rules of the game.

These and other features, objects and advantages will be understood or apparent to those of ordinary skill in the art from the following detailed description of the preferred embodiment as illustrated in the various drawing figures.

Brief Description of Drawings

FIG. 1 is a functional block diagram depicting a video file server in accordance with the present invention including a management operation center system; a supervisory main unit controller; a random access data storage subsystem; an archive data storage subsystem; eight communication subsystem boards; two compression-decompression cards; various buses interconnecting the management operation center system, the main unit controller, the random access data storage subsystem, the archive data storage subsystem, the communication subsystem boards, and the compression-decompression cards; communication channels through which the video file server communicates with subscriber systems; and input-output ports to the video file server through which it may receive or transmit either conventional video or audio signals;

FIG. 2 is a functional block diagram depicting in greater detail one of the communication subsystem boards illustrated in FIG. 1 including its four Small Computer System Interface ("SCSI") units, a VerasModule Eurocard ("VME") bus connecting it to the main unit controller, a control processor, a Random Access Memory ("RAM"), and eight communication subsystems each one of which communicates with a subscriber system through one of various alternative communication channels such as either a Local Area Network ("LAN"), an ISDN primary access, twisted pairs of wires, or, as illustrated in FIG. 2, through an ISDN basic access communication channel;

FIG. 3 is a functional block diagram depicting in greater detail one of the compression-decompression cards illustrated in FIG. 1 including its four SCSI units, a VME bus connecting it to the main unit controller, a control processor, RAM, a pair of audio compression-decompression subsystems including ports through which the audio compression-decompression subsystems may either receive or transmit conventional audio signals, and a pair of video compression-decompression subsystems including ports through which the video compression-decompression subsystems may either receive or transmit conventional video signals; and

FIG. 4 is a functional block diagram depicting in greater detail one of the two video compression-decompression subsystems illustrated in FIG. 3 that are included in each compression-decompression card.

Best Mode for Carrying Out the Invention

FIG. 1 depicts a video file server in accordance with the preferred embodiment of the present invention referred to by the general reference number 20. The video file server 20 includes a management operation center system 22 that is used to configure and maintain the entire operations and services of the video file server 20. The management operation center system 22 is preferably Unix workstation such as a Silicon Graphics Iris computer sold by Silicon Graphics of Mountain View, California, or a SPARC computer sold by Sun Microsystems Inc. of Mountain View, California. The management operation center system 22 provides a VME bus 24 over which the system 22 communicates with a local file system 26. The local file system 26 stores data and computer programs needed for the overall operation of the video file server 20 including the management operation center system 22.

The management operation center system 22 also connects by an Ethernet® 28 to a plurality of main units 32A-C. The management operation center system 22 and the main units 32 communicate over the Ethernet® 28 to establish and maintain the overall operation of the video file server 20. While FIG. 1 illustrates the Ethernet® 28 as connecting the management operation center system 22 to only three main units 32A-C, a video file server 20 in accordance with the present invention may include as few as one main unit 32, or as many as 100 main units 32. Regardless of the number of main units 32 included in the video file server 20, all main units 32 communicate with the management operation center system 22 via the Ethernet® 28.

Main Unit 32

Each main unit 32 included in the video file server 20 includes a main unit controller 34 that is preferably a SPARC

model 4-330 computer sold by Sun Microsystems Inc. of Mountain View, California. The main unit controller 34 included in each main unit 32 communicates directly with the management operation center system 22 via the Ethernet® 28. Similar to the management operation center system 22, the main unit controller 34 also provides a VME bus 36 over which the main unit controller 34 communicates with a local file system 38. In addition to communicating with the local file system 38 over the VME bus 36, the main unit controller 34 may also communicate with up to two compression-decompression cards 42 over the VME bus 36. As better illustrated in FIG. 3, each compression-decompression card 42 includes a pair of stereo input ports 44A and 44B, a pair of stereo output ports 46A and 46B, a pair of video input ports 54A and 54B, and a pair of video output ports 56A and 56B. Referring again to FIG. 1, the main unit controller 34 may also communicate with up to eight communication subsystem boards 62 over the VME bus 36. In the preferred embodiment of the present invention, each communication subsystem board 62 communicates over one of eight ISDN primary access lines 64A-64H with a subscriber system 66 as illustrated in FIG. 2.

In addition to communicating with the main unit controller 34 over the VME bus 36, both the compression-decompression cards 42 and the communication subsystem boards 62 communicate among themselves over three independent SCSI-2 buses 72A-72C. In addition to the three independent SCSI-2 buses 72A-72C, each of the compression-decompression cards 42 and each of the communication subsystem boards 62 also includes a SCSI-1 bus 74 provided at a SCSI-1 connector 76. The SCSI-1 bus 74 of each of the compression-decompression cards 42 and each of the communication subsystem boards 62 is used for exchanging data with peripheral devices such as SCSI-1 compatible hard disks, RAM disks, tape drives, etc.

In the embodiment of the video file server 20 depicted in FIG. 1, the SCSI-1 connector 76 of four of the compression-decompression cards 42 and communication subsystem boards 62 respectively connects to one of four independent SCSI-1 buses 74A-74D. The SCSI-1 buses 74A-74D extend the respective SCSI-1

buses 74 of the compression-decompression cards 42 or communication subsystem boards 62 with which they connect to a random access data storage subsystem 78. The compression-decompression cards 42 and the communication subsystem boards 62 exchange compressed data with the random access data storage subsystem 78 from which such data is randomly retrievable. The random access data storage subsystem 78 preferably includes a Redundant Array of Inexpensive Disks ("RAID") model 6101 manufactured by Amperif, 9232 Eton Avenue, Chatsworth, California, having a storage capacity of no less than one gigabyte (1×10^9 bytes).

In addition to the random access data storage subsystem 78, both the compression-decompression cards 42 and the communication subsystem boards 62 respectively connected to the SCSI-1 buses 74A-74D also communicate with an archive data storage subsystem 82 over the four independent SCSI-1 buses 74A-74D. The archive data storage subsystem 82 stores compressed data in a variety of different comparatively low performance storage devices such as laser video disk, optical laser data disk, or 8mm and/or 4mm Digital Audio Tape ("DAT") from which compressed video data is sequentially retrievable. The archive data storage subsystem 82 may also exchange compressed data with the random access data storage subsystem 78 over the SCSI-1 buses 74A-74D.

While the preferred embodiment of the present invention depicted in FIG. 1 illustrates four of the compression-decompression cards 42 and the communication subsystem boards 62 as being connected directly to the random access data storage subsystem 78 and the archive data storage subsystem 82 by the SCSI-1 buses 74A-74D, a video file server 20 in accordance with the present invention may include fewer than the four SCSI-1 buses 74A-74D depicted in FIG. 1, or more than the four SCSI-1 buses 74A-74D depicted in FIG. 1 depending upon the total number of compression-decompression cards 42 and/or communication subsystem boards 62 included in the video file server 20, and upon the precise characteristics of the random access data storage subsystem 78 and/or the archive data storage subsystem 82. Furthermore, depending upon the precise

configuration chosen for the video file server 20, if it should prove advantageous a local file 84 and/or a RAM disk 86 may also be connected to each of the compression-decompression cards 42 and/or to each of the communication subsystem boards 62 to provide them with local storage.

In addition to exchanging compressed data with either the compression-decompression cards 42 and/or the communication subsystem boards 62 over the SCSI-1 buses 74A-74D, the random access data storage subsystem 78 and the archive data storage subsystem 82 also communicate with the main unit controller 34 over a fifth SCSI-1 bus 92.

Within each main unit 32, the main unit controller 34 controls the operation of the compression-decompression cards 42 and communication subsystem boards 62 included in the unit 32 by exchanging commands and data with them over the VME bus 36. Furthermore, the main unit controller 34 included in each main unit 32 may exchange data over the SCSI-1 bus 92 directly with either the random access data storage subsystem 78 or the archive data storage subsystem 82. Using the SCSI-1 bus 92, the main unit controller 34 can easily determine what files of compressed video data are available in the random access data storage subsystem 78, or in the archive data storage subsystem 82.

Because of the flexibility in transferring data provided by the SCSI-2 buses 72A-72C and the SCSI-1 buses 74A-74D, commands from the main unit controller 34 may cause compressed data to be transferred between any two units connected to the buses 72A-72C and 74A-74D. Furthermore, those compression-decompression cards 42 and/or communication subsystem boards 62 in the main unit 32 that have their respective SCSI-1 buses 74 connected to the random access data storage subsystem 78 and/or to the archive data storage subsystem 82 exchange compressed data directly with those devices over the SCSI-1 buses 74A-74D in response to commands from the main unit controller 34. Similarly, commands from the main unit controller 34 cause compressed data to be transferred via the SCSI-2 buses 72A-72C between pairs made up of one of the communication subsystem boards 62 and one of the compression-

decompression cards 42, between pairs of communication subsystem boards 62, or between the two compression-decompression cards 42. However, compressed data exchange between those compression-decompression cards 42 and/or communication subsystem boards 62 whose SCSI-1 buses 74 do not connect to the random access data storage subsystem 78 or to the archive data storage subsystem 82 must pass through a card 42 or board 62 whose SCSI-1 bus 74 connects to the subsystem 78 and/or subsystem 82. For such data exchanges, the compressed data is exchanged between the compression-decompression cards 42 and/or the communication subsystem boards 62 via the SCSI-2 buses 72A-72C either before or after it passes over one of the SCSI-1 buses 74A-74D between a card 42 or board 62 connected thereto and the random access data storage subsystem 78 and/or the archive data storage subsystem 82.

Each compression-decompression card 42 may receive stereo audio signal(s) through either one or both of its stereo input ports 44A and 44B, compress the audio signal(s) in accordance with a compression standard specified by commands from the main unit controller 34, and store compressed audio data thus obtained into the random access data storage subsystem 78. Alternatively, each compression-decompression card 42 may receive compressed audio data from the random access data storage subsystem 78, decompress the audio data thus received, and transmit stereo audio signal(s) through either one or both of its stereo output ports 46A and 46B.

Similarly, each compression-decompression card 42 may also receive video signals(s) through either one or both of its video input ports 54A and 54B, compress the video signal(s) in accordance with a compression standard specified by commands from the main unit controller 34, and store compressed audio data thus obtained into the random access data storage subsystem 78. Alternatively, each compression-decompression card 42 may receive compressed video data from the random access data storage subsystem 78, decompress the video data thus received, and transmit video signal(s) through either one or both of its video output ports 56A and 56B.

Because the communication subsystem boards 62 receive compressed video data via the SCSI-1 buses 74A-74D directly from the random access data storage subsystem 78, and because the random access data storage subsystem 78 and the SCSI-1 buses 74A-74D can supply data to the communication subsystem boards 62 at a sufficiently high data rate, the video file server 20 is capable of simultaneously supplying all of the subscriber systems 66 with the same specific video data. Thus, in contrast to the system disclosed in the Baji et al. patent, a video file server 20 in accordance with the present invention need never notify a subscriber system 66 that it must wait for some interval of time until specific video data will become available.

Furthermore, each compression-decompression card 42 may receive video data from the SCSI-1 buses 74A-74D that is compressed in accordance with a first compression standard, convert that compressed video data into video data compressed in accordance with a second compression standard that differs from the first compression standard, and then transmit the compressed video data thus obtained over the SCSI-1 buses 74A-74D. Video data to be reformatted from one compression standard to another can come to the compression-decompression card 42 either from one of the communication subsystem boards 62, from the random access data storage subsystem 78, or from the archive data storage subsystem 82. Similarly, video data that has been reformatted from one compression standard to another can be transmitted from the compression-decompression card 42 to any of the communication subsystem boards 62, to the random access data storage subsystem 78, or to the archive data storage subsystem 82.

During operation of the video file server 20, the communication subsystem boards 62 receive control data that requests services from the video file server 20 from the subscriber systems 66 via the ISDN primary access lines 64A-64H. If the control data from a subscriber system 66 requests certain types of service from the video file server 20, the communication subsystem board 62 forwards the request to the main unit controller 34. In response to such a request

from a subscriber system 66, the main unit controller 34 may transmit commands back to the communication subsystem board 62 that cause it either to supply compressed video data to, and/or to receive compressed video data from the subscriber system 66 via the ISDN primary access lines 64A-64H. Because of the flexibility afforded by the SCSI-2 buses 72A-72C and the SCSI-1 buses 74A-74D, the communication subsystem boards 62 may obtain compressed video data for transmission to a subscriber system 66 from another communication subsystem board 62, from the random access data storage subsystem 78, from the archive data storage subsystem 82 or from one of the compression-decompression cards 42. Similarly, the communication subsystem boards 62 may deliver compressed video data received from the subscriber system 66 to another communication subsystem board 62, to the random access data storage subsystem 78, to the archive data storage subsystem 82 or to one of the compression-decompression cards 42.

If the main unit controller 34 detects that video data stored in the random access data storage subsystem 78 in one compression standard is being repetitively converted to a second compression standard, it can command the compression-decompression card 42 to store the video data, compressed in accordance with the second compression standard, in the random access data storage subsystem 78. Once video data has been stored in this second compression standard, then the main unit 32 can respond to further requests from subscriber system 66 to receive that video data in the second compression standard without again supplying the video data to the compression-decompression card 42.

The flexibility and facilities provided by the video file server 20 permits a subscriber system 66 that transmits and receives compressed video data in one compression standard to communicate, through the video file server 20, with another subscriber system 66 that transmits and receives compressed video data in a second compression standard that differs from the first compression standard. The video file server 20 permits communication between two such mutually incompatible subscriber system 66 by receiving compressed video data from

one subscriber system 66 at one of its communication subsystem boards 62, transmitting that compressed video data to one of the compression-decompression cards 42 where it is reformatted from one compression standard to another, and then passing the translated video data to one of the communication subsystem boards 62 for transmission to a second subscriber system 66.

During operation of the video file server 20, the management operation center system 22 configures the software and hardware of the video file server 20, performs system administration, accounting and billing services, provides for multimedia development and for developing the interface presented to users at subscriber systems 66, and reports statistics on the operation of the video file server 20. Because the interface presented to users at subscriber systems 66 is stored in the local file system 26 of the management operation center system 22, the video file server 20 is easily adapted for use in any language merely by preparing an interface for that language, or by appropriately selecting from among several different interfaces stored in the local file system 26, each such interface having been previously prepared for a particular language.

Communication Subsystem Board 62

Referring now to FIG. 2, the communication subsystem board 62 receives commands from the main unit controller 34 via the VME bus 36 with transceivers 102. The transceivers 102 also connect to a communication subsystem board bus 104 that interconnects them with a supervisory processor 106, a RAM access control processor 107, with four SCSI controllers 108A-108D, with a RAM pool 112, and with eight communication subsystems 114A-114H. The supervisory processor 106 and the RAM access control processor 107 are preferably both a Motorola MC68EC030 microprocessor that is more completely described in a "Motorola Semiconductor Technical Data" sheet MC68EC030/D, copyright Motorola Inc., 1991, that is incorporated herein by reference. The SCSI controllers 108A-108C for the SCSI-2 buses 72A-72C are each preferably either a Fujitsu MB86603 or a Fujitsu MB86602 SCSI protocol controller. The SCSI controller

108D for the SCSI-1 bus 74 is preferably a Fujitsu MB86601 SCSI protocol controller. Both the Fujitsu MB86602 and MB86601 SCSI protocol controllers are more fully described in a "MB86601 & MB86602 SCSI Protocol Controller Product Guide," Second Edition, dated March 11, 1991, Fujitsu VLSI Inc., that is incorporated herein by reference. The RAM pool 112 provides 256M bytes of 30 nanosecond static RAM memory organized as 4 million 64 bit words.

Operating under the control of the main unit controller 34, a computer program executed by the supervisory processor 106 in each communication subsystem board 62 assigns tasks to be performed by the SCSI controllers 108A-108D and by the communication subsystems 114A-114H. The RAM access control processor 107 manages requests for Direct Memory Access ("DMA") to the RAM pool 112. To effect task assignment and RAM access control, the communication subsystem board 62 includes a communication subsystem board control bus 122 by which the supervisory processor 106 and the RAM access control processor 107 exchange control signals with each other, with the transceivers 102, with the SCSI controllers 108A-108D, and with the communication subsystems 114A-114H.

The communication subsystem board control bus 122 couples control signals among the supervisory processor 106, the RAM access control processor 107, SCSI controller Programmable Array Logic Integrated Circuits ("PALs") 124A-124D, and communication subsystem PALs 126A-126H. The logic circuits in the SCSI controller PALs 124A-124D are programmed to adapt signals exchanged between both the supervisory processor 106 and the RAM access control processor 107, and the SCSI controllers 108A-108D that cause the SCSI controllers 108A-108D to transfer compressed data into or out of the RAM pool 112 over the SCSI-2 buses 72A-72C and the SCSI-1 bus 74. Similarly, the communication subsystem PALs 126A-126H are programmed to adapt signals exchanged between both from the supervisory processor 106 and the RAM access control processor 107, and the communication subsystems 114A-114H that cause the subsystems 114A-114H to transfer compressed data into or out of the RAM pool 112 via the ISDN primary access lines 64A-64H.

The communication subsystem board bus 104 is designed so the computer program executed by the RAM access control processor 107 can dynamically size the bus 104 into multiple narrower buses each of which may be used for exchanging compressed video data between the RAM pool 112 and either the SCSI controllers 108A-108D or the communication subsystems 114A-114H. Thus, the 64 bit wide communication subsystem board bus 104 may be subdivided into two 32 bit wide buses, four 16 bit wide buses, eight 8 bit wide buses, or any combination thereof totaling fewer than 64 bits.

Operating as slaves of the supervisory processor 106, the SCSI controllers 108A-108D and the communication subsystems 114A-114H access the RAM pool 112 using DMA operating in burst mode to transfer blocks of data. This method of operating the SCSI controllers 108A-108D, the communication subsystems 114A-114H, and the RAM pool 112 transfers blocks of data quickly between the RAM pool 112 and the local cache memories respectively located in the SCSI controllers 108A-108D and in the communication subsystems 114A-114H.

Each of the communication subsystems 114A-114H includes a Motorola MC68302 Integrated Multiprotocol Processors ("IMP"). The Motorola MC68302 IMP Integrated Circuit ("IC") is more completely described in the "MC68302 Integrated Multiprotocol Processor User's Manual," Second Edition, MC68302UM/AD Rev 2, copyright Motorola, Inc., 1991 ("MC68302 User's Manual"), that is incorporated herein by reference. In addition to the Motorola MC68302 IMP IC, each of the communication subsystems 114A-114H preferably also includes a Read Only Memory ("ROM") containing a program that is executed upon "booting" the video file server 20, 500k bytes of RAM, and an IC for sensing Dual Tone Multi Frequency ("DTMF") signals transmitted by a subscriber system 66 after it and the video file server 20 are exchanging signals through the ISDN primary access lines 64.

An ISDN interface IC 132, located between each communication subsystems 114A-114H and each ISDN primary access lines 64A-64H, exchanges signals over buses 134 and 136 with the Motorola MC68302 IMP IC to adapt the communication subsystems 114A-114H for exchanging compressed video data with subscriber

systems 66 over the ISDN primary access lines 64A-64H. The ISDN interface IC 132 used for an ISDN primary access line may be a Rockwell R8069 Line Interface Unit ("LIU"). The Rockwell R8069 LIU is more completely described in a Communication Products Data Book, Order No. 4, published by the Semiconductor Products Division of Rockwell International Corporation, Newport Beach, California.

The communication subsystem 114 may be adapted for use with an ISDN basic access line rather than a primary access line by employing a different integrated circuit for the ISDN interface IC 132. Depending upon the particular type of ISDN basic access telephone line over which data is to be transmitted, the ISDN interface IC 132 may be selected from among the Motorola MC145472, MC145474, MC145475, MC14554/7 or MC145564/7 ICs.

Each of the communication subsystems 114A-114H includes an IC for sensing DTMF signals so the subscriber systems 66 may present signals for controlling transmission of compressed video data from the video file server 20 after the subscriber system 66 and the video file server 20 are communicating via one of the ISDN primary access lines 64A-64H. For example, when the video file server 20 transmits compressed video data from the random access data storage subsystem 78 to the subscriber system 66, DTMF signals from the subscriber system 66 may command the video file server 20 to fast forward through a program, rewind the program, pause the program to display a single image, step through the program one image at a time, etc., similar to a conventional VCR.

Compression-Decompression Card 42

Referring now to FIG. 3, similar to the communication subsystem board 62, the compression-decompression card 42 also receives commands from the main unit controller 34 via the VME bus 36 with transceivers 202. Similar to the transceivers 102, the transceivers 202 connect to a compression-decompression card bus 204 that interconnects them with a supervisory processor 206, a RAM access control processor 207, with four SCSI controllers 208A-208D, with a RAM pool 212, with transceivers 214 for a pair of Coder-Decoders ("CODECs") 216A-216B,

and a pair of audio compression-decompression subsystems 218A-218B. The structure and operation of the combined transceivers 202, the compression-decompression card bus 204, the supervisory processor 206, RAM access control processor 207, the SCSI controllers 208A-208D, and the RAM pool 212 are identical to that described previously for the corresponding elements of the communication subsystem board 62.

Operating under the control of the main unit controller 34, a computer program executed by the supervisory processor 206 in each compression-decompression card 42 assigns tasks to be performed by the SCSI controllers 208A-208D, the CODECs 216A-216B, and the audio compression-decompression subsystems 218A-218B. The RAM access control processor 207 manages requests for DMA to the RAM pool 112. To effect task assignment and RAM access control, the compression-decompression card 42 includes a compression-decompression card control bus 222 by which the supervisory processor 206 and the RAM access control processor 207 exchange control signals with each other, with the transceivers 202, with the SCSI controllers 208A-208D, with the transceivers 214, with the CODECs 216A-216B, and with the audio compression-decompression subsystems 218A-218B.

The compression-decompression card control bus 222 couples control signals among the control processor 206, the RAM access control processor 207 and SCSI controller PALs 224A-224D. Similar to the SCSI controller PALs 124A-124D, the logic circuits in the SCSI controller PALs 224A-224D are programmed to adapt signals exchanged between both the supervisory processor 206 and the RAM access control processor 207, and the SCSI controllers 208A-208D that cause the SCSI controllers 208A-208D to transfer compressed data into or out of the RAM pool 212 over the SCSI-2 buses 72A-72C and the SCSI-1 bus 74. The compression-decompression card control bus 222 also supplies control signals to two pairs of video decoders-encoders 228A-228B.

Each of the audio compression-decompression subsystems 218A and 218B preferably includes a Motorola digital signal processing ICs DSP56000. The Motorola DSP56000 IC is more completely described in a DSP56000 Digital Signal Processor

User's Manual A19562-4 published by Motorola Inc. that is incorporated herein by reference. In addition to the DSP56000 IC, each audio compression-decompression subsystems 218A-218B includes a boot ROM and static RAM.

Each of the audio compression-decompression subsystems 218A-218B receives digitized audio data, respectively via a digitized stereo input bus 232A or 232B, from a pair of Analog-to-Digital Converters ("ADCs") 234A or 234B. The ADCs 234A and 234B are preferably a CS4215 dual ADC manufactured by Crystal Semiconductor Corporation of Austin, Texas. The ADCs 234A and 234B respectively receive stereo audio signals from the stereo input port 44A or 44B. Under the control of a computer program executed by each audio compression-decompression subsystem 218, the subsystem 218 compresses digitized audio data received from the ADCs 234 in accordance with a compression standard selected from the numerous different existing audio compression standards, or in accordance with a audio compression technique developed at some future date. The compressed audio data thus produced by each audio compression-decompression subsystem 218 is then transferred over the compression-decompression card bus 204 from the audio compression-decompression subsystem 218 to the RAM pool 212.

If the SCSI-1 bus 74 of a compression-decompression card 42 that has compressed audio data stored in its RAM pool 212 connects to the random access data storage subsystem 78, then that compressed audio data may be transferred through the SCSI controller 208D directly to the random access data storage subsystem 78 via the SCSI-1 bus 74. If the SCSI-1 bus 74 of the compression-decompression card 42 does not connect to the random access data storage subsystem 78, then compressed audio data in the RAM pool 212 must first be transferred via one of the SCSI-2 buses 72A-72C from the RAM pool 212 of the compression-decompression card 42 having the compressed audio data to the RAM pool 212 of another compression-decompression card 42 or of a communication subsystem board 62 whose SCSI-1 bus 74 connects to the random access data storage subsystem 78. After the compressed audio data has been thus transferred from the RAM pool 212 of one compression-decompression card 42 to the

RAM pool 212 of another compression-decompression card 42, or of a communication subsystem board 62, it may then be transferred through the SCSI controller 208D to the random access data storage subsystem 78 via one of the SCSI-1 buses 74A-74D.

Compressed audio data stored in the random access data storage subsystem 78 may be converted to stereo audio signals for transmission from the stereo output ports 46A or 46B of the compression-decompression card 42 essentially by reversing the process described above for converting stereo audio signals into stored compressed audio data. Thus, compressed audio data to be transmitted from the stereo output port 46A or 46B is transferred from the random access data storage subsystem 78 to the RAM pool 212 of one of the compression-decompression cards 42 either directly, via one of the SCSI-1 buses 74A-74D, or indirectly via one of the SCSI-1 buses 74A-74D and one of the SCSI-2 buses 72A-72C. The computer program executed by one of the audio compression-decompression subsystems 218A or 218B then fetches the compressed audio data from the RAM pool 212 and decompresses it into digitized stereo audio data. After the computer program executed by the audio compression-decompression subsystems 218A or 218B has thus produced the digitized stereo audio data, that data passes over a digitized stereo output bus 236A or 236B to a pair of Digital-to-Analog converters ("DACs") 238A or 238B. Upon receiving the digitized stereo data from the audio compression-decompression subsystems 218A or 218B, the pair of DACs 238A or 238B converts the digitized stereo data into stereo audio signals for transmission from the stereo output port 46A or 46B of the compression-decompression card 42.

Analogously to the audio compression-decompression subsystems 218A and 218B, the CODECs 216A and 216B included in each of the compression-decompression cards 42 operate to convert video signals into compressed video data for storage in the random access data storage subsystem 78, and to convert compressed video data stored in the random access data storage subsystem 78 back into video signals. FIG. 4 depicts in greater detail one embodiment of a CODEC 216 suitable for inclusion in the compression-decompression card 42. The

particular embodiment of the CODEC 216 depicted in FIG. 4 includes an Integrated Information Technology, Inc. ("IIT") Vision Controller ("VC") IC 252, and a pair of IIT Vision Processor ("VP") ICs 254 and 256. The VC IC 252 and the VP ICs 254 and 256 are manufactured by Integrated Technology, Inc. of Santa Clara, California.

The VC IC 252 included in each of the CODECs 216A and 216B may receive compressed video data from the RAM pool 212 via the compression-decompression card bus 204, the transceivers 214, and a compressed video data bus 262. The VC IC 252 may also transmit compressed video data back to the RAM pool 212 over that same path. The VC IC 252 may also receive uncompressed digitized video data from a video decoder 264 included in each of the video decoders-encoders 228A and 228B over a video data bus 266. The video decoder 264 illustrated in the embodiment depicted in FIG. 4 is preferably a Philips SAA7151A IC, manufactured by Philips Components-Signetics of Sunnyvale, California. The VC IC 252 may also transmit video data over the video data bus 266 to a video encoder 268 that is also included in each of the video decoders-encoders 228A and 228B. The video encoder 268 illustrated in the embodiment depicted in FIG. 4 is preferably a Philips SAA7199 IC, also manufactured by Philips Components-Signetics of Sunnyvale, California.

The video decoder 264 receives digitized video data via a digitized video input bus 272 from an ADC 274. The ADC 274 receives an analog video signal from the video input port 54. The ADC 274 is preferably a Philips TDA8708 IC, also manufactured by Philips Components-Signetics of Sunnyvale, California. The preferred video encoder 268 includes a DAC for producing an analog video signal on the video output port 56. Therefore, the video decoder-encoder 228 depicted in FIG. 4 does not separately illustrate a DAC IC. However, if a different IC were used for the video encoder 268, then a DAC might be required between the output of the video encoder 268 and the video output port 56.

In addition to the VC IC 252 and the VP ICs 254 and 256, the CODEC 216 includes a 2M byte or larger frame buffer dynamic RAM 282 that is accessed via a CODEC bus 284 by the VC IC 252

and the VP ICs 254 and 256. The CODEC 216 also includes a 32k byte boot ROM 286 and a 32k byte static RAM 288 that are accessible only to the VC IC 252. Similarly, each VP IC 254 and 256 accesses a 32k byte static RAM 292.

In the process of converting an analog video signal supplied to the compression-decompression card 42 through one of the video input ports 54A or 54B of either of the two compression-decompression cards 42 into compressed video data for storage in the random access data storage subsystem 78, the video decoder 264 receives the analog video signal from one of the video input ports 54A or 54B and digitizes it into uncompressed video data. The digitized video data thus obtained is then transmitted over the video data bus 266 to the VC IC 252. A computer program executed by the VC IC 252 controls the passage of data through the CODEC 216, and the processing of that data into Huffman encoded compressed video data by the VC IC 252 and by one or the other of the two VP ICs 254 or 256. In processing video data received from the video decoder 264, the VC IC 252 preprocesses that data, supplies the preprocessed video data to either one or the other of the two VP ICs 254 or 256, supervises compression of the video data by the VP IC 254 or 256, performs Huffman coding on the compressed data produced by the VP IC 254 or 256, and transmits the now Huffman encoded compressed video data to the RAM pool 212.

In converting compressed video data from the random access data storage subsystem 78 into an analog video signal to be transmitted from one of the video output ports 56A or 56B of the compression-decompression card 42, the VC IC 252 receives Huffman coded compressed video data from the RAM pool 212, performs Huffman decoding, supplies the Huffman decoded video data to either one or the other of the two VP ICs 254 or 256, supervises decompression of the video data by the VP IC 254 or 256, generates digital pixel video data from the decompressed video data produced by the VP IC 254 or 256, and transmits the video data thus obtained over the video data bus 266 to the video encoder 268. Upon receiving the video data from the VC IC 252 over the video data bus 266, the video encoder 268

converts it into an analog video signal for transmission from the video output port 56A or 56B of this compression-decompression card 42.

Because the CODEC 216 illustrated in FIG. 4 includes two VP ICs 254 and 256, it can use the VC IC 252 and one of the VP ICs 254 or 256 to compress video data received over the video data bus 266 from the video decoder 264 and store the compressed video data into the RAM pool 212 while simultaneously using the VC IC 252 and the other VP IC 256 or 254 to decompress compressed video data received from the RAM pool 212 and transmit it over the video data bus 266 to the video encoder 268. Because the VC IC 252, the VP IC 254, and the VP IC 256 all operate under software control, they may be readily adapted to compress video data in accordance with the H.261, the JPEG or the MPEG standards, or in accordance with a video compression technique developed at some future date. Similarly, the VC IC 252, the VP IC 254, and the VP IC 256 may be readily adapted for decompressing video data that has been compressed in accordance with any of these three standards, or some future technique.

During the operation of each CODEC 216 and each video decoder-encoder 228 for compressing a video signal and/or for decompressing compressed video data, the control processor 206 transmits signals over the compression-decompression card control bus 222 to the CODEC 216 and to the video decoder-encoders 228 for controlling the operation. These control signals may select various features of the video decoder 264 and/or the video encoder 268 such as enabling the processing of either Phase Alternation Line ("PAL") or National Television Systems Committee ("NTSC") video signals, adjusting the contrast, tint, hue, color level, sharpness, coring, etc. of the picture, or other features of the video decoder 264 and/or the video encoder 268. For the CODEC 216, the control signals received over the compression-decompression card control bus 222 from the control processor 206 may select the type of compression and/or decompression, e.g. H.261, MPEG or JPEG, size and location of the image being compressed or decompressed, video timing, etc.

There exist other ICs that may be used for the CODEC 216 in addition to the VC IC 252 and VP ICs 254 and 256 manufactured by IIT. For example, LSI Logic Corporation of Milpitas, California offers a set of ICs that may be used to implement the CODEC 216. Another set of ICs that may be used to implement the CODEC 216 is the X64000 set of ICs sold by GC Technology Corporation of Tokyo, Japan.

As described above, each compression-decompression card 42 provides the video file server 20 with an authoring capability that permits easily storing program material that is available in the form of a conventional audio signal or a conventional video signal into the random access data storage subsystem 78 as compressed audio data or as compressed video data. For example, the video signal for Cable Network News ("CNN") could be supplied to one of the video input ports 54A or 54B of one of the compression-decompression cards 42 included in the video file server 20 and stored in compressed form in the random access data storage subsystem 78 or in the archive data storage subsystem 82.

The compression-decompression card 42 also provides the video file server 20 with a compression standard conversion capability. This capability for converting between two different, incompatible video compression standards may be effected in two different ways. Video compression conversion may be effected digitally by suitably processing the data within a single CODEC 216. Alternatively, video compression conversion may be effected through video signals by coupling the video output port 56 from a video decoder-encoder 228A or 228B to its video input port 54. Analogously, audio compression standard conversion may be performed either digitally in the audio compression-decompression subsystems 218A-218B, or by coupling a stereo output port 46 from a DAC 238 to a stereo input port 44 of a ADC 234.

Industrial Applicability

Operation of the video file server 20 as described above permits supplying all subscriber systems 66 requesting a specific item of video data, e.g., a movie, a music video, or

any other program that is stored in the random access data storage subsystem 78, with the requested video data without restricting the access of any subscriber system to the video data; and without restricting the manipulation, e.g., fast forwarding, rewinding, temporarily stopping, or displaying slowly, of the video data by any subscriber system 22.

While the preceding disclosure has been generally made with reference to an ISDN communication channel, the video file server 20 of the present invention may be readily adapted for use with other comparatively narrow bandwidth communication channels other than ISDN communication channels. Such alternative communication channels include mere twisted wire pairs within only a single building or a portion of a building, for example, a school or a Karaoke business establishment.

Because all the functional elements of the adaptive video file server 20 of the present invention are programmable and because the video file server 20 can convert video data compressed in accordance with one compression standard into a different, mutually incompatible standard, it can facilitate a wide variety of different, real-time interactive communication services. Thus, a video file server 20 in accordance with the present invention can first transmit compressed video data from its random access data storage subsystem 78; and then, perhaps in response to a request from the subscriber system 66, augment the stored video data with a real-time video communication to a different subscriber system 66. For example, during a sequence of transmissions to a subscriber system 66 in which the video file server 20 transmits video data relating to travel, in response to a request from the subscriber system 66, the video file server 20 could first establish an ISDN communication channel with a second subscriber system 66 of a travel supplier such as an airline, hotel, etc.; and then the video file server 20 could permit individuals at the two the subscriber systems 66 to conduct a video telephone conference even though both subscriber systems 66 respectively communicate in mutually incompatible video data compression formats.

In an application of the video file server 20 such as that described in the immediately preceding paragraph, because the video data relating to travel may be a stationary image, e.g., an image of a page in an airline schedule, it may be transmitted from the video file server 20 to the subscriber system 66 at a comparatively high resolution, perhaps in accordance with an image compression standard such as JPEG. Subsequently, while the video file server 20 is transmitting compressed video data for moving images to the subscriber system 66, e.g., a video of activities at a resort, or while a video telephone conference is being conducted between the subscriber systems 66 through the video file server 20, video data, compressed in accordance with a different compression standard such as H.261 or MPEG, may be exchanged between the video file server 20 and each of the subscriber systems 66. Thus, the video file server 20 of the present invention is capable of inserting compressed video data for a single stationary image between segments of compressed video data for moving images, and conversely.

Because all the functional elements of the adaptive video file server 20 of the present invention are programmable, it can also be programmed to provide an interactive video game environment in which subscribers playing a game can encounter each other, visually observe each other, and communicate with each other within the game playing environment and rules established by the computer program being executed by the video file server 20. The video file server 20 may provide a game playing environment that is either real-time or not real-time. If the game playing environment is not real time, players may use the video file server 20 to leave messages and/or clues for their opponents, or they may personalize the game playing environment.

For example, the video file server 20 may be used in conducting a "quick draw" contest between two individuals respectively present at subscriber systems 66 located at a distance from each other. In conducting such a "quick draw" contest, each subscriber system 66 transmits compressed video data to the video file server 20 which then retransmits compressed video data onto the other subscriber system 66. In

conducting such a "quick draw" contest, the video file server 20 may provide the contestants with a signal indicating when they should begin drawing their respective guns. Moreover, by analyzing the compressed video data received from each of the subscriber system 66, the video file server 20 may determine if either of the participants moves before the video file server sends the signal indicating that they should begin drawing their respective guns, and penalize a participant if they move too soon. Analogously, such a contest could be conducted wherein only a single individual located at a subscriber system 66 competes in a "quick draw" contest with an image of an opponent stored in the random access data storage subsystem 78.

A video file server 20 in accordance with the present invention may be readily used as a historical video archive, analogous to a newspaper's clipping file, that stores news items in the form of videos. That is, video signals for news items could be supplied to the video input ports 54A and 54B of the video file server 20 for storage as compressed video data in the random access data storage subsystem 78 or in the archive data storage subsystem 82. Subsequently, that compressed video data could be retrieved from random access data storage subsystem 78 and/or the archive data storage subsystem 82 during the production of a news program such as that produced by CNN.

While the specific embodiment of the video file server 20 described thus far discloses its use only with ISDN primary access and basic access communication channels, the video file server 20 of the present invention is readily adaptable for use with other types of digital communication channels, even digital communication channels capable of a much higher data transfer rates provided by ISDN primary access. Thus, it is envisioned that the video file server 20 of the present invention may be readily adapted for communicating over a Very Small Aperture Terminal ("VSAT") communication channel, or over any type of digital communication channel, including both electronic or optical digital communication channels whether dedicated or shared, including shared digital communication

channels provided by local area networks such as Ethernet®, token ring, or ArcNet®.

A deficiency in the video file server 20 as described thus far is that a particular item of compressed video data present in only one of the main units 32A, 32B or 32C is accessible to the other main units 32 in the video file server 20 only via the Ethernet® 28 that interconnects the main unit controllers 34 in each of the main units 32. If the video file server 20 requires a higher performance communication capability for compressed video data among the main units 32 than that provided by the Ethernet® 28, then SCSI-1 buses 74 of the compression-decompression cards 42 and/or the communication subsystem boards 62 that are not connected to the SCSI-1 buses 74A-74D within a main unit 32 may be used for interconnecting the main units 32. Interconnecting the compression-decompression cards 42 and/or communication subsystem boards 62 of the main units 32 by means of SCSI-1 buses 74 makes compressed video data stored in the random access data storage subsystem 78 and/or archive data storage subsystem 82 of any of the main units 32 rapidly accessible to any of the compression-decompression cards 42 and/or communication subsystem boards 62 in any of the main units 32.

Although the present invention has been described in terms of the presently preferred embodiment, it is to be understood that such disclosure is purely illustrative and is not to be interpreted as limiting. Consequently, without departing from the spirit and scope of the invention, various alterations, modifications, and/or alternative applications of the invention will, no doubt, be suggested to those skilled in the art after having read the preceding disclosure. Accordingly, it is intended that the following claims be interpreted as encompassing all alterations, modifications, or alternative applications as fall within the true spirit and scope of the invention.

The Claims

What is claimed is:

1. A video file server for storing compressed video data and transmitting compressed video data to a plurality of subscriber systems, said video file server comprising:

a main unit controller for controlling transmission of compressed video data to subscriber systems;

a random access data storage subsystem for storing compressed video data and from which such data is randomly retrievable; and

a plurality of communication subsystems, all of said communication subsystems operating in response to commands from said main unit controller, each communication subsystem also receiving control data transmitted from a particular one of the subscriber systems to said communication subsystem, such control data received from the subscriber system requesting that said communication subsystem transmit specific video data stored in said random access data storage subsystem back to the subscriber system, responsive to the control data received from the subscriber system said communication subsystem transmitting control data to said random access data storage subsystem for causing said random access data storage subsystem to retrieve the specific video data and to supply such data to said communication subsystem for transmission to said subscriber system, all subscriber systems being able to concurrently request transmission of the same specific video data from the communication subsystem from which they respectively receive video data and all of said communication subsystems together with said random access data storage subsystem concurrently supplying all subscriber systems with the same specific video data.

2. The video file server of claim 1 wherein said communication subsystems are adapted for exchanging data with subscriber systems over twisted pair of wires, said communication subsystems receiving control data from subscriber systems over twisted pairs of wires and transmitting compressed

video data back to subscriber systems over twisted pairs of wires.

3. The video file server of claim 1 wherein said communication subsystems are adapted for exchanging data with subscriber systems over Integrated Services Digital Network ("ISDN") primary access communication channels, said communication subsystems receiving control data from subscriber systems over said ISDN primary access communication channels and transmitting compressed video data back to subscriber systems over said ISDN primary access communication channels.

4. The video file server of claim 1 further comprising a compressed video data format conversion subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said compressed video data format conversion subsystem being adapted for receiving video data from said communication subsystem or from said random access data storage subsystem that is compressed in accordance with a first compression standard, and transmitting such video data compressed in accordance with a second compression standard that differs from the first compression standard to said communication subsystem or to said random access data storage subsystem.

5. The video file server of claim 4 further comprising a video data compression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data compression subsystem being adapted for receiving a video signal, compressing the video signal in accordance with a compression standard specified by said main unit controller, and transmitting the compressed video data to said random access data storage subsystem or to said communication subsystem.

6. The video file server of claim 5 further comprising a video data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video data to produce a video signal, and transmitting the video signal thus generated.

7. The video file server of claim 6 further comprising an audio compression and audio data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed audio data with said communication subsystem or with said random access data storage subsystem, said audio compression and audio data decompression subsystem being adapted for receiving an audio signal, compressing the audio signal in accordance with a compression standard specified by said main unit controller, and transmitting the compressed audio data to said random access data storage subsystem, said audio compression and audio data decompression subsystem also being adapted for receiving compressed audio data from said random access data storage subsystem, decompressing such audio data to produce an audio signal, and transmitting the audio signal thus generated.

8. The video file server of claim 7 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

9. The video file server of claim 6 further comprising an archive data storage subsystem for storing compressed video

data and from which such data is sequentially retrievable, said archive data storage subsystem being responsive to control data transmitted by said communication subsystem to said archive storage subsystem for causing said archive data storage subsystem to retrieve compressed video data and to supply such data to said communication subsystem for transmission to said subscriber system or to said random access data storage subsystem.

10. The video file server of claim 9 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

11. The video file server of claim 6 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

12. The video file server of claim 5 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

13. The video file server of claim 4 further comprising a video data decompression subsystem responsive to commands

from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video data to produce a video signal, and transmitting the video signal thus generated.

14. The video file server of claim 13 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

15. The video file server of claim 1 further comprising a video data compression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data compression subsystem being adapted for receiving a video signal, compressing the video signal in accordance with a compression standard specified by said main unit controller, and transmitting the compressed video data to said random access data storage subsystem or to said communication subsystem.

16. The video file server of claim 15 further comprising a video data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video

data to produce a video signal, and transmitting the video signal thus generated.

17. The video file server of claim 16 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

18. The video file server of claim 15 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

19. The video file server of claim 1 further comprising a video data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video data to produce a video signal, and transmitting the video signal thus generated.

20. The video file server of claim 19 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating

accounting charges for transmission of video data to said subscriber systems.

21. The video file server of claim 1 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

22. A video file server for storing video data and transmitting compressed video data to a plurality of subscriber systems, said video file server comprising:

a main unit controller for controlling transmission of compressed video data to subscriber systems;

a random access data storage subsystem for storing compressed video data and from which such data is randomly retrievable;

a plurality of communication subsystems, all of said communication subsystems operating in response to commands from said main unit controller, each communication subsystem also receiving control data transmitted from a particular one of the subscriber systems to said communication subsystem, such control data received from the subscriber system requesting that said communication subsystem transmit specific video data stored in said random access data storage subsystem back to the subscriber system, responsive to the control data received from the subscriber system said communication subsystem transmitting control data to said random access data storage subsystem for causing said random access data storage subsystem to retrieve the specific video data and to supply such data to said communication subsystem for transmission to said subscriber system; and

compressed video data format conversion subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said

communication subsystem or with said random access data storage subsystem, said compressed video data format conversion subsystem being adapted for receiving video data from said communication subsystem or from said random access data storage subsystem that is compressed in accordance with a first compression standard, and transmitting such video data compressed in accordance with a second compression standard that differs from the first compression standard to said communication subsystem or to said random access data storage subsystem.

23. The video file server of claim 22 wherein said communication subsystems are adapted for exchanging data with subscriber systems over twisted pair of wires, said communication subsystems receiving control data from subscriber systems over twisted pairs of wires and transmitting compressed video data back to subscriber systems over twisted pairs of wires.

24. The video file server of claim 22 wherein said communication subsystems are adapted for exchanging data with subscriber systems over Integrated Services Digital Network ("ISDN") primary access communication channels, said communication subsystems receiving control data from subscriber systems over said ISDN primary access communication channels and transmitting compressed video data back to subscriber systems over said ISDN primary access communication channels.

25. The video file server of claim 22 further comprising a video data compression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data compression subsystem being adapted for receiving a video signal, compressing the video signal in accordance with a compression standard specified by said main unit controller, and transmitting the compressed video data to said random

access data storage subsystem or to said communication subsystem.

26. The video file server of claim 25 further comprising a video data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video data to produce a video signal, and transmitting the video signal thus generated.

27. The video file server of claim 26 further comprising an audio compression and audio data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed audio data with said communication subsystem or with said random access data storage subsystem, said audio compression and audio data decompression subsystem being adapted for receiving an audio signal, compressing the audio signal in accordance with a compression standard specified by said main unit controller, and transmitting the compressed audio data to said random access data storage subsystem, said audio compression and audio data decompression subsystem also being adapted for receiving compressed audio data from said random access data storage subsystem, decompressing such audio data to produce an audio signal, and transmitting the audio signal thus generated.

28. The video file server of claim 27 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

29. The video file server of claim 26 further comprising an archive data storage subsystem for storing compressed video data and from which such data is sequentially retrievable, said archive data storage subsystem being responsive to control data transmitted by said communication subsystem to said archive storage subsystem for causing said archive data storage subsystem to retrieve compressed video data and to supply such data to said communication subsystem for transmission to said subscriber system or to said random access data storage subsystem.

30. The video file server of claim 29 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

31. The video file server of claim 26 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

32. The video file server of claim 25 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

33. The video file server of claim 22 further comprising a video data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video data to produce a video signal, and transmitting the video signal thus generated.

34. The video file server of claim 33 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

35. The video file server of claim 22 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video file server to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

36. A video data format conversion system for receiving video data from a first subscriber system and for retransmitting such video data to a second subscriber system, said video data format conversion system comprising:

a main unit controller for controlling transmission of compressed video data to subscriber systems;

a plurality of communication subsystems, all of said communication subsystems operating in response to commands from

said main unit controller, a first one of said communication subsystems receiving from the first subscriber system control data and video data, the video data from the first subscriber system being compressed in accordance with a first compression standard, a second one of said communication subsystems receiving control data from the second subscriber system and transmitting to the second subscriber system video data that is compressed in accordance with a second compression standard that is incompatible with the first compression standard; and

compressed video data format conversion subsystem responsive to commands from said main unit controller, said compressed video data format conversion subsystem receiving video data from said first communication subsystem that is compressed in accordance with the first compression standard, and transmitting such video data compressed in accordance with the compression standard to the second communication subsystem whereby said video data format conversion system permits the first and the second subscriber systems to exchange video data.

37. The video data format conversion system of claim 36 wherein said communication subsystems are adapted for exchanging data with subscriber systems over twisted pair of wires, said communication subsystems receiving control data from subscriber systems over twisted pairs of wires and transmitting compressed video data back to subscriber systems over twisted pairs of wires.

38. The video data format conversion system of claim 36 wherein said communication subsystems are adapted for exchanging data with subscriber systems over ISDN primary access communication channels, said communication subsystems receiving control data from subscriber systems over said ISDN primary access communication channels and transmitting compressed video data back to subscriber systems over said ISDN primary access communication channels.

39. The video data format conversion system of claim 36 further comprising a video data compression subsystem

responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data compression subsystem being adapted for receiving a video signal, compressing the video signal in accordance with a compression standard specified by said main unit controller, and transmitting the compressed video data to said random access data storage subsystem or to said communication subsystem.

40. The video data format conversion system of claim 39 further comprising a video data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video data to produce a video signal, and transmitting the video signal thus generated.

41. The video data format conversion system of claim 40 further comprising an audio compression and audio data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed audio data with said communication subsystem or with said random access data storage subsystem, said audio compression and audio data decompression subsystem being adapted for receiving an audio signal, compressing the audio signal in accordance with a compression standard specified by said main unit controller, and transmitting the compressed audio data to said random access data storage subsystem, said audio compression and audio data decompression subsystem also being adapted for receiving compressed audio data from said random access data storage subsystem, decompressing such audio data to produce an audio signal, and transmitting the audio signal thus generated.

42. The video data format conversion system of claim 41 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video data format conversion system to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

43. The video data format conversion system of claim 40 further comprising an archive data storage subsystem for storing compressed video data and from which such data is sequentially retrievable, said archive data storage subsystem being responsive to control data transmitted by said communication subsystem to said archive storage subsystem for causing said archive data storage subsystem to retrieve compressed video data and to supply such data to said communication subsystem for transmission to said subscriber system or to said random access data storage subsystem.

44. The video data format conversion system of claim 43 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video data format conversion system to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

45. The video data format conversion system of claim 40 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video data format conversion system to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

46. The video data format conversion system of claim 39 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video data format conversion system to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

47. The video data format conversion system of claim 36 further comprising a video data decompression subsystem responsive to commands from said main unit controller and capable of exchanging compressed video data with said communication subsystem or with said random access data storage subsystem, said video data decompression subsystem being adapted for receiving compressed video data from said communication subsystem or from said random access data storage subsystem, decompressing such video data to produce a video signal, and transmitting the video signal thus generated.

48. The video data format conversion system of claim 47 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video data format conversion system to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

49. The video data format conversion system of claim 36 further comprising a management operation center system for receiving data from said main unit controller, said main unit controller reporting to said management operation center system transmission of video data by said video data format conversion system to subscriber systems, said management operation center system periodically generating accounting charges for transmission of video data to said subscriber systems.

50. A method for transmitting compressed video data from a video file server to a plurality of subscriber systems in response to requests received from the subscriber systems by a plurality of communication subsystems equal in number to the plurality of subscriber systems, the communication subsystems being included in the video file server, all subscriber systems being able to concurrently request transmission of the same specific video data from the file server and the file server concurrently providing the requested specific video data to all subscriber systems, the method comprising the steps of:

storing compressed video data in a random access data storage subsystem from which such data is randomly retrievable;

each communication subsystem, upon receiving control data from the subscriber system requesting transmission of specific video data, transmitting control data to the random access data storage subsystem requesting the retrieval of compressed video data stored therein and the supplying of compressed video data by the random access data storage subsystem to the communication subsystem;

the random access data storage subsystem, upon receiving control data from the communication subsystem requesting retrieval of compressed video data, supplying compressed video data to the communication subsystem for transmission to the subscriber system from which the communication subsystem received control data; and

the communication subsystem, upon receiving compressed video data, transmitting the specific video data to the subscriber system from which the request was received.

51. The method of claim 50 wherein the subscriber system is adapted to receive video data compressed in accordance with a first compression standard and the video data stored in the random access data storage subsystem is compressed in accordance with a second compression standard that differs from the first compression standard, the compressed video data supplied by the random access data storage subsystem being received by a compressed video data format conversion subsystem

before compressed video data is received by the communication subsystem, the method further comprising the steps of:

the compressed video data format conversion subsystem receiving video data compressed in accordance with the second compression standard from the random access data storage subsystem; and

the compressed video data format conversion subsystem transmitting video data compressed in accordance with the first compression standard to the communication subsystem.

52. The method of claim 51 further comprising the steps of:

a main unit controller detecting that compressed video data stored in the random access data storage subsystem in the first compression standard is being repetitively converted to the first conversion standard prior to its transmission by the communication subsystem to the subscriber system; and

the main unit controller causing the video data, after being compressed in accordance with the first conversion standard, to also be stored in the random access data storage subsystem whereby the compressed video data may subsequently be transmitted to a subscriber system adapted to receive video data compressed in accordance with the first conversion standard without being received by the compressed video data format conversion subsystem.

53. The method of claim 52 further comprising the steps of:

the main unit controller reporting to a management operation center system transmission of video data to subscriber systems; and

the management operation center periodically generating accounting charges for transmission of video data to subscriber systems.

54. The method of claim 51 further comprising the steps of:

a main unit controller reporting to a management operation center system transmission of video data to subscriber systems; and

the management operation center periodically generating accounting charges for transmission of video data to subscriber systems.

55. The method of claim 50 further comprising the steps of:

retrieving compressed video data from an archive data storage subsystem from which such data is sequentially retrievable; and

storing the compressed video data retrieved from the archive data storage subsystem into said random access data storage subsystem from which such data is randomly retrievable.

56. The method of claim 55 further comprising the steps of:

a main unit controller reporting to a management operation center system transmission of video data to subscriber systems; and

the management operation center periodically generating accounting charges for transmission of video data to subscriber systems.

57. The method of claim 50 further comprising the steps of:

a main unit controller reporting to a management operation center system transmission of video data to subscriber systems; and

the management operation center periodically generating accounting charges for transmission of video data to subscriber systems.

58. A method for storing compressed video data into a random access data storage subsystem included in a video file server, the method comprising the steps of:

a video data compression subsystem included in the video file server receiving a video signal, the video data compression subsystem compressing the video signal in accordance with a specified compression standard to obtain compressed video data, and transmitting the compressed video data thus obtained to a random access data storage subsystem; and

storing the compressed video data into the random access data storage subsystem from which such data is randomly retrievable.

59. A method for transmitting a video signal from a video file server in which compressed video data is stored in a random access data storage subsystem from which such data is randomly retrievable, the method comprising the steps of:

the random access data storage subsystem retrieving compressed video data stored therein, and transmitting the compressed video data to a video data decompression subsystem included in the video file server; and

the video data decompression subsystem receiving the compressed video data from the random access data storage subsystem, decompressing the video data in accordance with a specified compression standard to obtain a video signal, and transmitting the video signal thus obtained.

60. A method for transmitting compressed audio data from a video file server to a plurality of subscriber systems in response to requests received from the subscriber systems by a plurality of communication subsystems equal in number to the plurality of subscriber systems, the communication subsystems being included in the video file server, all subscriber systems being able to concurrently request transmission of the same specific audio data from the file server and the file server concurrently providing the requested specific audio data to all subscriber systems, the method comprising the steps of:

storing compressed audio data in a random access data storage subsystem from which such data is randomly retrievable;

each communication subsystem, upon receiving control data from the subscriber system requesting transmission of specific audio data, transmitting control data to the random access data storage subsystem requesting the retrieval of compressed audio data stored therein and the supplying of compressed audio data by the random access data storage subsystem to the communication subsystem;

the random access data storage subsystem, upon receiving control data from the communication subsystem requesting retrieval of compressed audio data, supplying compressed audio data to the communication subsystem for transmission to the subscriber system from which the communication subsystem received control data; and

the communication subsystem, upon receiving compressed audio data, transmitting the specific audio data to the subscriber system from which the request was received.

61. A method for storing compressed audio data into a random access data storage subsystem included in a video file server, the method comprising the steps of:

an audio compression-decompression subsystem included in the video file server receiving an audio signal, the audio compression-decompression subsystem compressing the audio signal in accordance with a specified compression standard to obtain compressed audio data, and transmitting the compressed audio data thus obtained to a random access data storage subsystem; and

storing the compressed audio data into the random access data storage subsystem from which such data is randomly retrievable.

62. A method for transmitting an audio signal from a video file server in which compressed audio data is stored in a random access data storage subsystem from which such data is randomly retrievable, the method comprising the steps of:

the random access data storage subsystem retrieving compressed audio data stored therein, and transmitting the

compressed audio data to an audio compression-decompression subsystem included in the video file server; and

the audio compression-decompression subsystem receiving the compressed audio data from the random access data storage subsystem, decompressing the audio data in accordance with a specified compression standard to obtain an audio signal, and transmitting the audio signal thus obtained.

63. A method for playing a game comprising the steps of:

transmitting compressed video data that includes an image of the gaming environment from a video file server to a first subscriber system;

the video file server receiving compressed video data that includes an image of a first individual participating in the game from the first subscriber system; and

the video file server analyzing the compressed video data received from the first subscriber system to assess whether the compressed video data conforms with rules for playing the game that are stored within the video file server.

64. The method of claim 63 further comprising the steps of:

the video file server receiving compressed video data that includes an image of a second individual participating in the game from a second subscriber system; and

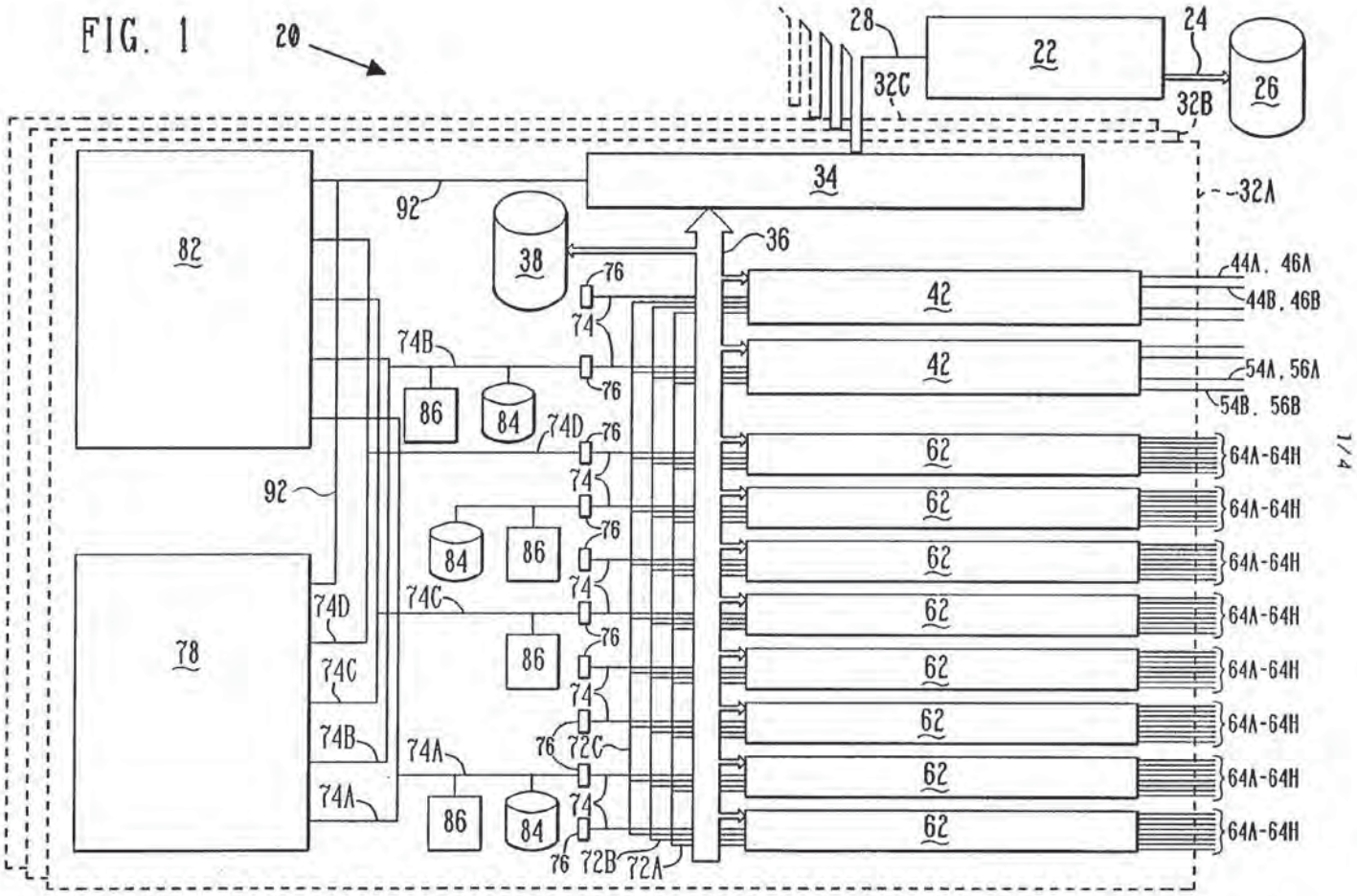
including video data from the second subscriber system in the compressed video data transmitted to the first subscriber system.

65. The method of claim 64 wherein the first subscriber system is adapted to receive video data compressed in accordance with a first compression standard and the second subscriber system is adapted to transmit video data compressed in accordance with a second compression standard that differs from the first compression standard, the method further comprising the step of:

the video file server converting the compressed video data received from the second subscriber system into video data

compressed in accordance with the first compression standard.

FIG. 1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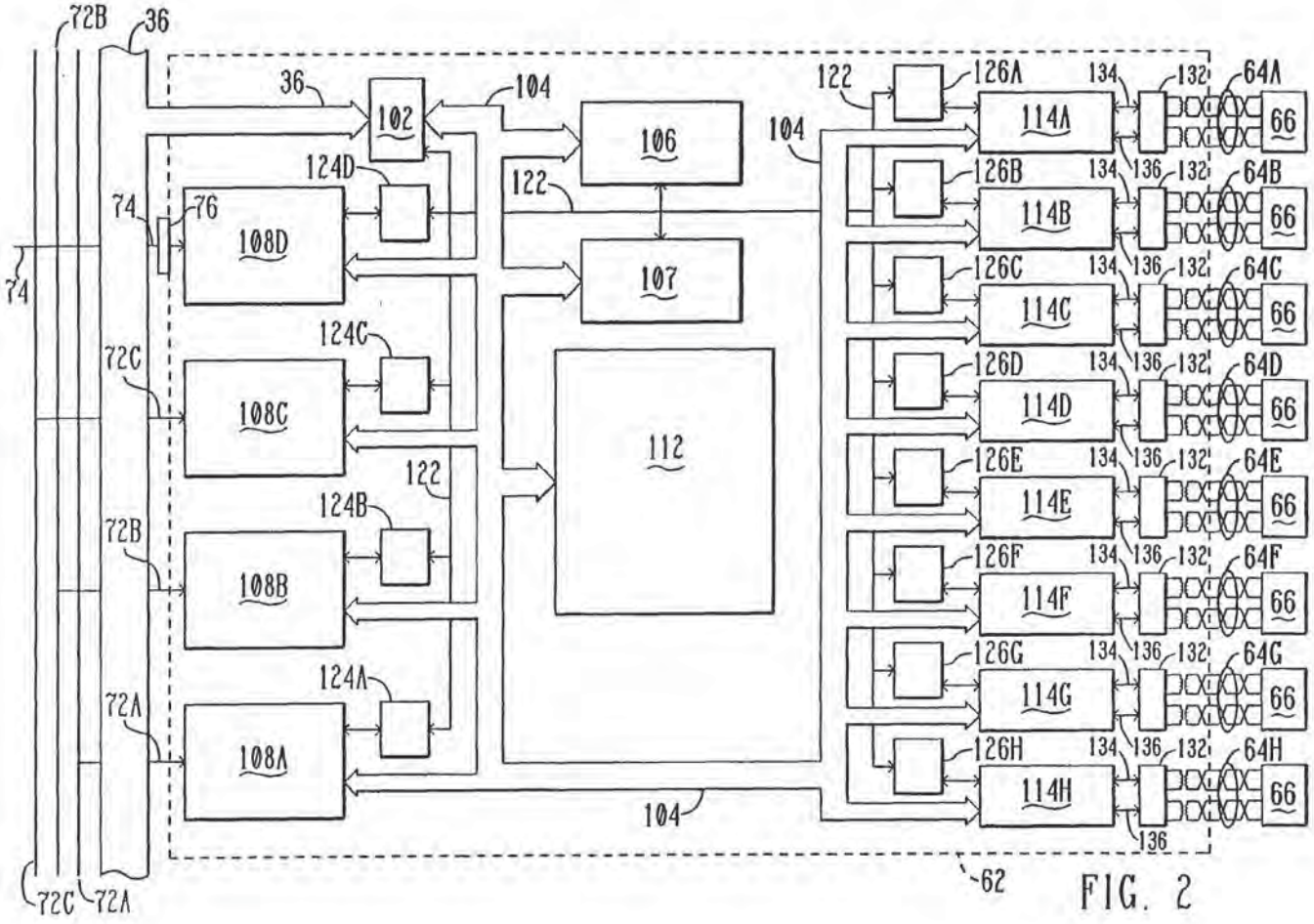
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FIG. 2

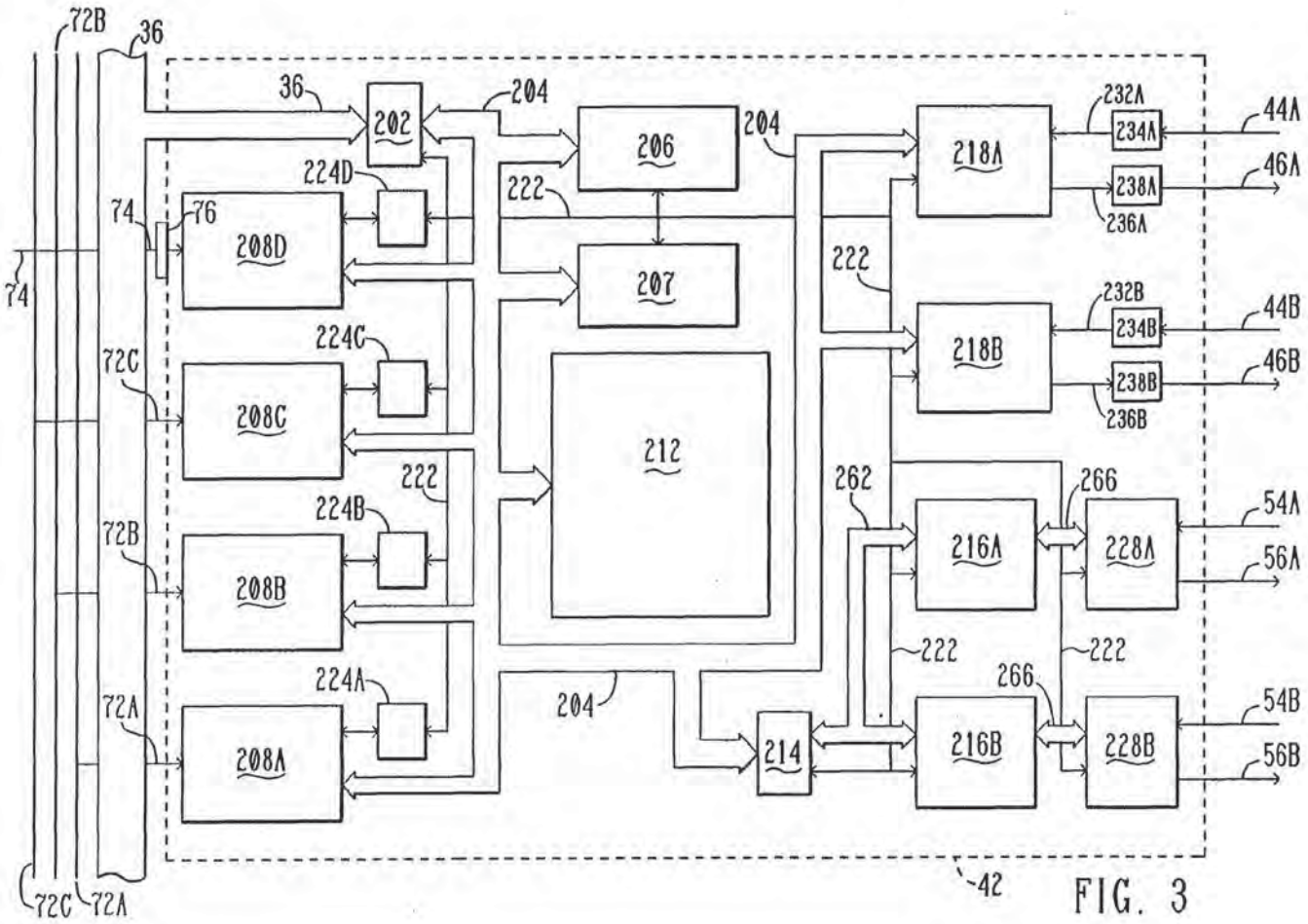
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FIG. 3

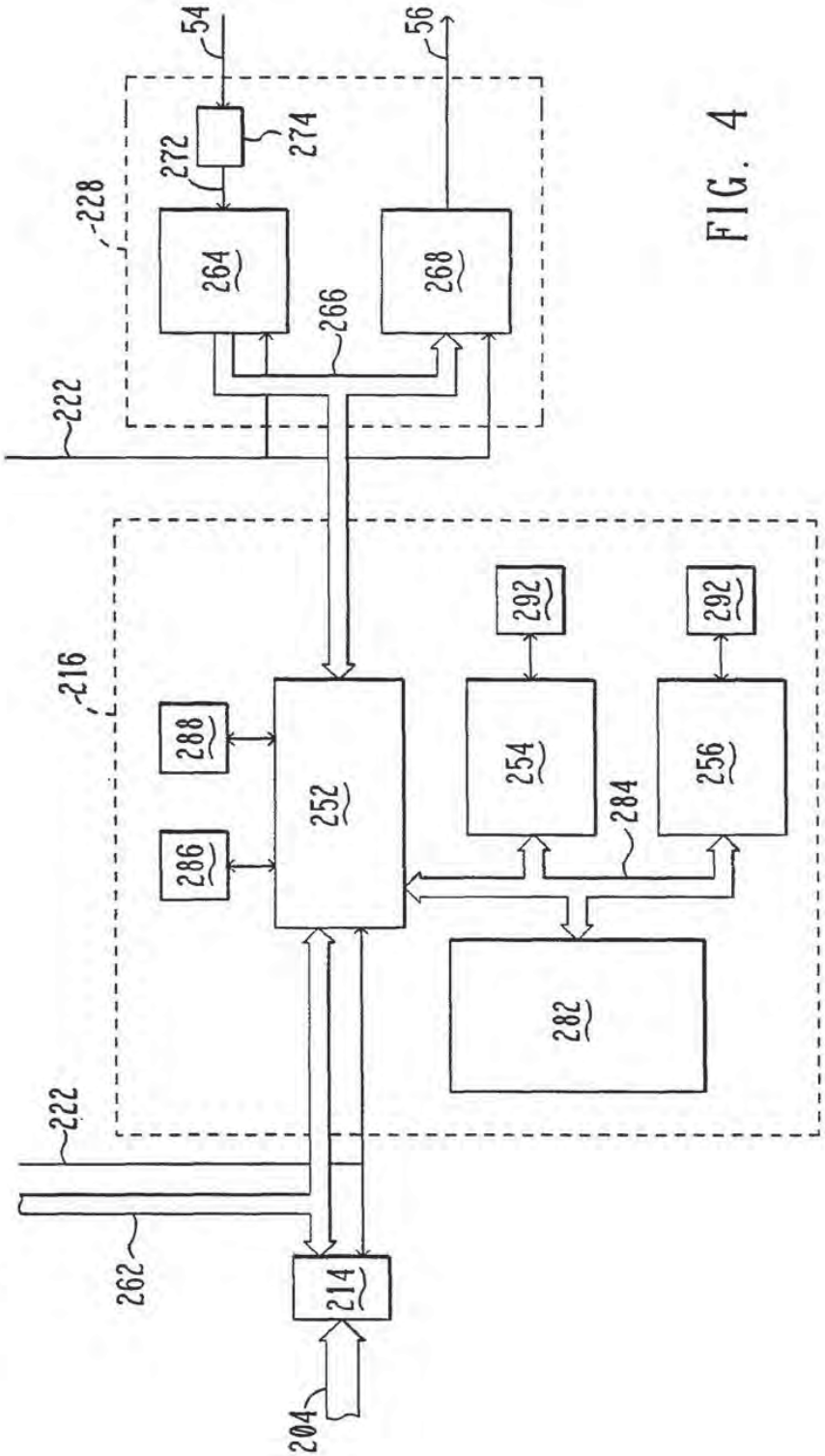
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FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/01084

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04N 7/173
US CL :358/85, 86; 379/102, 105; 455/4, 5
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 358/85, 86; 379/102, 105; 455/4, 5

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,506,387 (Walter) 19 March 1985 See abstract.	1-65
Y	US, A, 4,829,372 (McCalley et al) 09 May 1989, see abstract.	1-65
Y	US, A, 4,890,320 (Monslow et al) 26 December 1989, see abstract.	1-65
Y	US, A, 4,949,187 (Cohen) 14 August 1990 See abstract.	1-65
Y	US, A, 4,975,771 (Kassatly) 04 December 1990, see abstract.	1-65

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 09 SEPTEMBER 1992	Date of mailing of the international search report 02 NOV 1992
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer Ngoc-No Nguyen Tm WING FU CHAN NGUYEN NGOC-NO INTERNATIONAL DIVISION Telephone No. (703) 305-4732

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(54) Title: TELEVISION SET WITH A BUFFER MEMORY

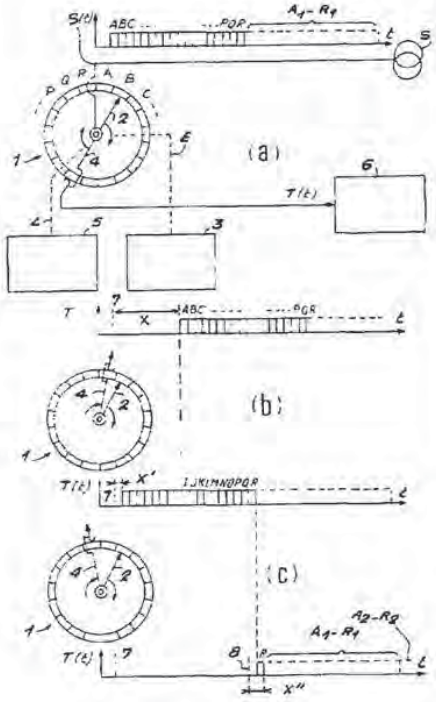
(54) Titre: RECEPTEUR DE TELEVISION A MEMOIRE TAMPON

(57) Abstract

A television set provided with internal devices (1, 3, 5) for generating a delayed source signal in order to affect the magnitude (X) of the delay and enable a portion of the programme being watched to be replaced or skipped. The invention relates particularly to colour television and television sets incorporating video signal compression and decompression devices.

(57) Abrégé

L'invention a pour objet un récepteur de télévision équipé de moyens internes (1, 3, 5) destinés à produire un signal source différé, afin d'agir sur l'ampleur (X) du différé pour permettre la relecture ou l'escamotage d'une tranche du programme en cours de visualisation. L'invention s'applique notamment à la télévision en couleurs et aux récepteurs de télévision incorporant des moyens de compression et de décompression des signaux vidéo.



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Récepteur de télévision à mémoire tampon

La présente invention se rapporte aux récepteurs de télévision. Lorsqu'on visualise sur l'écran d'un récepteur de télévision une séquence d'images animées, les signaux reçus sont directement appliqués aux moyens de visualisation. De ce fait, le téléspectateur est prisonnier du déroulement du programme reçu et s'il veut intervenir sur ce déroulement, il ne peut que changer de programme. Lors de l'utilisation d'un magnétoscope, il est possible de relire un passage du programme enregistré sur la bande magnétique ou de sauter un passage jugé sans intérêt. Ces fonctions sont obtenues par une modification des conditions de défilement de la bande magnétique face aux têtes magnétiques. Lorsqu'on ne désire pas mettre en oeuvre un magnétoscope pour obtenir ces fonctions, il est nécessaire de prévoir à l'intérieur du téléviseur des moyens permettant de différer dans le temps la lecture des images constituant le signal reçu. En effet, la relecture d'un passage suppose que son contenu soit conservé un certain temps dans le récepteur et le saut d'un passage n'est concevable que comme la réduction d'un traitement en différé des signaux provenant du syntonisateur ou de la prise de péritélévision. On voit donc que le téléviseur doit être équipé d'une mémoire tampon capable d'emmagasiner un grand nombre d'images et d' une commande d'adressage permettant la simulation d'un saut dans le temps portant sur un groupe d'images et la récupération automatique imperceptible des conditions de lecture préexistantes.

L'invention a donc pour objet un récepteur de télévision comprenant des moyens d'obtention d'un signal source représentatif d'une séquence d'images animées et des moyens d'affichage permettant la visualisation de ladite séquence, caractérisé en ce qu'il qu'il comporte des moyens internes permettant d'appliquer en différé ledit signal source auxdits moyens d'affichage; ledit différé subissant un changement de valeur à la demande et reprennant automatiquement sa valeur initiale pour satisfaire une demande ultérieure; ledit différé étant produit par une mémoire tampon ayant une contenance de plusieurs images.

L'invention a également pour objet un dispositif comportant des moyens de transmission en différé d'une séquence d'images animées via une mémoire tampon associée à des moyens d'adressage en écriture et en lecture, ledit différé subissant un changement brusque de valeur à la demande et reprennant automatiquement sa valeur initiale pour satisfaire une demande ultérieure, ladite mémoire tampon ayant une capacité suffisante pour contenir plusieurs images de ladite séquence, caractérisé en ce que ledit changement brusque de valeur est au choix positif ou négatif, afin d'offrir la possibilité de répéter et celle d'escamoter une portion de ladite séquence.

L'invention sera mieux comprise au moyen de la description ci-après et des figures annexées, parmi lesquelles:

La figure 1 schématise les moyens internes d'un récepteur de télévision selon l'invention et leur application à la fonction qui permet l'escamotage d'un groupe d'images.

La figure 2 représente les moyens de la figure 1 appliqués à la fonction relecture

La figure 3 est un schéma de récepteur de télévision équipé d'une mémoire tampon et de moyens de compression-décompression des images à charger et à extraire de ladite mémoire.

La figure 4 est un organigramme précisant les modalités de fonctionnement d'un système de gestion des adresses de la mémoire tampon illustrée dans les figures qui précèdent.

Sur la figure 1, on peut voir en (a) une mémoire 1 capable d'emmagasiner une séquence d'images animées provenant d'une source S. Cette mémoire comporte N zones affectées au stockage des images A,B,C,....PQR et pour mieux illustrer le fonctionnement cyclique, ces zones sont disposées en boucle fermée. Le signal S(t) à incrire dans la mémoire 1 comporte une suite de N images A,B,C,.....,PQR, suivie par une autre suite A_1-R_1. Pour symboliser la fonction écriture, on a représenté un bras 2 qui assure le chargement du signal S(t) dans les zones de la mémoire 1.Ce bras tourne dans le sens des aiguilles d'une montre en adressant une nouvelle zone à chaque nouvelle image. La

commande du bras 2 dépend d'une adresse de zone fournie via une ligne d'écriture E par un circuit 3 d'adressage en écriture. Sur la figure 1, en (a), on a supposé que la séquence A,B,C,....,P,Q,R a commencé à être chargée lorsque le bras 2 était pointé vers le haut, l'instant précis du début de ce chargement étant noté 7 sur les diagrammes temps de la figure 1. La lecture de la mémoire 1 est symbolisée par un autre bras 4 tournant aussi dans le sens des aiguilles d'une montre, mais qui retarde par rapport au bras 2. Sur la figure 1, en (a) le décalage est d'un demi tour. L'adressage en lecture est symbolisé par une ligne L reliée à un circuit 5 d'adressage en lecture. La lecture donne naissance à un signal T(t) qui est une séquence d'images A,B,C,....,P,Q,R comme celle du signal S(t), mais dont la restitution débute X intervalles images après l'instant référencé 7. Le signal de lecture T(t) est appliqué aux moyens d'affichage 6 d'un téléviseur muni de la mémoire 1 et des moyens produisant le signal source S(t). La phase de fonctionnement normal est supposée correspondre au maintien de ce décalage de X intervalles images.

D'après ce qui précède, on voit que la mémoire est rafraichie après chaque rotation complète du bras 2. Lorsque le décalage temporel entre la lecture et l'écriture est constant et n'excède pas la période de rafraichissement, on observe sur l'écran du téléviseur un programme retardé, puisque les images ont été émises par la source S avant d'être affichées.

L'utilisateur du téléviseur peut vouloir escamoter un passage du programme, comme celà se produit avec un magnétoscope lorsqu'on agit sur la commande d'avance rapide. Cette commodité connue sous le vocable " Fast Forward " permet de rapprocher dans le temps deux parties de programme séparées par exemple par un spot publicitaire, ce spot étant carrément éliminé si le rapprochement est soudain et si le saut présente l'amplitude appropriée. Cette commodité est illustrée en (b) sur la figure 1 où l'on voit que le bras lecteur 4 a été avancé vers le bras d'écriture 2 pour écourter l'intervalle qui sépare la lecture de l'écriture. L'intervalle passe de X à X' au moment où débutait la lecture de la séquence A,B,C,...,P,Q,R, si bien que les images A à H sont lues à

cadence accélérée ou sont purement et simplement escamotées si le passage est instantané, comme supposé sur la figure 1 en (b). Cette seconde phase de fonctionnement illustre un premier aspect de l'invention.

Un second aspect de l'invention consiste à récupérer automatiquement et progressivement les conditions initiales, c'est à dire le retard X, après avoir utilisé la commande " Fast Forward ". On suppose donc que ce qui reste de la séquence A,B,C,....,P,Q,R a été affiché et qu'à l'instant 8, on commence le chargement de la séquence A_1-R_1 On voit en (c) sur la figure 1 que l'on augmente d'une unité le décalage entre la zone chargée et la zone lue. Ceci entraine un redoublement de la lecture de l'image R lequel est immédiatement suivi de la lecture de la séquence A_1-R_1. On constate que le retard de la séquence écrite par rapport à la séquence lue est devenu X" = X' + 1. Lors de la lecture de la séquence A_2-R_2, on procèdera au redoublement de l'image R_1 ce qui aura pour effet de porter le retard à X" + 1. Au bout d'un certain temps, on retrouve le retard X, ce qui met fin à la phase de récupération et permet la réutilisation de la commande " Fast Forward ".

Si l'on part de la situation initiale illustrée en (a) sur la figure 1, on peut souhaiter revoir un passage du programme qui vient juste d'être affiché sur l'écran du téléviseur. Cette commodité, également offerte par les magnétoscopes, correspond à la commande de marche arrière, connue sous le vocable "Instant Replay". On l'obtient avec le système de la figure 1 en augmentant le retard du bras 4 par rapport au bras 2. Ceci constitue un troisième aspect de l'invention qui est illustré par la figure 2.

Sur la figure 2, en (a) on retrouve la situation correspondant à la partie (a) de la figure 1. En (b), sur la figure 2, on voit que le bras de lecture 4 a pivoté dans le sens inverse des aiguilles d'une montre pour venir juste à côté du bras 2. Grâce à ce déplacement, le signal de lecture accuse un retard X plus important. Si ce changement a lieu brusquement lorsqu'on a affiché l'image H, on constate en (b) que l'image suivante est

de nouveau A. On est donc en mesure de visualiser une seconde fois le passage comportant les images A à H.

Selon un quatrième aspect de l'invention , après avoir exécuté un "Instant Replay", il faut revenir progressivement à la situation initiale. Lors d'un deuxième cycle d'écriture débutant à l'instant 8 du détail (c) de la figure 2, on s'arrange pour obtenir un retard de lecture dont la valeur X" est inférieure d'une unité à X'. La différence entre le signal de lecture T(t) représenté en (a) et en (c) réside dans l'escamotage de l'image R, de sorte que la séquence suivante A_1-Q_1 est lue immédiatement après l'image Q. Ce retrait d'une image sera répété cycle après cycle, afin de ramener le retard à sa valeur initiale X.

Si l'on se contente de l'une des deux commandes " Fast Forward " et " Instant Replay ", l'état initial du bras 4 peut être situé juste après, ou juste avant la position de début d'écriture du bras 2. Sur les figures 1 et 2 les deux possibilités ont été prévues, mais on pourrait offrir le choix entre disposer des deux commandes ou n'avoir accès qu'à l'une d'elles avec une amplitude de retard doublée.

Dans la description qui précède, on a indiqué comment coopéraient une source de signal S, une mémoire tampon 1, des circuits de commande 3 et 5 et des moyen d'affichage 6. Ce qui est vrai pour l'image s'applique également au son d'accompagnement qui peut être associé au signal video par échantillonage, quantification et multiplexage temporel. Un téléviseur mettant en oeuvre l'invention est composé des moyens illustrés sur la figure 3.

Les signaux audio-video sont produits par un tuner 9 ou obtenus à partir d'une prise de péritélévision. Un circuit de décodage couleur et son 10 traite ces signaux et délivre des composantes images Y,U,V auxquelles est associé un signal son W. Ces signaux sont appliqués à un convertisseur analogique-numérique 11 qui les quantifie et les multiplexe.Le signal son échantillonné et multiplexé est adressé à une mémoire dédiée en vue du déroulement d'un processus de lecture différée tel que décrit ci-dessus. Les signaux video numériques issus du convertisseur 11 sont envoyés sur l'une des voies d'un commutateur 12 qui les affectent à un circuit encodeur-décodeur 15 qui réalise des

opérations de compression et de décompression permettant d'obtenir des débits de 1 à 15 Mbits/s en vue du stockage des images dans une mémoire 16 qui regroupe les moyens 1,3 et 5 précédemment décrits. Cette mémoire peut présenter une capacité extensible obtenue en rajoutant des modules qui se présentent par exemple sous la forme de cartes à puce. L'autre voie du commutateur 12 est reliée d'une part à une mémoire de trame 17 et à l'entrée d'un convertisseur numérique-analogique 13. La sortie du convertisseur 13 est reliée à l'entrée d'un circuit de matriçage RVB 14 qui alimente les moyens d'affichage 6. Dans l'exemple schématisé sur la figure 3, l'encodeur-décodeur 15 est un processeur JPEG-MPEG (compression intra-image, compatible MPEG) travaillant en half-duplex à raison de 15 images/s. Le commutateur 12 commute à 30 Hz ou à 25 Hz selon la norme de télévision envisagée. Dans cette réalisation, la mémoire de trame est relue deux fois pour éviter le papillotement. Sans s'écarter du domaine de l'invention, on peut aussi envisager un fonctionnement en full-duplex. Dans ce cas, le schéma de la figure 3 ne comporte plus de commutateur 12 et on utilise sous la référence 15 un simple encodeur. Il faut alors rajouter un décodeur entre la mémoire 16 et le convertisseur numérique-analogique 13.

La mise en oeuvre d'une lecture différée à décalage temporel ajustable, tel qu'elle a été décrite, peut être basée sur une mémoire à semiconducteur comportant par exemple quatre puces de 16 Mbits pour réaliser des sauts temporels de l'ordre de la minute.

Sans s'écarter du domaine de l'invention, on peut envisager d'utiliser une mémoire magnétique comportant par exemple une bande sans fin associée à des têtes d'écriture et de lecture à entrefer. On peut modifier la longueur de bande qui sépare ces têtes pour réaliser les fonctions évoquées ci-dessus, ce qui revient à disposer d'un magnétoscope interne ayant une bande de faible longueur en boucle fermée et un mécanisme de transport de bande particulier. Dans une telle éventualité, il n'est pas nécessaire de numériser l'information à inscrire sur la bande.

On peut aussi envisager de placer dans le récepteur de télévision un enregistreur-lecteur à disque magnéto-optique muni de têtes de lecture et d'écriture indépendantes, afin de positionner la tête de lecture n'importe où à l'intérieur de la plage du disque utilisée par la tête d'écriture pour stocker sous forme binaire une séquence d'images animées. Si l'on adopte un disque à vitesse angulaire constante et un enregistrement d'une image par tour, on peut, par des déplacements radiaux importants, faire varier rapidement le différé de la lecture et moyennant des sauts de piste à piste le ramener le à sa valeur initiale. Un disque dur du genre utilisé en informatique est également envisageable comme mémoire tampon, à condition de prévoir des têtes indépendantes pour l'écriture et la lecture des données.

Pour réaliser une lecture différée portant sur un grand nombre d'images, il est nécessaire d'adopter un codage approprié, afin que la mémoire tampon stocke chaque image sous la forme d'un signal comprimé. L'image restituée après décodage est normalement de qualité inférieure à l'image originale. Il est donc avantageux de réaliser un dispositif à mémoire tampon qui conserve un certain nombre d'images pour revoir un passage de séquence d'images animées, mais qui, en temps normal, n'emprunte pas la voie retardée. Dans cette variante de réalisation, le signal S(t) est directement transmis vers le dispositif d'affichage 6, afin de conserver la meilleure qualité d'image possible. Ce n'est qu'en présence du mode "Instant Replay" que le dispositif d'affichage est commuté sur la mémoire tampon 1. Dans le mode "Fast Forward", on utilise normalement le contenu de la mémoire tampon, de sorte que la qualité d'image est liée au processus de compression-décompression. L'utilisateur pourra adopter un compromis entre la qualité d'image et l'ampleur du différé grâce à une commande fixant le taux de compression et partant, l'étendue de la zone mémoire affectée à chaque image.

Les organigrammes (a) et (b) de la figure 4 illustrent les principales étapes du processus à mettre en oeuvre pour gérer par microprocesseur la mémoire tampon 1. On a supposé que cette mémoire tampon est capable de stocker K images, le différé se situant initialement

à la valeur D qui représente le nombre d'images entre l'adresse d'écriture et l'adresse de lecture; D sera, par exemple, voisin de la demi capacité K/2. La fonction "Instant Replay" pourra porter au maximum sur Q images successives et la fonction "Fast Forward" sur R images successives. Les adresses d'écriture sont obtenues à partir d'une variable N. En (a) sur la figure 4, on voit qu'en partant de la condition initiale N=D et P=0, P étant l'adresse de lecture, on effectue l'opération de la case 18, c'est à dire N modulo(K) pour obtenir l'adresse d'écriture de la première image. La case 19 indique le chargement à cette adresse de l'image source et la case 20 procède à l'incrémentation de N. Parallèlement, le processus illustré en (b) indique le traitement appliqué à l'adresse de lecture. Lorsqu'on est dans les conditions de lecture sans appel aux fonctions " Relecture " ou " Avance rapide ", on effectue le contenu de la case 21, de la case 22, de la case 27 et de la case 33. Celà revient à évaluer l'adresse de lecture, à extraire l'image à cette adresse pour l'afficher et à incrémenter P d'une unité. Les branchements conditionnels 23,24 et 28 se font sur la réponse "NON". L'incrémentation simultanée des adresses d'écriture et de lecture maintient une différence N-P égale à D.

Si l'on commande une relecture, le branchement conditionnel 23 commande l'opération $X=-X_R$, où X est une variable système que l'on retrouve à la case 33. La valeur $-X_R$ est au plus égale à Q. L'adresse de lecture est changée dès le prochain cycle du processus, ce qui va engendrer un branchement conditionnel de la case 28 à la case 29 et si la variable N modulo(Y) est nulle, un branchement de 29 à 30 pour exécuter l'opération de la case 31 ou 32 qui incrémente ou décrémente P. Grâce à cette phase de fonctionnement, le changement d'adresse de lecture intervenu va se résorber imperceptiblement à raison d'un décalage d'une image toutes les Y images.

Un fonctionnement du même genre s'applique au cas d'une avance rapide, mais il met en jeu le branchement sur la case 26 qui porte X à la valeur $+X_A$ ayant pour limite supérieure R. Le branchement conditionnel 30 sélectionne l'incrémentation ou la décrémentation, afin de résorber le décalage des adresses de lecture et de retrouver un

décalage D sans que l'on s'aperçoive de l'insertion ou du retrait d'une image dans la séquence d'images animées.

Il va sans dire que la détermination des adresses d'écriture et de lecture pourrait se faire en logique cablée, notamment au moyen de compteurs d'adresses appropriés.

REVENDICATIONS

1. Dispositif comportant des moyens de transmission en différé d'une séquence d'images animées, ledit différé étant obtenu par l'écriture et la lecture desdites images dans une mémoire tampon d'une capacité suffisante pour contenir plusieurs desdites images, des moyens étant prévus pour faire subir audit différé un changement brusque de valeur à la demande, suivi par une reprise automatique et progressive de sa valeur initiale, caractérisé en ce que lesdits moyens de transmission en différé sont internes à un récepteur de télévision et relient les moyens de réception délivrant ladite séquence aux moyens d'affichage permettant la visualisation de ladite séquence.

2. Dispositif comportant des moyens de transmission en différé d'une séquence d'images animées via une mémoire tampon associée à des moyens d'adressage en écriture et en lecture, ledit différé subissant un changement brusque de valeur à la demande et reprennant automatiquement sa valeur initiale pour satisfaire une demande ultérieure, ladite mémoire tampon ayant une capacité suffisante pour contenir plusieurs images de ladite séquence, caractérisé en ce que ledit changement brusque de valeur est au choix positif ou négatif, afin d'offrir la possibilité de répéter et celle d'escamoter une portion de ladite séquence.

3. Dispositif selon l'une quelconque des revendications 1 et 2, caractérisé en ce que lesdits moyens de transmission différée comprennent: un support d'information inscriptible et effaçable, des moyens assurant le défilement dudit support face à une tête d'enregistrement et à une tête de lecture et des moyens de déplacement de ladite tête de lecture, pour modifier sa position dans la plage dudit support explorée par ladite tête d'enregistrement.

4. Dispositif selon la revendication 3, caractérisé en ce que ledit support d'information comporte un matériau d'enregistrement magnétique.