IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF TEXAS
CORPUS CHRISTI DIVISION

TWO-WAY MEDIA LLC,

Plaintiff,

v.

AMERICA ONLINE, INC.,

Defendant.

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CIVIL ACTION
NO. C-04-089

JURY TRIAL DEMANDED

COMPLAINT

Plaintiff Two-Way Media LLC ("TWM") brings this action against America Online, Inc. ("AOL") for patent infringement arising out of the Patent Laws of the United States, Title 35, United States Code.

I. PARTIES

1. All facts herein are alleged on information and belief except those facts concerning TWM's own activities.

2. TWM is a Nevada corporation with its principal place of business at 380 Boulder Street, Minturn, Colorado 81645. TWM is the owner of various patents relating to methods and systems for providing audio and visual information over a communication network.

3. AOL is a Delaware corporation with its principal place of business at 22000 AOL Way, Dulles, Virginia 20166. AOL may be served with this complaint through its registered agent, Corporation Service Company, located at 701 Brazos Street, Suite 1050, Austin, Texas 78701.

II. JURISDICTION AND VENUE

4. This is an action for patent infringement under the Patent Act, 35 U.S.C. § 271. AOL provides infringing services in the Southern District of Texas. This Court has personal jurisdiction over AOL, in part, because AOL has members who reside in the Southern District of Texas and AOL provides infringing online services to its members in this district. This Court has subject matter jurisdiction by virtue of Section 1338(a) of Title 28, United States Code. Venue in this Court is proper by virtue of Sections 1391(b) and (c) and 1400(b) of Title 28, United States Code.

III. BACKGROUND

A. TWM and the TWM Patents

5. TWM's predecessor in interest, Netcast Communications Corp. ("Netcast"), is one of the early pioneers of technology that allows Internet users to listen to music and other audio programming over the Internet without having to wait for the entire music or program to download. This technology is sometimes referred to as "live streaming." Live streaming allows users to receive and listen to a radio station over the Internet at approximately the same time as the signals for that radio station are transmitted. TWM's technology performs useful functions in connection with live streaming. For example, TWM's technology permits collection of information about the listening habits of users, insertion of advertising content into live streaming signals, and the combination of various e-commerce opportunities with live streaming (*e.g.,* buying music CDs that relate to a song that the user is listening to).

6. TWM has filed numerous patent applications that cover audio and visual streaming technology. On July 7, 1998, the United States Patent and Trademark Office issued the first of these utility patent applications. Specifically, United States Patent No. 5,778,187 (the

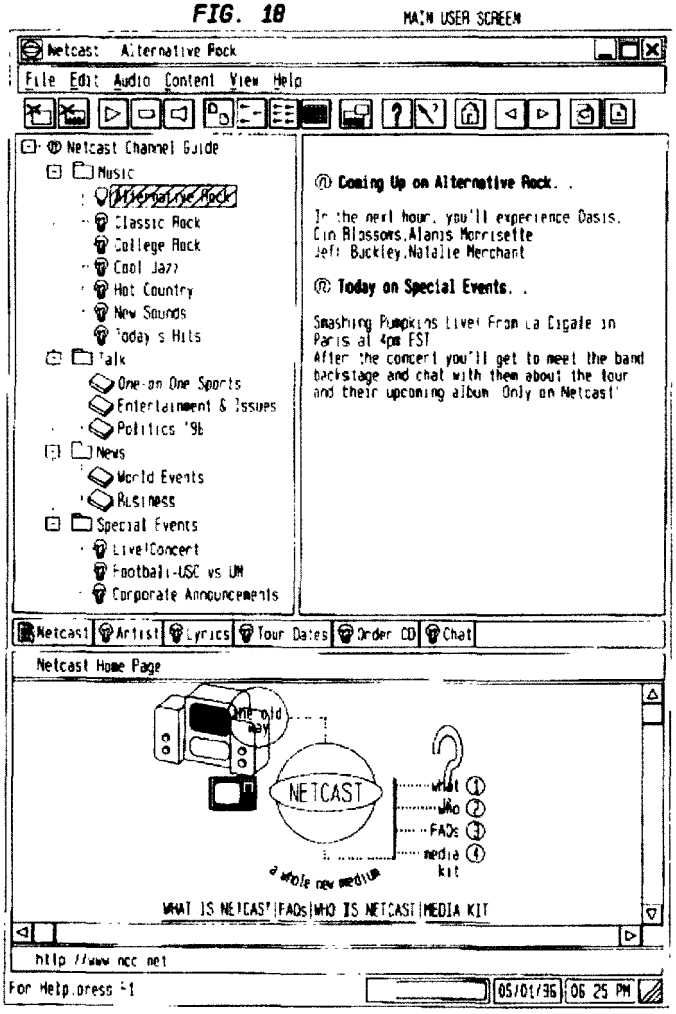
"'187 Patent") was duly and legally issued to Netcast as the legal assignee of the inventors, Antonio M. Monteiro and James F. Butterworth. The title of the '187 Patent is "Multicasting Method and Apparatus." A true and correct copy of the '187 Patent is attached as Exhibit "A." Thereafter, the United States Patent Office issued other patents on TWM's technology, including U.S. Patent No. 5,983,005 (the "'005 Patent"), which issued on November 9, 1999, and U.S. Patent No. 6,434,622 B1 (the "'622 Patent"), which issued on August 13, 2002. A true and correct copy of the '005 Patent is attached as Exhibit "B" and a true and correct copy of the '622 Patent is attached as Exhibit "C." The '005 Patent and the '622 Patent are continuations of the '187 Patent and bear the same title as the '187 Patent. The '187 Patent, the '005 Patent and the '622 Patent collectively constitute the "TWM Patents." In 2002, Netcast sold the TWM Patents to Netcast Innovations Ltd., which later in 2002 changed its name to TWM.

7. Before a user can listen to a radio station over the Internet, the analog transmission signals of a traditional radio station must first be converted to digital signals. This is because computers can only process data or signals that are digital, *i.e.,* data that has been converted to a format consisting of zeros and ones. The incoming radio signals are received by a central facility, which typically converts the analog signals to digital signals that computers can understand. This central facility then feeds digitized radio signals to various computers or servers, which transmit the radio signals to users across the Internet and monitor the reception of the signals by the users. The servers may play a role in ensuring that each user receives the particular station of the user's choosing and that the user receives the signals at substantially the same time as the signals are transmitted from the original source (*e.g.,* the actual physical radio station, such as 102.7 KIIS FM located in Los Angeles).

8. In order to listen to a particular radio station over the Internet, a user must first

select the desired station from a list of available stations on the user's personal computer ("PC"). Figure 18 of the '187 Patent (reproduced below) illustrates this process. Figure 18 is one example of what a user's PC screen might look like. The screen in Fig. 18 is divided into three main sections: a channel guide (upper left frame), program guide (upper right frame) and a multimedia frame (lower half of the screen). The channel guide lists all available stations or genres of music that are available to the user. The user may select a desired station or genre by simply clicking on it. In Fig. 18, for example, the user has selected "Alternative Rock." The program guide section provides information about the selected station. In Fig. 18, for example, this section informs the user what artists are coming up in the selected Alternative Rock genre. The multimedia frame section provides various other features, such as e-commerce and chat. In Fig. 18, for example, the user can order a music CD of the song he or she is listening to by clicking on the "Order CD" tab or button.

FIG. 18



9. While the user is viewing or listening to the selected station, one or more of the servers may monitor the user's reception of the selected station and capture certain information about the viewing or listening habits of the user. The information that may be captured may include, for example, the identity of the specific radio program or channel that the user is listening to, how long the user listens to that channel, and when the user starts and stops listening to the channel. Additionally, the server computers may have the ability to insert advertising into the signals that are sent to users. The content of the advertising may be varied based on the identity of the user such that the advertising may be targeted to different demographics.

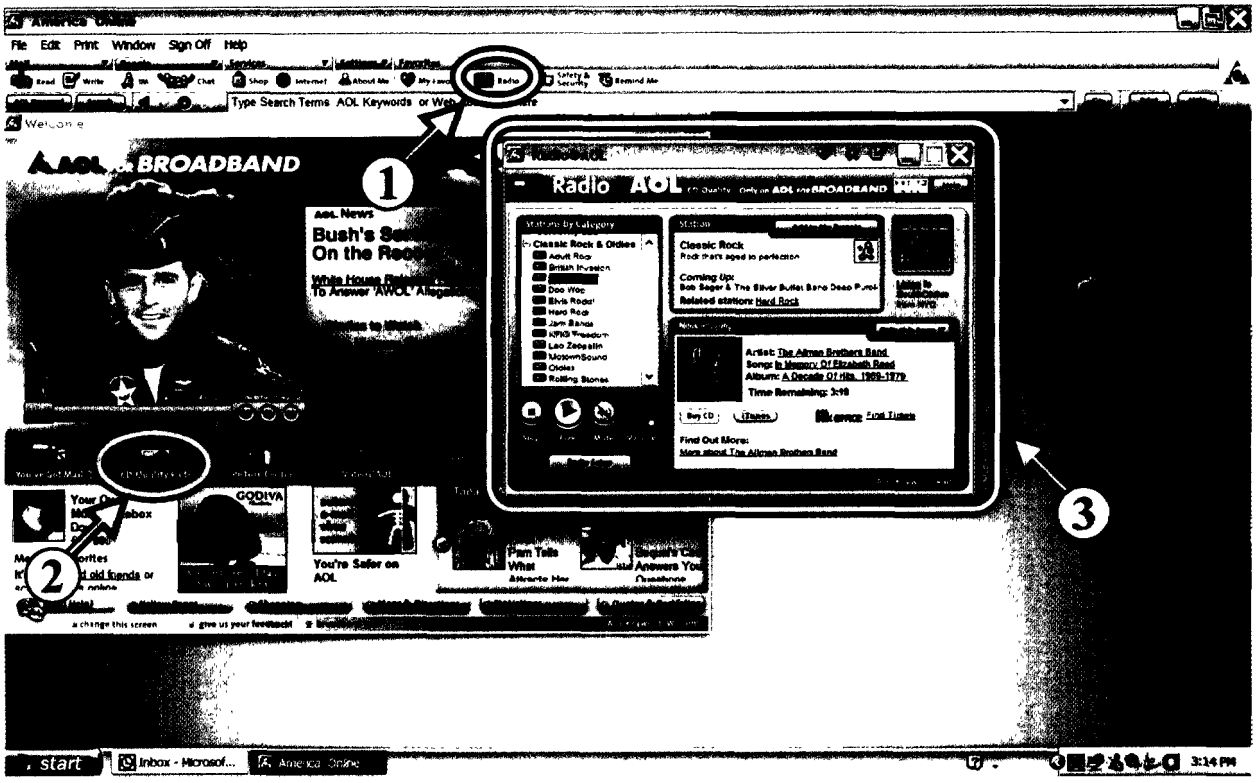
B. AOL and AOL's Infringing Services

10. After TWM invented its technology, streaming of audio and/or visual information over the Internet became one of the most popular Internet activities. Arbitron Internet Broadcast Ratings ("Arbitron"), a highly respected third-party Internet broadcasting reporter, regularly publishes statistics regarding top Internet radio broadcasters. The December 2003 Arbitron report on the top ten Internet radio broadcasters shows that last December, for these ten Internet radio broadcasters alone, more than ten (10) million users listened to over sixty (60) million hours of Internet radio. *See* Exhibit "D." The same report shows that AOL's radio broadcasting service is the number one Internet radio broadcasting service, both in terms of number of users and number of hours. *Id.* With more than 4.5 million users listening to over 26 million hours of radio over the Internet during the month of December 2003 alone, AOL accounts for almost half of all of the users and the hours for all Arbitron-rated Internet broadcasters combined. *Id.*

11. In addition to providing Internet radio listening, AOL is engaged in the business of providing other online services and Internet access to its members. To be an AOL member, a user must sign up and agree to pay a subscription fee for the membership. AOL has more than 30 million members worldwide, most of whom reside in the United States. As noted above, many of the AOL members use AOL's Internet radio service. AOL's annual subscription fee revenues exceed $5 billion in the United States and $8 billion worldwide. In addition, AOL generates revenues from advertising fees and sales generated from e-commerce activities that are combined with the content delivered to its users.

12. In order to receive AOL's Internet radio services, generally an AOL member must install AOL-provided user software on his or her computer ("AOL Client Software"). As can be seen from AOL Client Software's main page for members (reproduced below), AOL provides

buttons along the top of the page that provide quick access to a few select AOL services. Those buttons represent AOL's most popular and most used services. For example, the AOL screen-shot below shows buttons for quick access to email, chat and shopping services. Among the quick access buttons for the most popular AOL services is a "Radio" button (shown below within an oval labeled "1"). Similarly, in the middle of the screen-shot below, AOL has a second and larger quick access button entitled "CD Quality Radio" along with a large radio icon (shown below within an oval labeled "2"). When a user selects either the "Radio" button at the top of screen or the "CD Quality Radio" button in the middle of the screen, the user is immediately connected with AOL's Internet radio services. As seen in the screen-shot below, a window entitled "Radio@AOL" appears (shown below in the foreground to the main user page, within a rectangular box labeled "3") when an AOL member selects either of the quick access radio buttons. The inclusion of these quick access buttons or links indicates that online radio service is one of AOL's most significant services.



13. In order to enter the Internet streaming market, and recognizing the importance of this market, AOL paid more than $400 million in June 1999 to acquire two companies, Spinner Networks, Inc. and Nullsoft, Inc. These two companies had previously developed technology relating to audio streaming. These acquisitions were AOL's entrée into the very important and lucrative audio streaming market. According to AOL's web site, AOL launched its radio broadcasting service in October 2001. Radio@AOL and Broadband Radio@AOL comprise AOL's audio programming and transmission services over the Internet (collectively "Radio@AOL"). AOL transmits more than 175 stations over the Internet to its members, including Internet radio stations covering music, news, talk radio and sports. *See* Exhibit "E."

14. AOL provides its Radio@AOL service using a technology called Ultravox. *See* Exhibit "E." Ultravox is a software program that enables live streaming of audio and visual information. Ultravox runs on one or more server computers and controls the transmission of

Radio@AOL stations and monitors the reception of those stations by AOL members. As stated above, in order to receive Radio@AOL, generally an AOL member must install the AOL Client Software on his or her PC. Currently, the AOL Client Software is called "AOL 9.0 Optimized." *See* Exhibit "E." The AOL Client Software includes special audio player software ("Radio@AOL Player") that AOL members use to connect and listen to Radio@AOL. Exhibit "F" shows the Radio@AOL Player (shown in the foreground within a rectangular box labeled "3") playing a classic rock selection. Various older versions of AOL Client Software, prior to the AOL 9.0 Optimized software, also include a version of the Radio@AOL Player software. Former and current AOL members have used, and in many instances are still using, such older versions of AOL Client Software, including, for example, versions 7.0 and 8.0, to receive and play streaming audio programming that is transmitted by AOL over the Internet.

15. AOL's Radio@AOL service, including the use of AOL's Ultravox software, the AOL Client Software and Radio@AOL Player software, infringes the TWM Patents. As a result of AOL's unauthorized and infringing use of TWM's patented technology, TWM has suffered damages in at least the tens of millions of dollars. To illustrate AOL's infringement of the TWM Patents, Claim 19 of the '187 Patent is discussed below. Claim 19 is representative of the claims that were issued by the United States Patent office to TWM and that are infringed by AOL. Claim 19 provides:

> A method for transmitting at least one stream of audio and/or visual information over a communications network to a plurality of users comprising the steps of:
>
> controlling the routing of the stream of information through the network in response to selection signals received from the users, and
>
> monitoring the reception of the stream of information by the users and accumulating records relating to the reception of the stream of information by the users wherein at least one stream

> of information comprises an audio and/or visual selection and the records that are accumulated indicate the time that a user starts receiving the audio and/or visual selection and the time that the user stops receiving the audio and/or visual selection.

AOL infringes claim 19 of the '187 patent (as well as many other claims of the TWM Patents) by streaming its Radio@AOL service over the Internet to its members using at least the Ultravox server software, the AOL Client Software and the Radio@AOL Player software. More particularly, AOL operates its Radio@AOL service by using one or more servers running the Ultravox software ("Ultravox Servers") to route streams of information over AOL's proprietary communication network and the Internet before the streams are received by AOL members. AOL Ultravox Servers control the routing of the streams over communication networks as the streams make their way to their final destination at an AOL member's PC. AOL uses the Radio@AOL Player software and the AOL Client Software to present AOL members with the 175+ stations. Exhibit "F" shows an AOL member's selection of a station called "Classic Rock." That selection signal is transmitted to AOL's Ultravox Servers. AOL responds to that selection signal by controlling the routing of streams of information relating to the Classic Rock selection.

16. AOL's Ultravox Servers monitor the streams of information relating to the selected station for normal and abnormal terminations during delivery to the AOL member. AOL gathers certain information about the use of Radio@AOL by its members, including statistical ratings, Internet protocol ("IP") addresses of users, and data to determine how and how many of its members use the Radio@AOL services. AOL also sends at least some part of such accumulated records to Arbitron so that Arbitron can publish detailed reports regarding the use and/or the popularity of the Radio@AOL service. For example, Arbitron has published statistics detailing the total number of "Cume Persons" that listen to Radio@AOL during a given period. According to

Arbitron, "Cume Persons" means "the estimated number of unique listeners tuning in for more than five minutes." *See* Exhibit "G." Arbitron also publishes the total time spent listening ("TTSL") for top Radio@AOL stations. *See* Exhibit "D." AOL accumulates records relating to the time that an AOL member starts listening to a particular station on Radio@AOL and the time that the member stops listening to that station. AOL transmits such accumulated records, or portions thereof, to Arbitron for compilation and publication. These AOL activities and services infringe claim 19 of the '187 Patent, as well as many other claims in the TWM Patents.

IV. CAUSES OF ACTION

A. Patent Infringement

17. AOL has, without authority, consent, right or license, and in direct infringement of the TWM Patents, made, used, offered for sale and/or sold the methods and systems claimed in the TWM Patents in this country. This conduct constitutes infringement under 35 U.S.C.A. § 271(a).

18. In addition, AOL has in this country actively induced others to make, use and/or sell the systems and methods claimed in the TWM Patents. This conduct constitutes infringement under 35 U.S.C.A. § 271(b).

19. AOL also has provided software designed for use in practicing the methods claimed in the TWM Patents, where the software constitutes a material part of the invention that is not a staple article of commerce, and which has no use other than for streaming audio and/or visual information over the Internet. AOL has committed these acts with knowledge that the software it makes and sells is specially made for use in a manner that directly infringes the TWM Patents. This conduct constitutes contributory infringement under 35 U.S.C.A. § 271(c).

20. AOL's infringing conduct is unlawful and willful and will continue unless

enjoined by this Court. This willful conduct by AOL makes this an exceptional case as provided in 35 U.S.C.A. § 285.

21. As a result of AOL's infringement, TWM has been damaged, and will continue to be damaged, until AOL is enjoined from further acts of infringement.

22. TWM faces real, substantial and irreparable damage and injury of a continuing nature from AOL's infringement for which TWM has no adequate remedy at law.

B. Jury Demand

23. TWM demands a trial by jury on all issues.

WHEREFORE, TWM prays:

(a) That this Court find AOL has committed acts of patent infringement under the Patent Act, 35 U.S.C. § 271;

(b) That this Court enter judgment that:

(i) TWM is the owner of the TWM Patents and all rights of recovery under the TWM Patents;

(ii) the TWM Patents are valid and enforceable; and

(iii) AOL has willfully infringed the TWM Patents;

(c) That this Court issue an injunction enjoining the defendant, its officers, agents, servants, employees and attorneys, and any other person in active concert or participation with them, from continuing the acts herein complained of, and more particularly, that the defendant and such other persons be permanently enjoined and restrained from further infringing the TWM Patents;

(d) That this Court require defendant AOL to file with this Court, within thirty (30) days after entry of final judgment, a written statement under oath setting forth in detail the manner in which AOL has complied with the injunction;

(e) That this Court award TWM the damages to which it is entitled due to AOL's patent infringement with both pre-judgment and post-judgment interest;

(f) That AOL's infringement of TWM Patents be adjudged willful and that the damages to TWM be increased by three times the amount found or assessed pursuant to 35 U.S.C. § 284;

(g) That this be adjudged an exceptional case and that TWM be awarded its attorney fees in this action pursuant to 35 U.S.C. § 285;

(h) That this Court award TWM its costs and disbursements in this civil action, including reasonable attorney's fees; and

(i) That this Court grant TWM such other and further relief, in law or in equity, both general and special, to which it may be entitled.

Respectfully submitted,

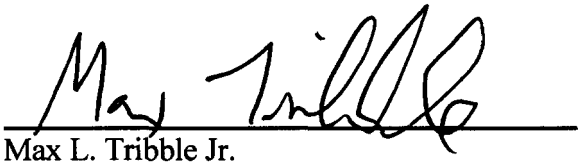


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EXHIBIT LIST

EXHIBIT "A" – '187 Patent.

EXHIBIT "B" – '005 Patent.

EXHIBIT "C" – '622 Patent.

EXHIBIT "D" – Arbitron "December 2003" report, dated January 20, 2004.

EXHIBIT "E" – General Info web page from AOL.COM mentioning Radio@AOL, Broadband Radio@AOL, Ultravox and AOL 9.0 Optimized.

EXHIBIT "F" – Radio@AOL Player.

EXHIBIT "G" – Arbitron Press Release, dated June 10, 2003.

A

US005778187A

United States Patent [19]

Monteiro et al.

[11] Patent Number: 5,778,187

[45] Date of Patent: Jul. 7, 1998

[54] **MULTICASTING METHOD AND APPARATUS**

[75] Inventors: **Antonio M. Monteiro; James F. Butterworth**, both of New York, N.Y.

[73] Assignee: **Netcast Communications Corp.**, New York, N.Y.

[21] Appl. No.: **644,072**

[22] Filed: **May 9, 1996**

[51] **Int. Cl.**[6] **H04L 12/00**

[52] **U.S. Cl.** **395/200.61**; 370/351

[58] **Field of Search** 395/200.15, 285, 395/200.61; 348/7, 10, 12, 16, 17; 370/351, 355

[56] **References Cited**

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5,604,542	2/1997	Dedrick	348/552
5,617,565	4/1997	Augenbraun et al.	395/604

OTHER PUBLICATIONS

K. Savetz et al. MBONE Multicasting Tomorrow's Internet (IDG Books WorldWise Inc., 1996), Chapters 1–3; Appendixes A and B.

D.P. Brutzman et al., "MBONE Provides Audio and Video Across the Internet," IEEE Computer, vol. 27, No. 4, pp. 30–36 (Apr. 1994).

PCT International Search Report, International Application No. PCT/US97/07893.

Primary Examiner—Emanuel Todd Voeltz
Assistant Examiner—Thomas Peeso
Attorney, Agent, or Firm—Pennie & Edmonds LLP

[57] **ABSTRACT**

A scalable architecture is disclosed for delivery of real-time information over a communications network. Embedded into the architecture is a control mechanism that provides for the management and administration of users who are to receive the real-time information. In the preferred embodiment, the information being delivered is high-quality audio. However, it could also be video, graphics, text or any other type of information that can be transmitted over a digital network. Preferably, there are multiple channels of information available simultaneously to be delivered to users, each channel consisting of an independent stream of information. A user chooses to tune in or tune out a particular channel, but does not choose the time at which the channel distributes its information. Advantageously, interactive (two-way) information can be incorporated into the system, multiple streams of information can be integrated for delivery to a user, and certain portions of the information being delivered can be tailored to the individual user.

51 Claims, 23 Drawing Sheets

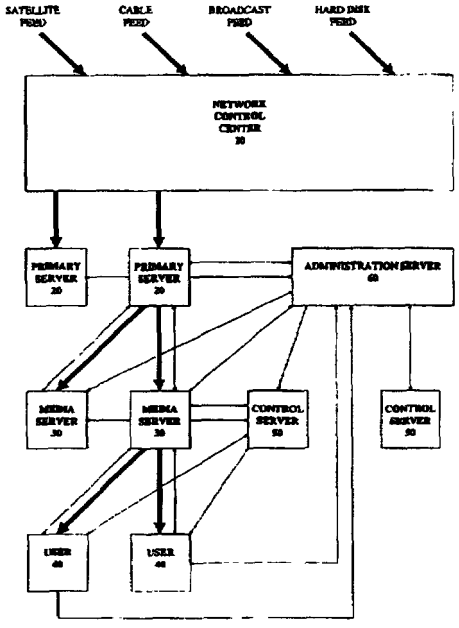


FIGURE 1

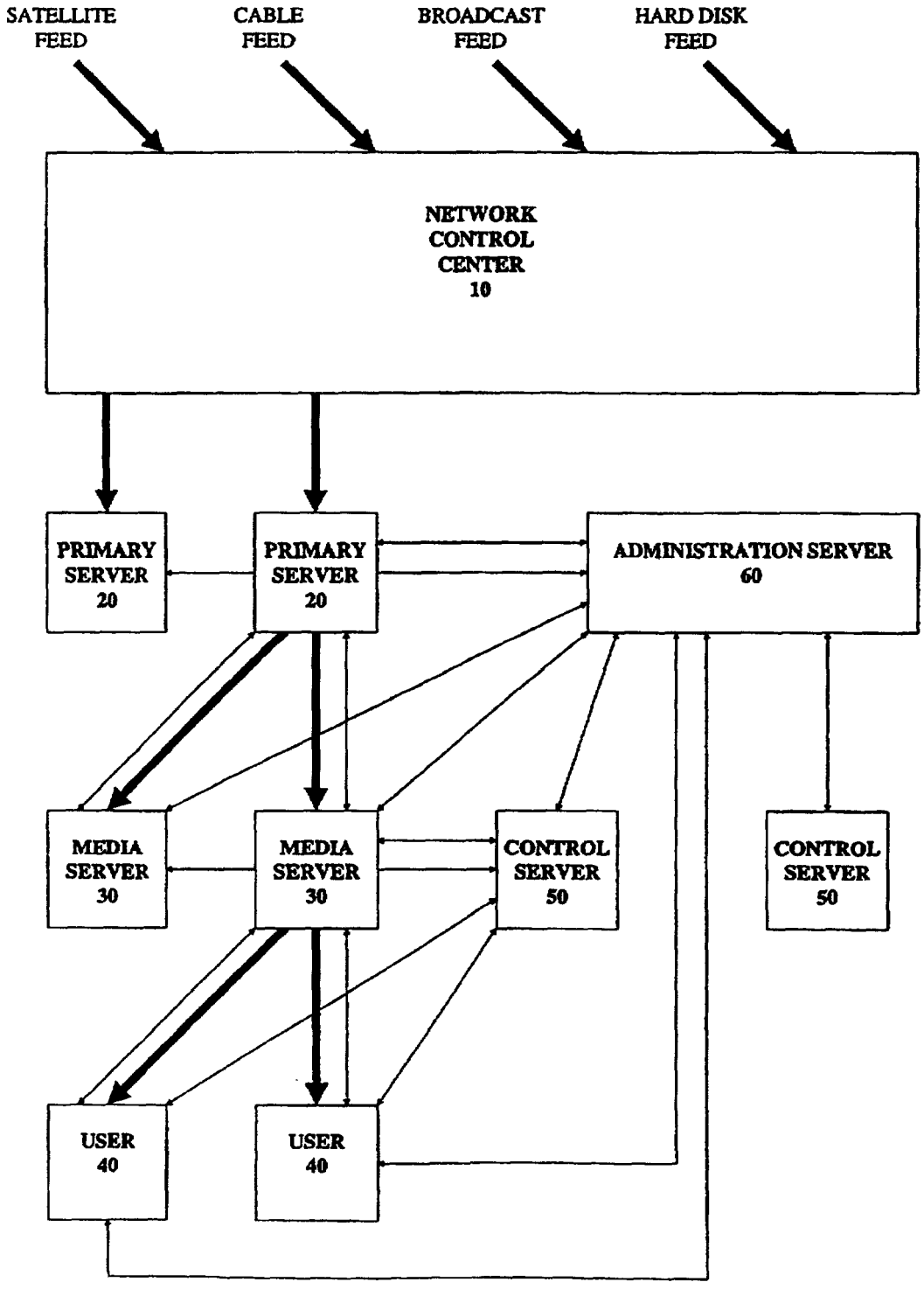

SATELLITE FEED
CABLE FEED
BROADCAST FEED
HARD DISK FEED
NETWORK CONTROL CENTER 10
PRIMARY SERVER 20
PRIMARY SERVER 20
ADMINISTRATION SERVER 60
MEDIA SERVER 30
MEDIA SERVER 30
CONTROL SERVER 50
CONTROL SERVER 50
USER 40
USER 40

FIGURE 2

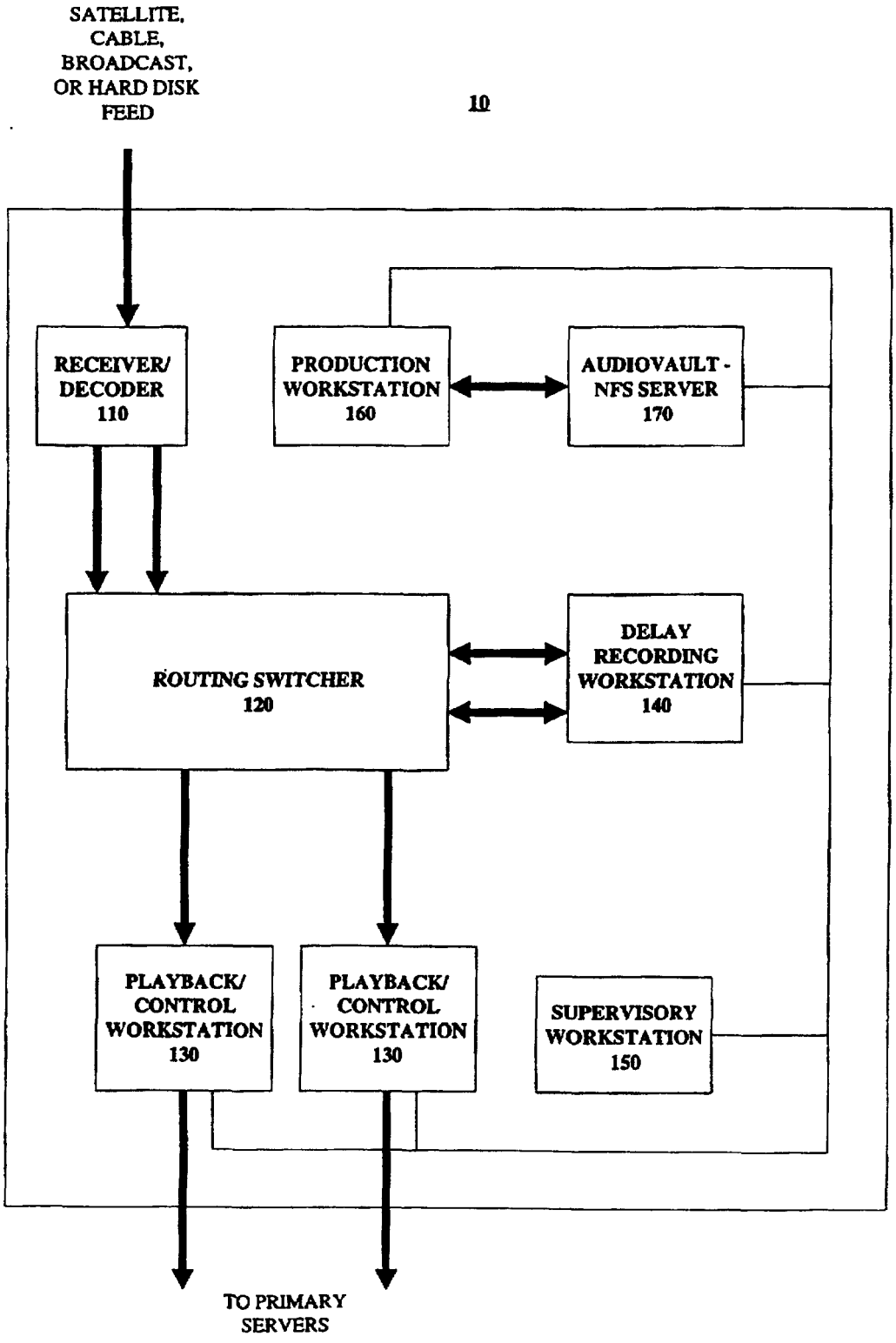

SATELLITE, CABLE, BROADCAST, OR HARD DISK FEED
10
RECEIVER/ DECODER 110
PRODUCTION WORKSTATION 160
AUDIOVAULT - NFS SERVER 170
ROUTING SWITCHER 120
DELAY RECORDING WORKSTATION 140
PLAYBACK/ CONTROL WORKSTATION 130
PLAYBACK/ CONTROL WORKSTATION 130
SUPERVISORY WORKSTATION 150
TO PRIMARY SERVERS

FIGURE 3

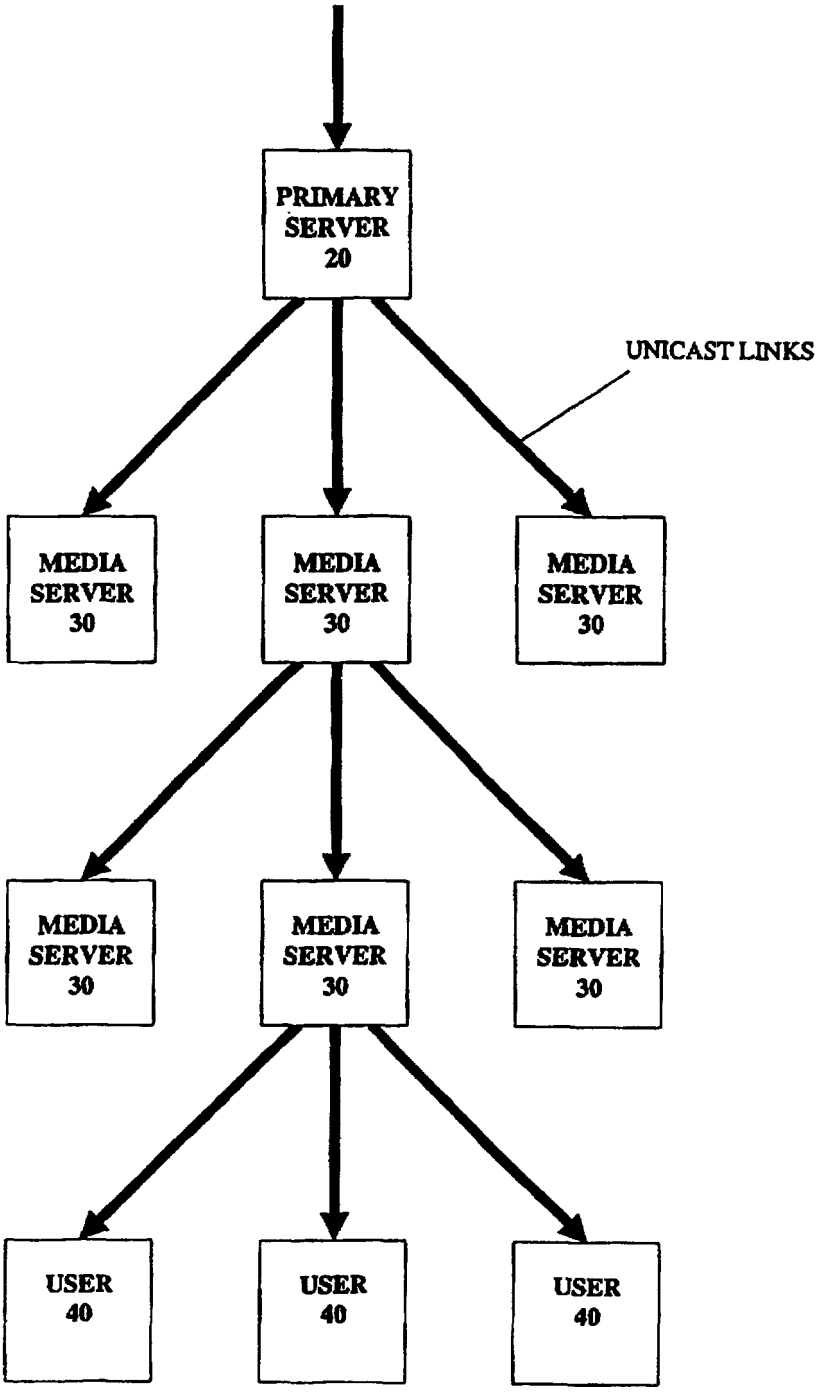

PRIMARY SERVER 20
UNICAST LINKS
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
USER 40
USER 40
USER 40

FIGURE 4

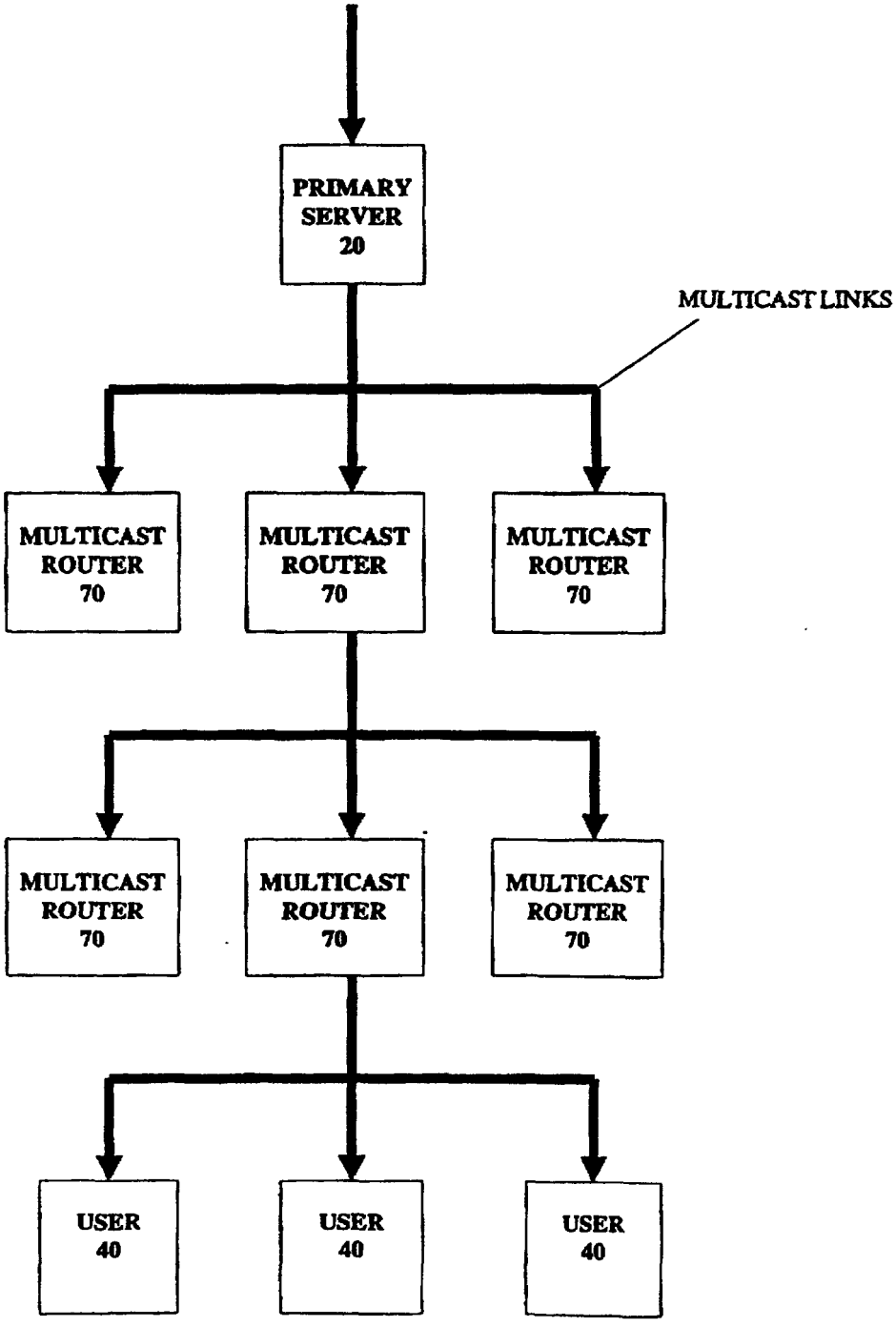
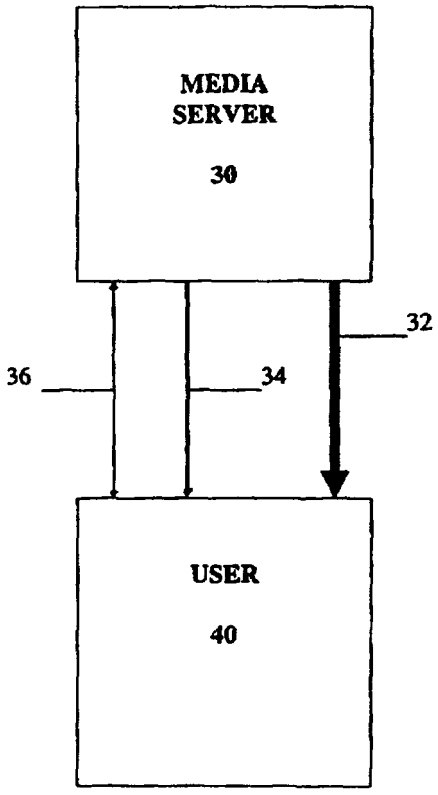

PRIMARY SERVER 20
MULTICAST LINKS
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
USER 40
USER 40
USER 40

FIGURE 5



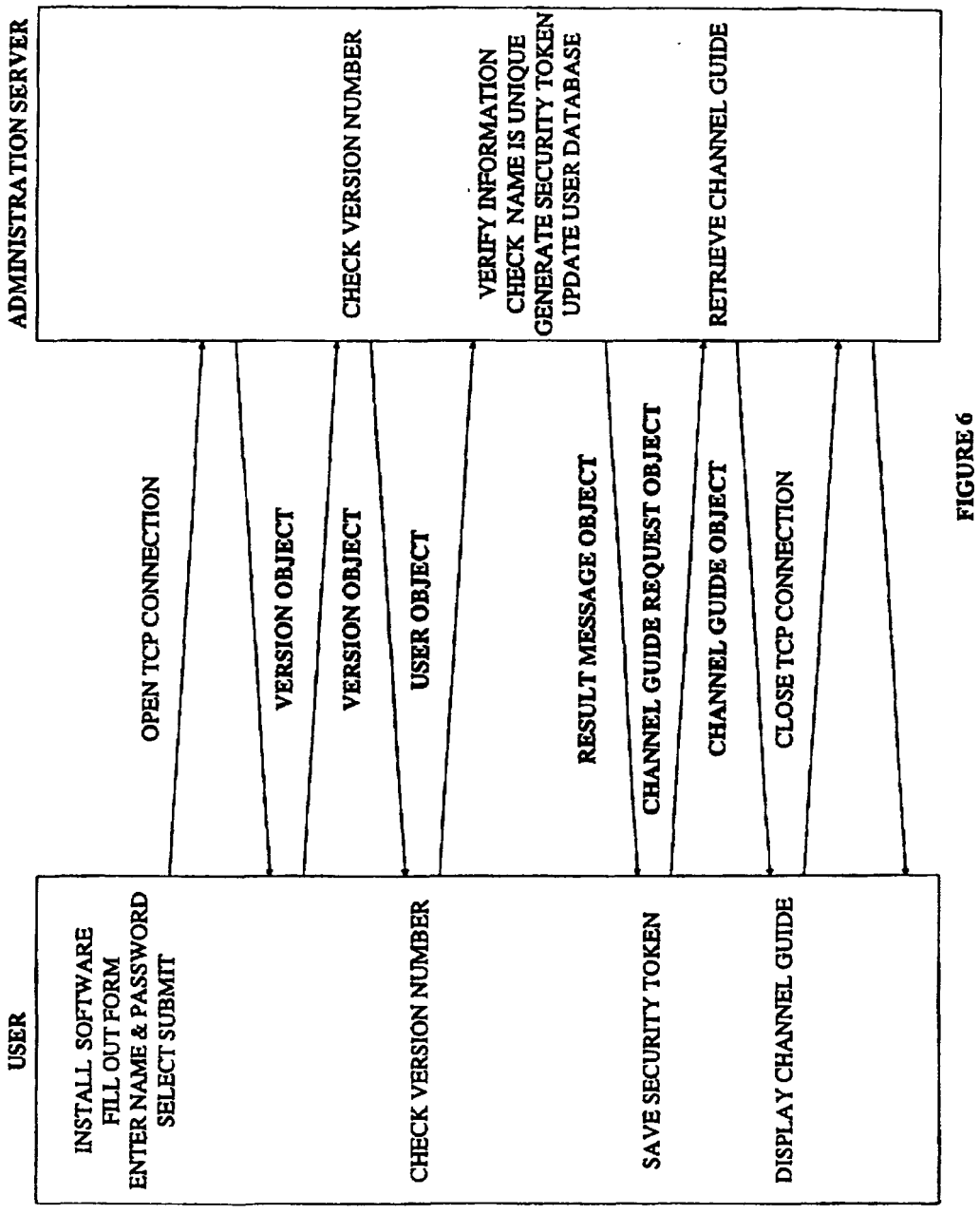

ADMINISTRATION SERVER
CHECK VERSION NUMBER
VERIFY INFORMATION
CHECK NAME IS UNIQUE
GENERATE SECURITY TOKEN
UPDATE USER DATABASE
RETRIEVE CHANNEL GUIDE
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
USER OBJECT
RESULT MESSAGE OBJECT
CHANNEL GUIDE REQUEST OBJECT
CHANNEL GUIDE OBJECT
CLOSE TCP CONNECTION
USER
INSTALL SOFTWARE
FILL OUT FORM
ENTER NAME & PASSWORD
SELECT SUBMIT
CHECK VERSION NUMBER
SAVE SECURITY TOKEN
DISPLAY CHANNEL GUIDE

FIGURE 6

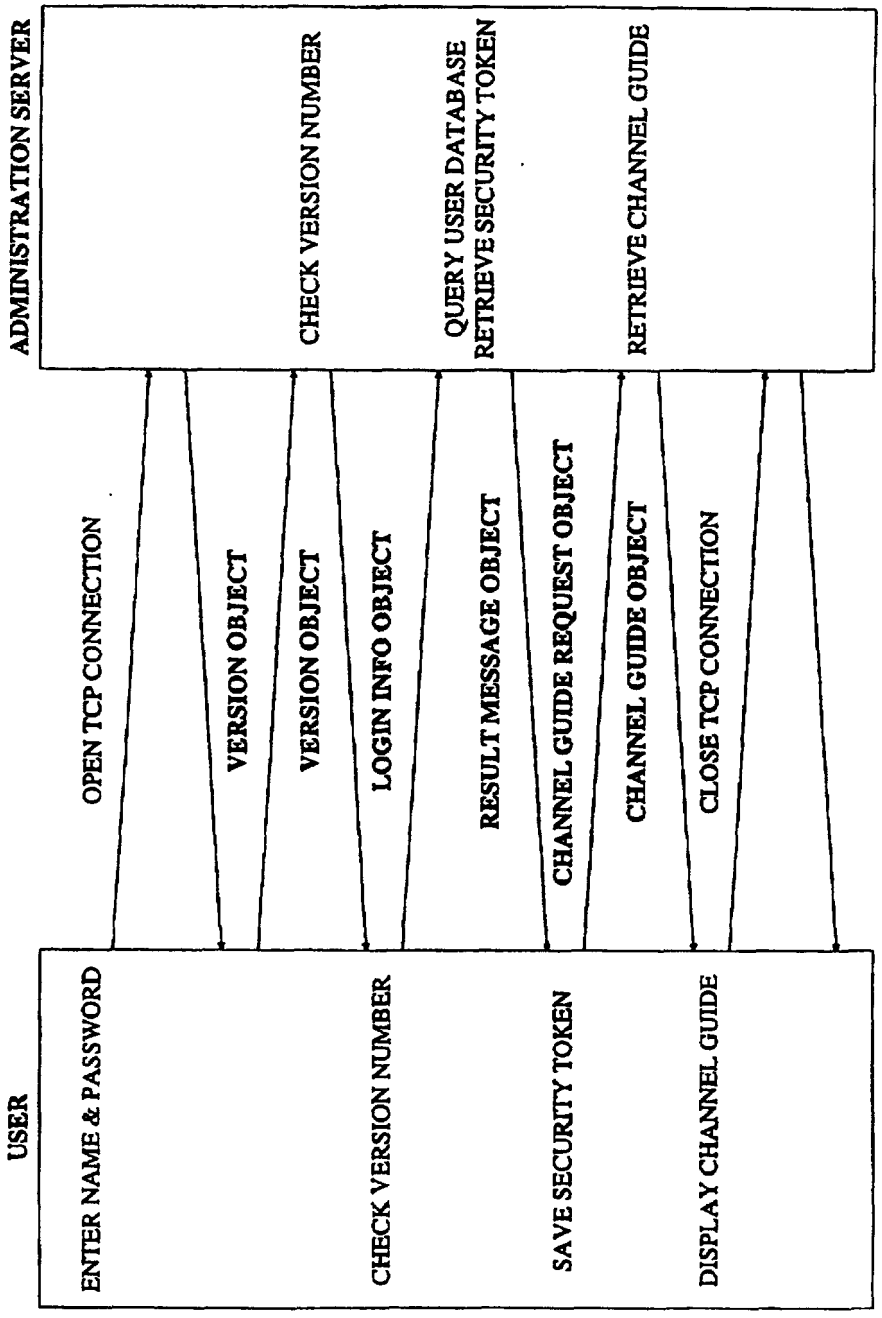

ADMINISTRATION SERVER
CHECK VERSION NUMBER
QUERY USER DATABASE
RETRIEVE SECURITY TOKEN
RETRIEVE CHANNEL GUIDE
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
LOGIN INFO OBJECT
RESULT MESSAGE OBJECT
CHANNEL GUIDE REQUEST OBJECT
CHANNEL GUIDE OBJECT
CLOSE TCP CONNECTION
USER
ENTER NAME & PASSWORD
CHECK VERSION NUMBER
SAVE SECURITY TOKEN
DISPLAY CHANNEL GUIDE

FIGURE 7

FIGURE 8A

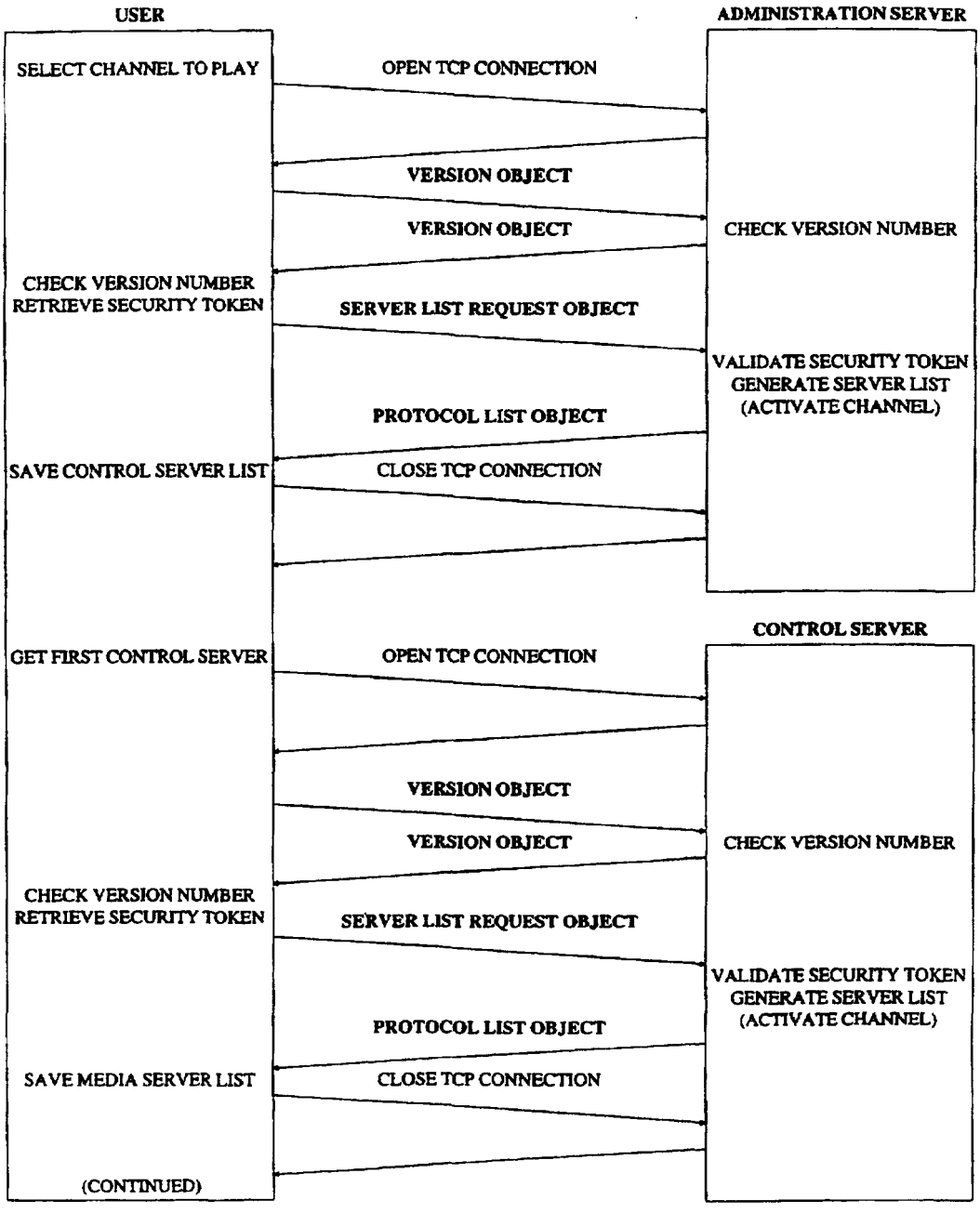
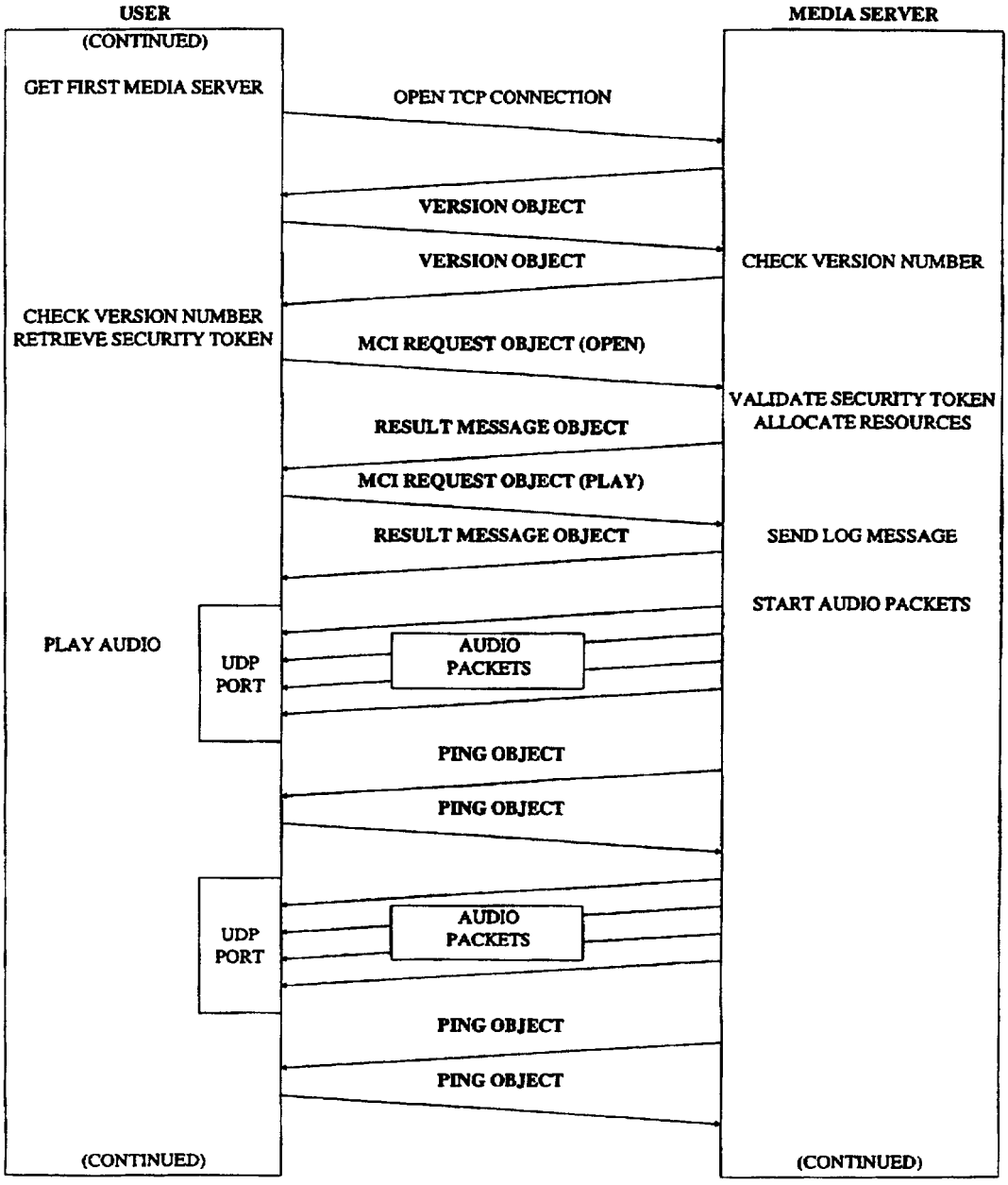

USER
ADMINISTRATION SERVER
SELECT CHANNEL TO PLAY
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
SERVER LIST REQUEST OBJECT
VALIDATE SECURITY TOKEN
GENERATE SERVER LIST
(ACTIVATE CHANNEL)
PROTOCOL LIST OBJECT
SAVE CONTROL SERVER LIST
CLOSE TCP CONNECTION
CONTROL SERVER
GET FIRST CONTROL SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
SERVER LIST REQUEST OBJECT
VALIDATE SECURITY TOKEN
GENERATE SERVER LIST
(ACTIVATE CHANNEL)
PROTOCOL LIST OBJECT
SAVE MEDIA SERVER LIST
CLOSE TCP CONNECTION
(CONTINUED)

FIGURE 8B


USER
(CONTINUED)
MEDIA SERVER
GET FIRST MEDIA SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
MCI REQUEST OBJECT (OPEN)
VALIDATE SECURITY TOKEN
ALLOCATE RESOURCES
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (PLAY)
RESULT MESSAGE OBJECT
SEND LOG MESSAGE
START AUDIO PACKETS
PLAY AUDIO
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
(CONTINUED)
(CONTINUED)

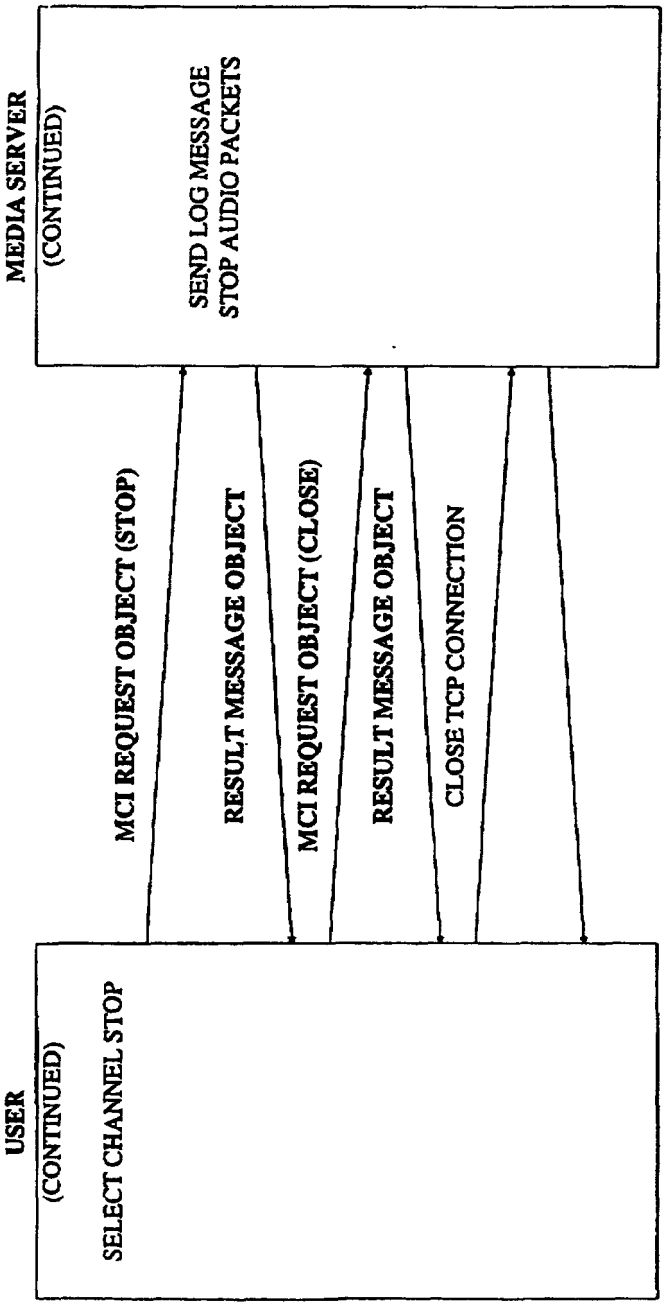

MEDIA SERVER
(CONTINUED)
SEND LOG MESSAGE
STOP AUDIO PACKETS
MCI REQUEST OBJECT (STOP)
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (CLOSE)
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
USER
(CONTINUED)
SELECT CHANNEL STOP

FIGURE 8C

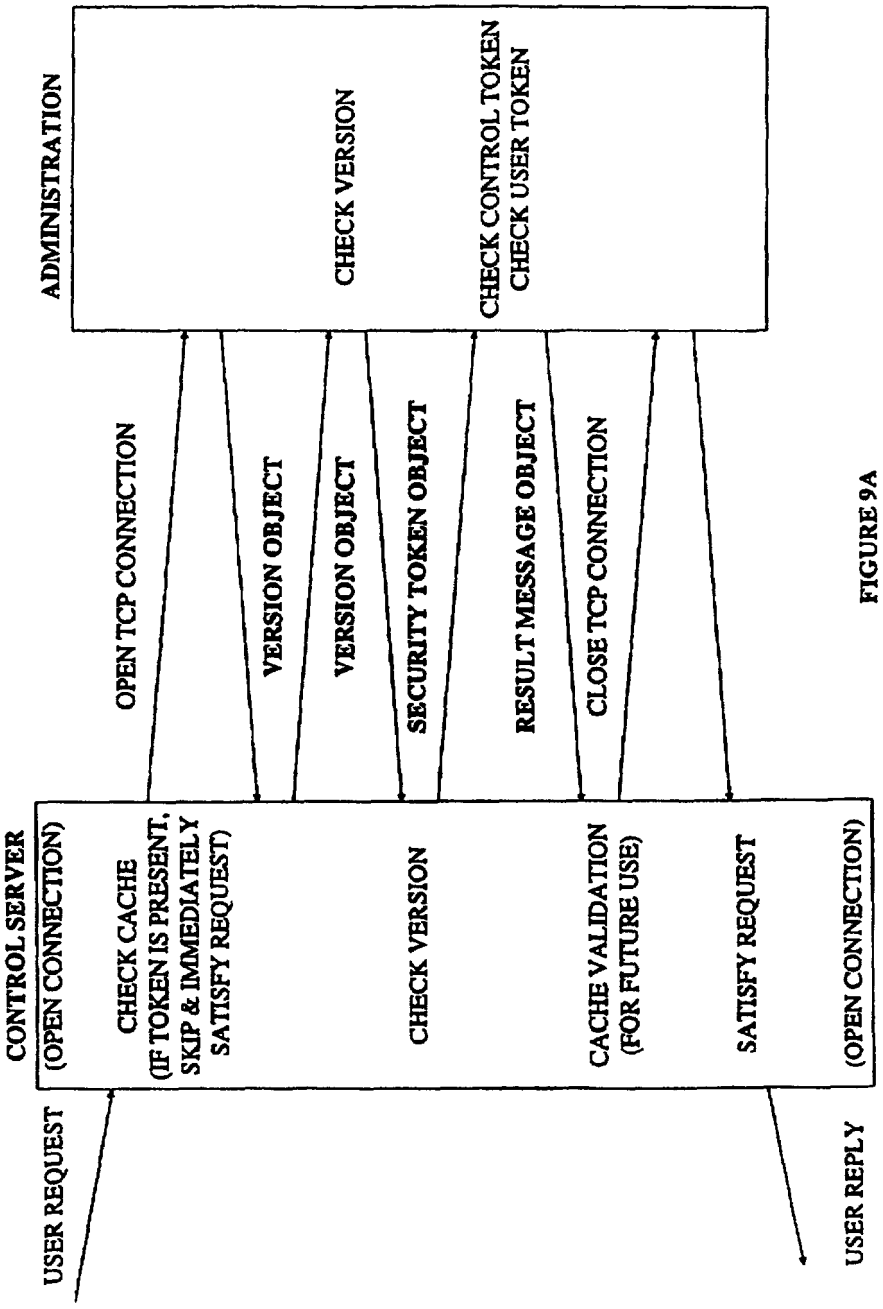

ADMINISTRATION
CHECK VERSION
CHECK CONTROL TOKEN
CHECK USER TOKEN
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
SECURITY TOKEN OBJECT
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
CONTROL SERVER
(OPEN CONNECTION)
CHECK CACHE
(IF TOKEN IS PRESENT, SKIP & IMMEDIATELY SATISFY REQUEST)
CHECK VERSION
CACHE VALIDATION
(FOR FUTURE USE)
SATISFY REQUEST
(OPEN CONNECTION)
USER REQUEST
USER REPLY

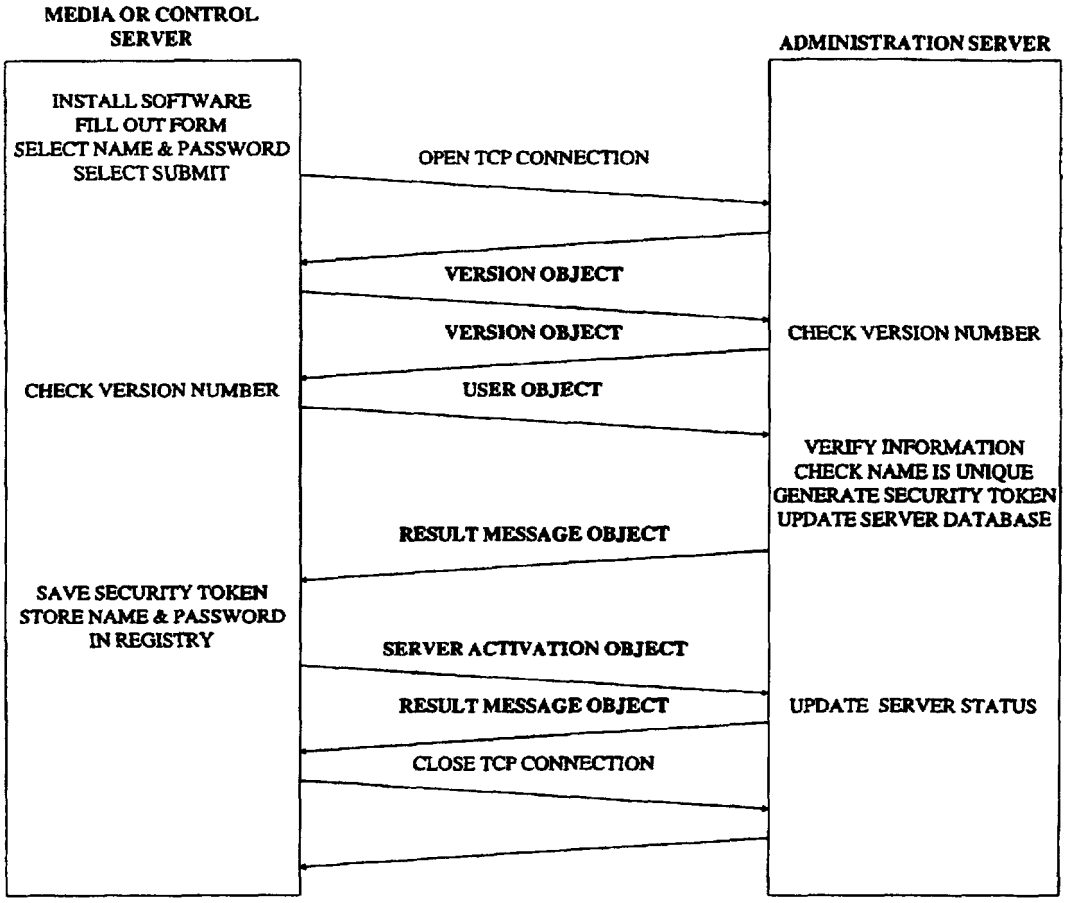
FIGURE 9A

FIGURE 9B

(SHOWN ABOVE)

REQUEST FROM	REQUEST TO	VALIDATION WITH
USER	CONTROL SERVER	ADMINISTRATION SERVER
USER	MEDIA SERVER	CONTROL SERVER
MEDIA SERVER	MEDIA SERVER	CONTROL SERVER
MEDIA SERVER	PRIMARY SERVER	ADMINISTRATION SERVER
MEDIA SERVER	CONTROL SERVER	ADMINISTRATION SERVER
CONTROL SERVER	MEDIA SERVER	ADMINISTRATION SERVER

FIGURE 10


MEDIA OR CONTROL SERVER
ADMINISTRATION SERVER
INSTALL SOFTWARE
FILL OUT FORM
SELECT NAME & PASSWORD
SELECT SUBMIT
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
USER OBJECT
VERIFY INFORMATION
CHECK NAME IS UNIQUE
GENERATE SECURITY TOKEN
UPDATE SERVER DATABASE
RESULT MESSAGE OBJECT
SAVE SECURITY TOKEN
STORE NAME & PASSWORD
IN REGISTRY
SERVER ACTIVATION OBJECT
RESULT MESSAGE OBJECT
UPDATE SERVER STATUS
CLOSE TCP CONNECTION

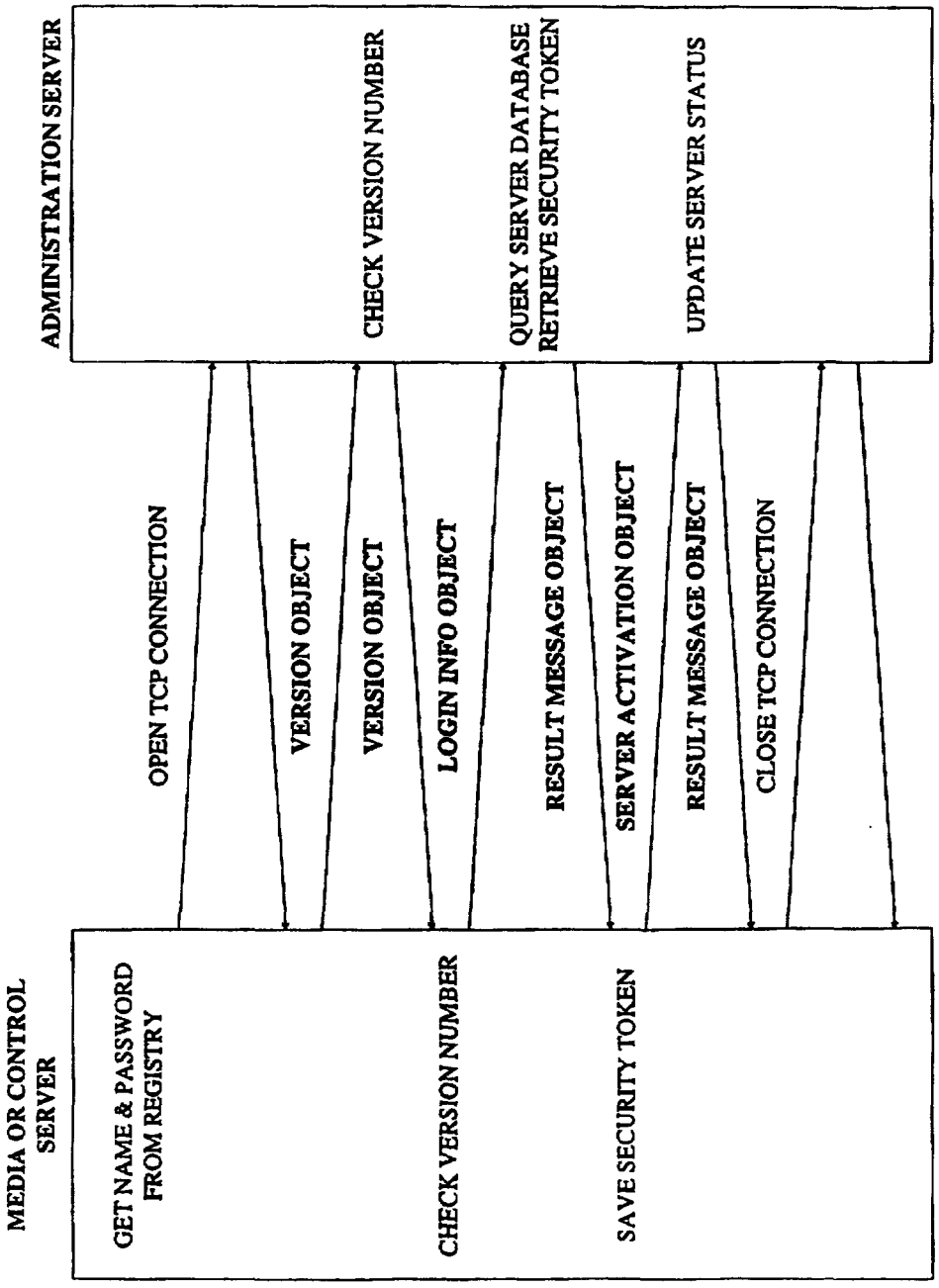

ADMINISTRATION SERVER
MEDIA OR CONTROL SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
LOGIN INFO OBJECT
RESULT MESSAGE OBJECT
SERVER ACTIVATION OBJECT
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
GET NAME & PASSWORD FROM REGISTRY
CHECK VERSION NUMBER
CHECK VERSION NUMBER
QUERY SERVER DATABASE RETRIEVE SECURITY TOKEN
SAVE SECURITY TOKEN
UPDATE SERVER STATUS

FIGURE 11

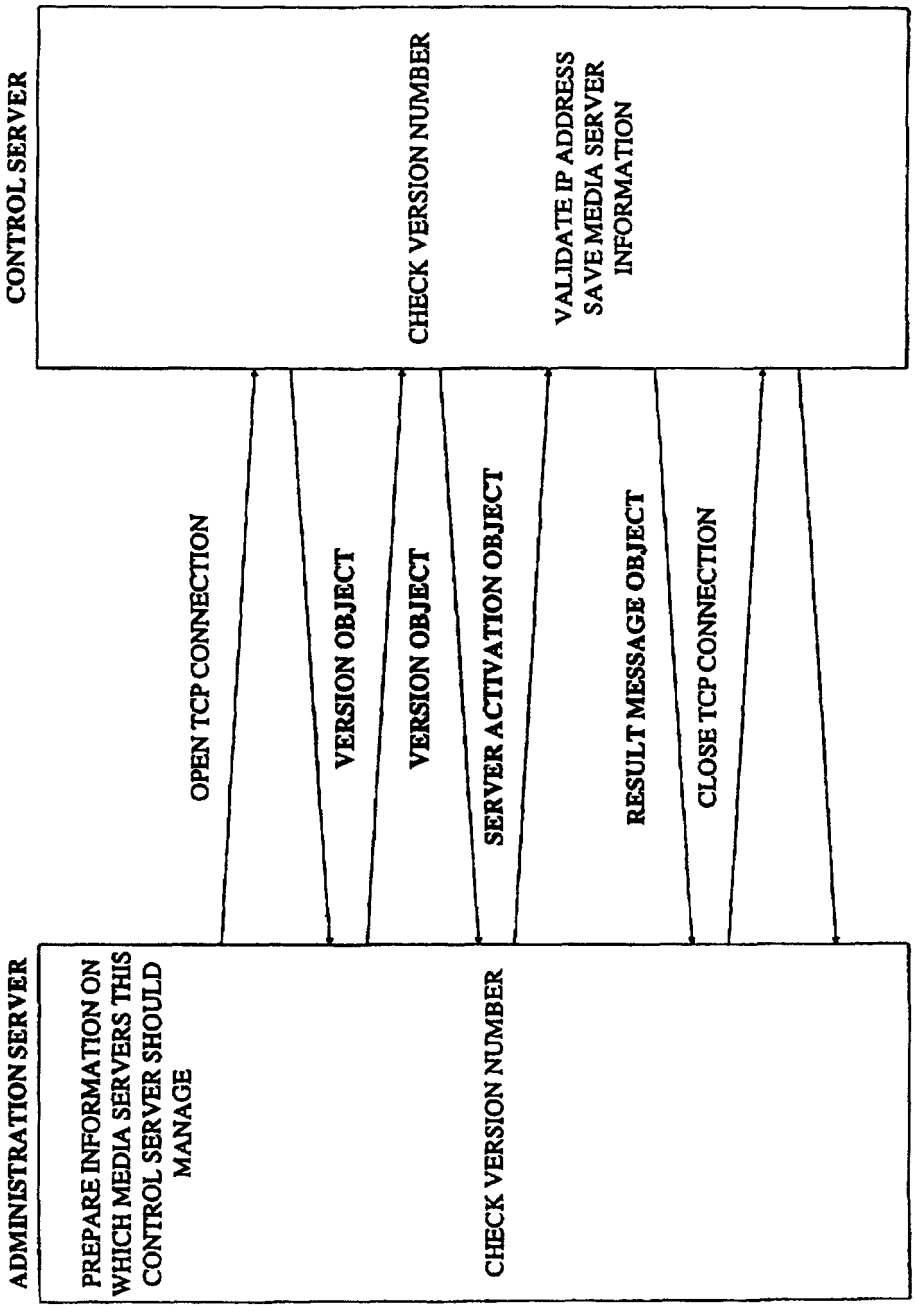
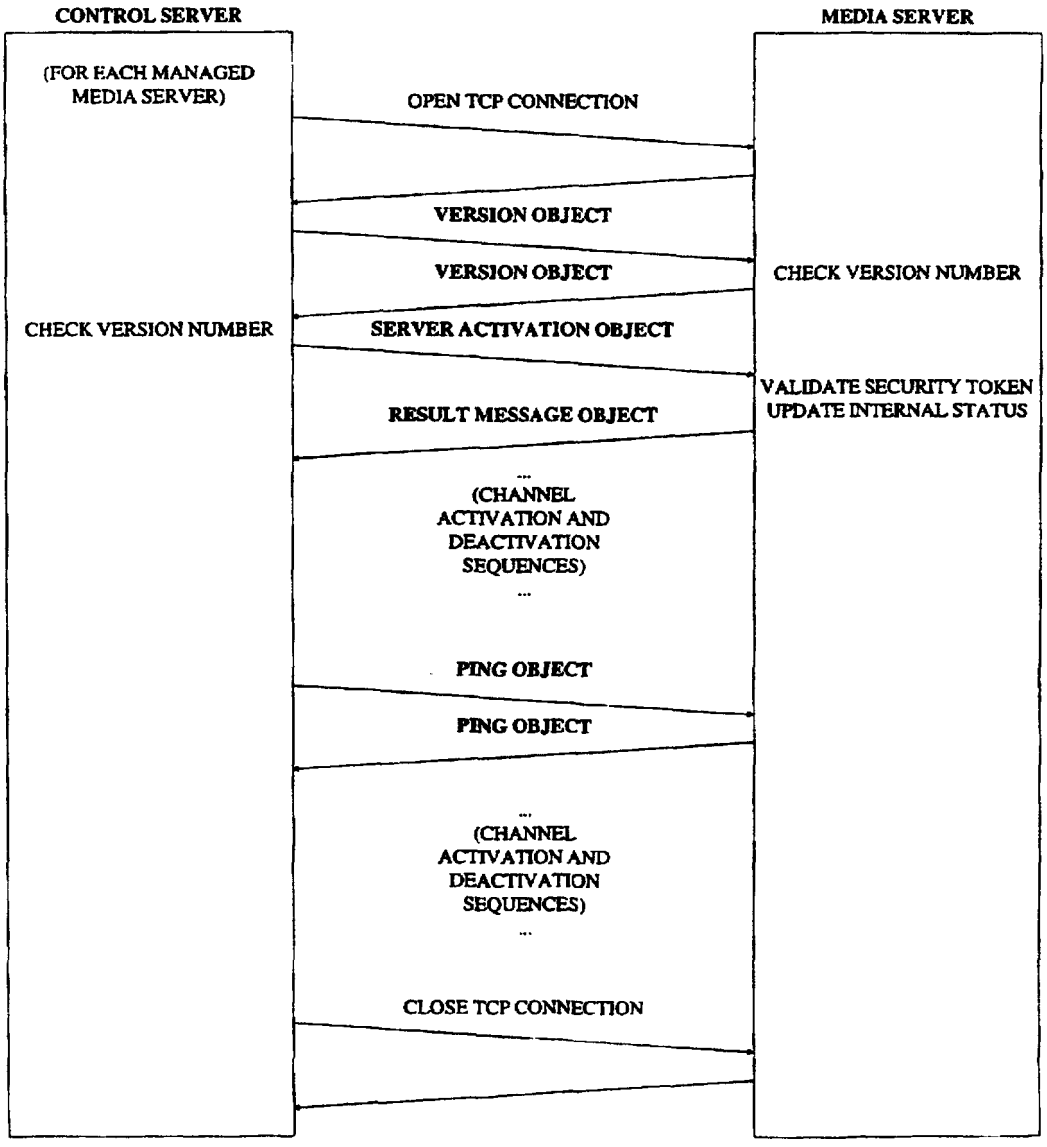

CONTROL SERVER
ADMINISTRATION SERVER
PREPARE INFORMATION ON WHICH MEDIA SERVERS THIS CONTROL SERVER SHOULD MANAGE
OPEN TCP CONNECTION
VERSION OBJECT
CHECK VERSION NUMBER
VERSION OBJECT
CHECK VERSION NUMBER
SERVER ACTIVATION OBJECT
VALIDATE IP ADDRESS SAVE MEDIA SERVER INFORMATION
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION

FIGURE 12

FIGURE 13


CONTROL SERVER
MEDIA SERVER
(FOR EACH MANAGED MEDIA SERVER)
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
SERVER ACTIVATION OBJECT
VALIDATE SECURITY TOKEN
UPDATE INTERNAL STATUS
RESULT MESSAGE OBJECT
...
(CHANNEL ACTIVATION AND DEACTIVATION SEQUENCES)
...
PING OBJECT
PING OBJECT
...
(CHANNEL ACTIVATION AND DEACTIVATION SEQUENCES)
...
CLOSE TCP CONNECTION

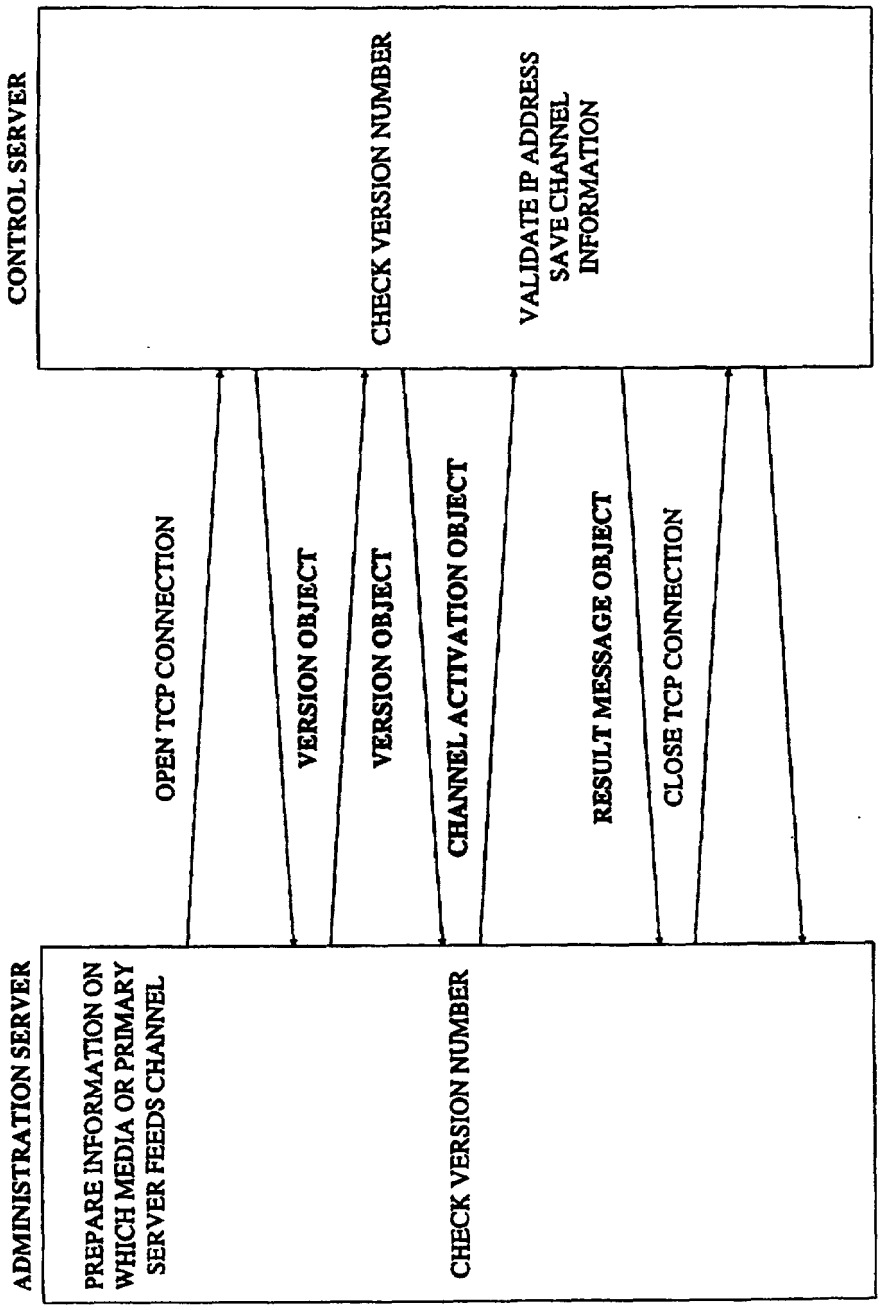

CONTROL SERVER
CHECK VERSION NUMBER
VALIDATE IP ADDRESS
SAVE CHANNEL
INFORMATION
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHANNEL ACTIVATION OBJECT
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
ADMINISTRATION SERVER
PREPARE INFORMATION ON
WHICH MEDIA OR PRIMARY
SERVER FEEDS CHANNEL
CHECK VERSION NUMBER

FIGURE 14

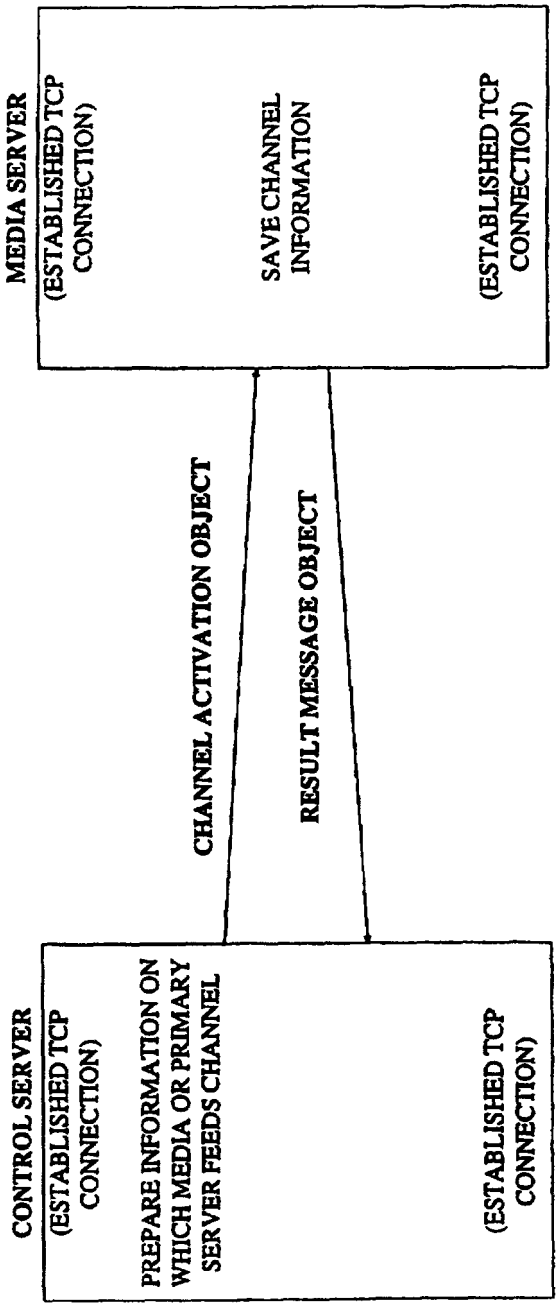
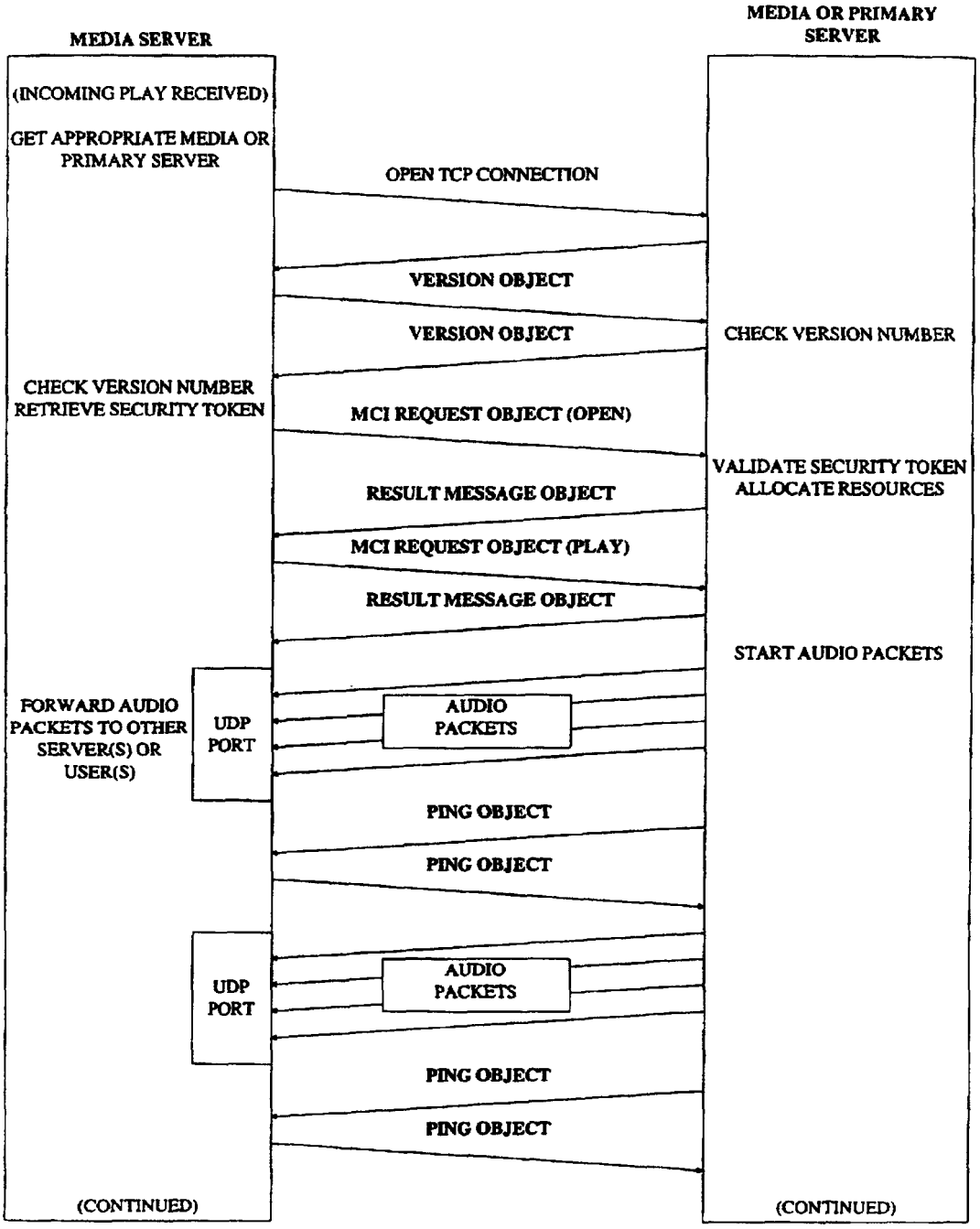

MEDIA SERVER
(ESTABLISHED TCP CONNECTION)
SAVE CHANNEL INFORMATION
(ESTABLISHED TCP CONNECTION)
CHANNEL ACTIVATION OBJECT
RESULT MESSAGE OBJECT
CONTROL SERVER
(ESTABLISHED TCP CONNECTION)
PREPARE INFORMATION ON WHICH MEDIA OR PRIMARY SERVER FEEDS CHANNEL
(ESTABLISHED TCP CONNECTION)

FIGURE 15

FIGURE 16A


MEDIA SERVER
MEDIA OR PRIMARY SERVER
(INCOMING PLAY RECEIVED)
GET APPROPRIATE MEDIA OR PRIMARY SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER RETRIEVE SECURITY TOKEN
MCI REQUEST OBJECT (OPEN)
VALIDATE SECURITY TOKEN ALLOCATE RESOURCES
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (PLAY)
RESULT MESSAGE OBJECT
START AUDIO PACKETS
FORWARD AUDIO PACKETS TO OTHER SERVER(S) OR USER(S)
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
(CONTINUED)
(CONTINUED)

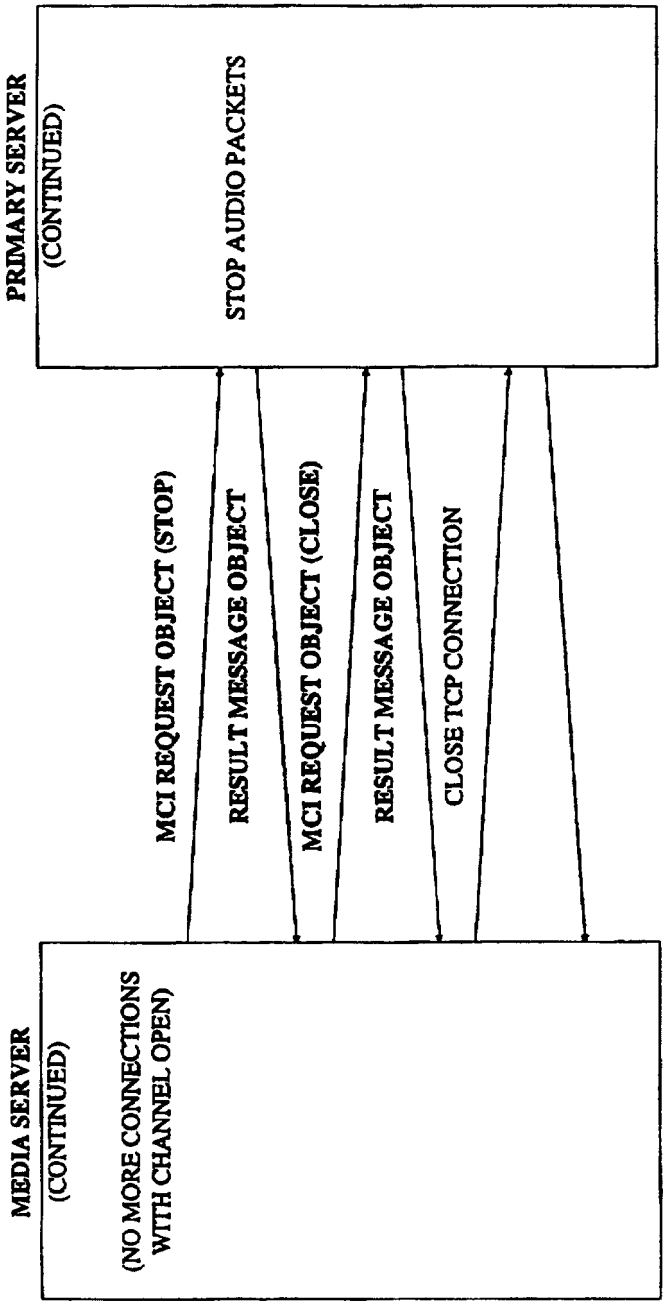

PRIMARY SERVER
(CONTINUED)
STOP AUDIO PACKETS
MCI REQUEST OBJECT (STOP)
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (CLOSE)
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
MEDIA SERVER
(CONTINUED)
(NO MORE CONNECTIONS WITH CHANNEL OPEN)

FIGURE 16B

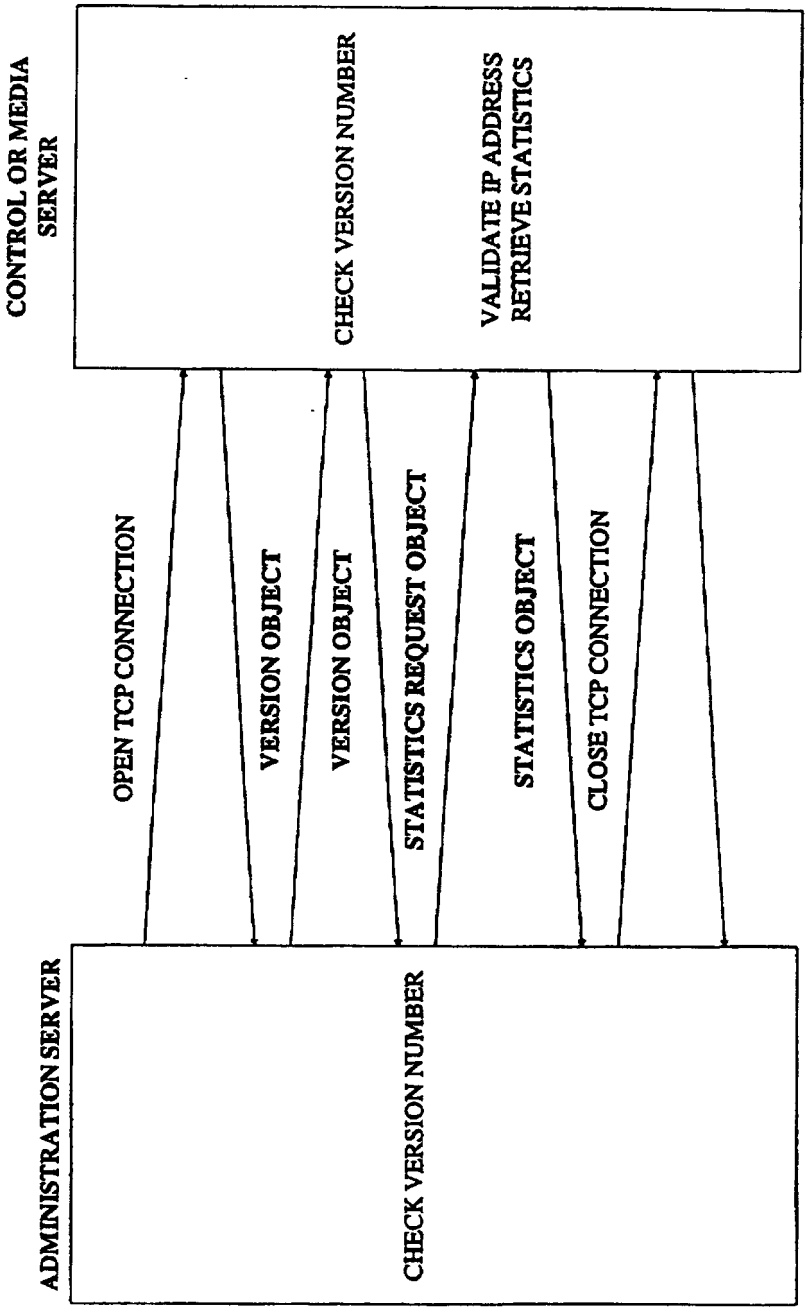

CONTROL OR MEDIA SERVER
CHECK VERSION NUMBER
VALIDATE IP ADDRESS
RETRIEVE STATISTICS
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
STATISTICS REQUEST OBJECT
STATISTICS OBJECT
CLOSE TCP CONNECTION
ADMINISTRATION SERVER
CHECK VERSION NUMBER

FIGURE 17

FIG. 18

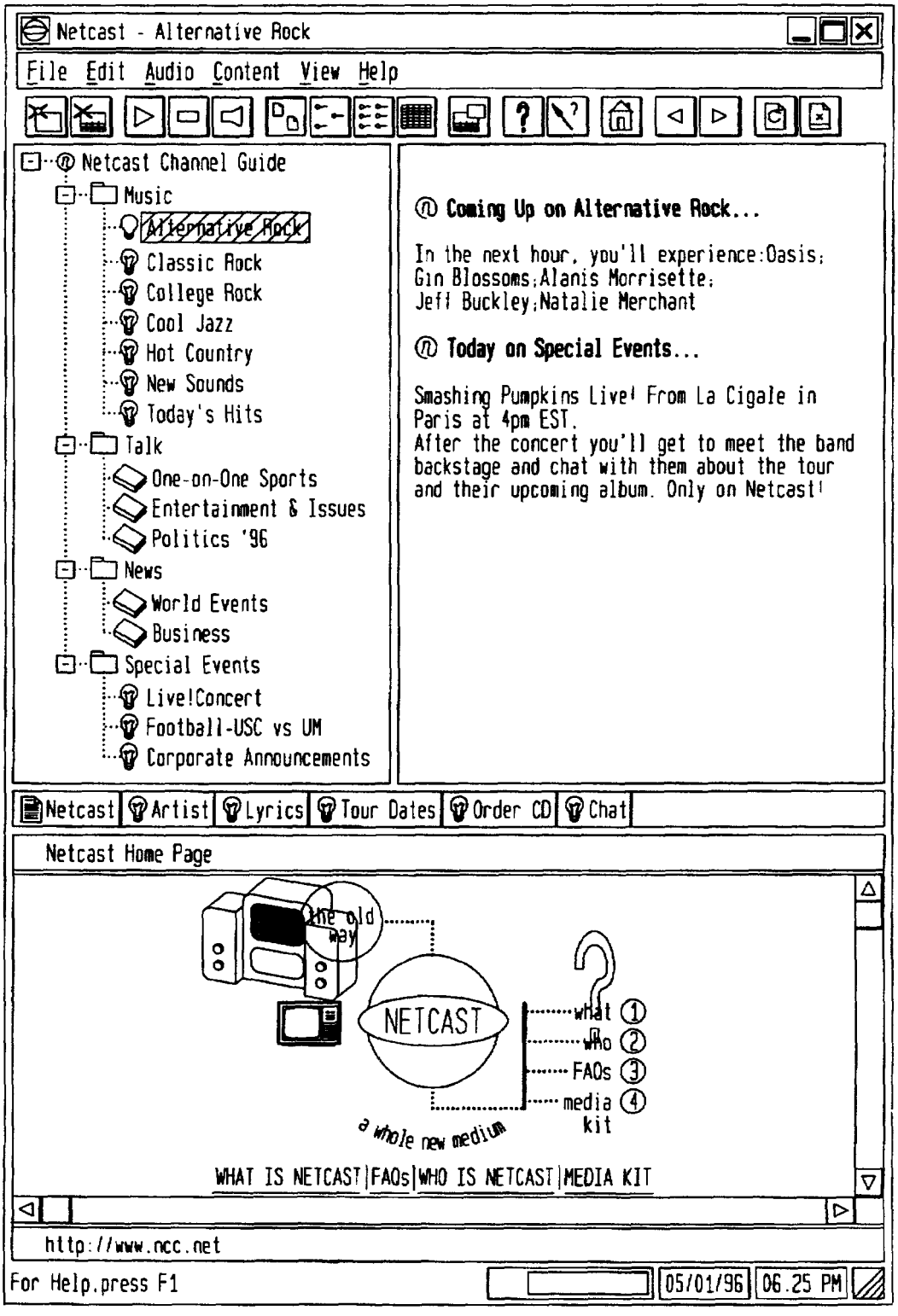
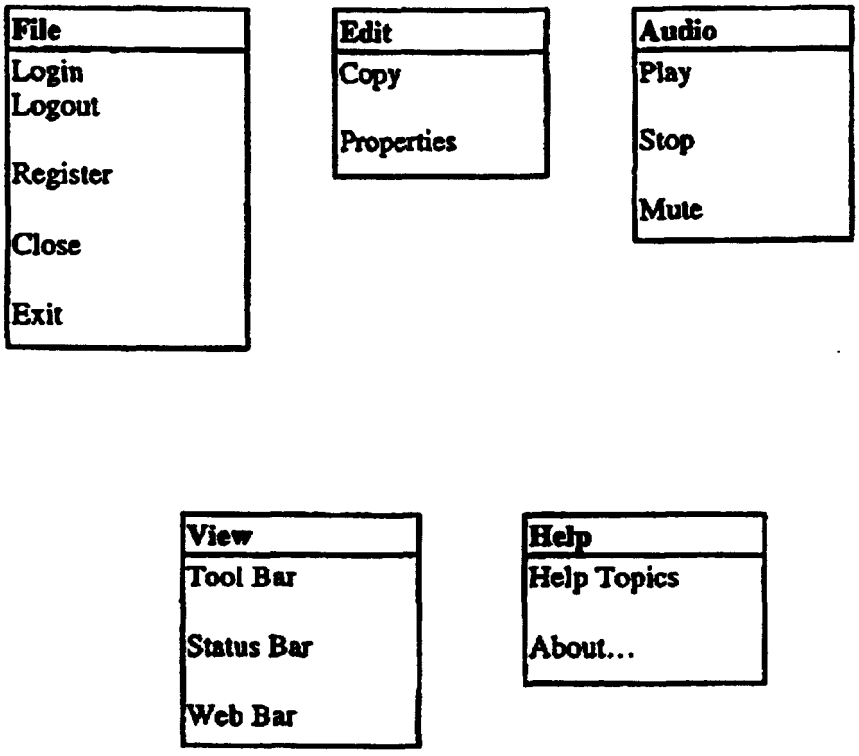

MAIN USER SCREEN
Netcast - Alternative Rock
File Edit Audio Content View Help
Netcast Channel Guide
Music
Alternative Rock
Classic Rock
College Rock
Cool Jazz
Hot Country
New Sounds
Today's Hits
Talk
One-on-One Sports
Entertainment & Issues
Politics '96
News
World Events
Business
Special Events
Live!Concert
Football-USC vs UM
Corporate Announcements
Coming Up on Alternative Rock...
In the next hour, you'll experience:Oasis;
Gin Blossoms;Alanis Morrisette;
Jeff Buckley;Natalie Merchant
Today on Special Events...
Smashing Pumpkins Live! From La Cigale in
Paris at 4pm EST.
After the concert you'll get to meet the band
backstage and chat with them about the tour
and their upcoming album. Only on Netcast!
Netcast
Artist
Lyrics
Tour Dates
Order CD
Chat
Netcast Home Page
the old way
NETCAST
what 1
who 2
FAQs 3
media kit 4
a whole new medium
WHAT IS NETCAST | FAQs | WHO IS NETCAST | MEDIA KIT
http://www.ncc.net
For Help,press F1
05/01/96
06:25 PM

Figure 19
Key Pull-Down Menus on Main User Screen



MULTICASTING METHOD AND APPARATUS

FIELD OF THE INVENTION

This relates to a method and apparatus for providing audio and/or visual communication services, in real-time to a multiplicity of identifiable users on a communications network, such as the Internet. In a preferred embodiment, the invention monitors which users are receiving signals on which one of a plurality of channels and modifies the content of at least some signals in response thereto. A particular application is to provide services akin to multi-channel radio or television with commercial programming content adjusted in accordance with the identity of the individual user.

BACKGROUND OF THE INVENTION

Systems such as the Internet typically are pointto-point (or unicast) systems in which a message is converted into a series of addressed packets which are routed from a source node through a plurality of routers to a destination node. In most communication protocols the packet includes a header which contains the addresses of the source and the destination nodes as well as a sequence number which specifies the packet's order in the message.

In general, these systems do not have the capability of broadcasting a message from a source node to all the other nodes in the network because such a capability is rarely of much use and could easily overload the network. However, there are situations where it is desirable for one node to communicate with some subset of all the nodes. For example, multi-party conferencing capability analogous to that found in the public telephone system and broadcasting to a limited number of nodes are of considerable interest to users of packet-switched networks. To satisfy such demands, packets destined for several recipients have been encapsulated in a unicast packet and forwarded from a source to a point in a network where the packets have been replicated and forwarded on to all desired recipients. This technique is known as IP Multicasting and the network over which such packets are routed is referred to as the Multicast Backbone or MBONE. More recently, routers have become available which can route the multicast addresses (class D addresses) provided for in communication protocols such as TCP/IP and UDP/IP. A multicast address is essentially an address for a group of host computers who have indicated their desire to participate in that group. Thus, a multicast packet can be routed from a source node through a plurality of multicast routers (or mrouters) to one or more devices receiving the multicast packets. From there the packet is distributed to all the host computers that are members of the multicast group.

These techniques have been used to provide on the Internet audio and video conferencing as well as radio-like broadcasting to groups of interested parties. See, for example, K. Savetz et al. *MBONE Multicasting Tomorrow's Internet* (IDG Books WorldWide Inc., 1996).

Further details concerning technical aspects of multicasting may be found in the Internet documents Request for Comments (RFC) 1112 and 1458 which are reproduced at Appendices A and B of the Savetz book and in D.P. Brutaman et al., "MBONE provides Audio and Video Across the Internet," *IEEE Computer*, Vol. 27, No. 4, pp. 30–36 (April 1994), all of which are incorporated herein by reference.

Citation of the foregoing documents is not to be construed as an admission that any of such documents is a prior art publication relative to the present invention.

SUMMARY OF THE INVENTION

The present invention is a scalable architecture for delivery of real-time information over a communications network. Embedded into the architecture is a control mechanism that provides for the management and administration of users who are to receive the real-time information.

In the preferred embodiment, the information being delivered is high-quality audio. However, it could also be video, graphics, text or any other type of information that can be transmitted over a digital network. This information is delivered in real-time to any number of widely distributed users. It is real-time in that for a given channel of information, approximately the same information is being sent at approximately the same time to everyone who is enabled to receive the information.

Preferably, there are multiple channels of information available simultaneously to be delivered to users, each channel consisting of an independent stream of information. A user chooses to tune in or tune out a particular channel, but does not choose the time at which the channel distributes its information. Advantageously, interactive (two-way) information can be incorporated into the system, multiple streams of information can be integrated for delivery to a user, and certain portions of the information being delivered can be tailored to the individual user.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of our invention will be more readily apparent from the following Detailed Description of a Preferred Embodiment of our invention in which

FIG. **1** is a schematic diagram depicting an overview of the system of the present invention;

FIG. **2** is a schematic diagram depicting the network control center for the system of FIG. **1**;

FIG. **3** is a schematic diagram depicting a unicast distribution structure;

FIG. **4** is a schematic diagram depicting a multicast distribution structure;

FIG. **5** is a schematic diagram depicting the connection between the media server and the user in the system of FIG. **1**;

FIGS. **6**, **7**, **8A–8C**, **9A**, **9B**, **10–15**, **16A**, **16B**, **17** are timing diagrams which depict various aspects of the operation of the system of FIG. **1**; and

FIGS. **18** and **19** depict the user interface for control of the system of FIG. **1**.

Where the same reference numerals appear in multiple drawings, the numerals refer to the same or corresponding structure in such drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1**, the system of the present invention comprises a Network Control Center **10**, a plurality of Primary Servers **20**, Media Servers **30**, Users **40** and Control Servers **50** and an Administration Server **60**. The servers are interconnected by a communications network, which in the preferred embodiment is the global connected internetwork known as the Internet. The Network Control Center **10** is the source of the information being distributed. It receives audio feeds from satellite, over the air broadcast or in other ways and processes this information for delivery over the network on multiple channels of information. This processing con-

sists of optionally recording the information for future broadcast and dynamically inserting paid commercial advertisements.

For each channel of information, there is a Primary Server **20** that receives the stream of information from the Network Control Center **10** and compresses the information stream to allow for more efficient transmission. The Primary Servers **20** are directly connected to the network.

The Primary Servers forward information via the network to a number of Media Servers **30**. There may be a large number of Media Servers and in fact there may be many levels of Media Servers. For example, a Media Server which receives a stream of information from a Primary Server may forward that stream via the network to another Media Server which then forwards it to a User **40**. This multilevel hierarchical structure is described in more detail below.

The topology of the Internet dictates the ideal placement of Media Servers, the fan-out of each Media Server and the number of levels of Media Servers between the Primary Server and Users. For example, the Media Servers which feed from a Primary Server might be placed at a major points of presence (POPs) of each of the large Internet service providers. These Media Servers might also be placed near clouds which serve as high bandwidth exchange points between the major carriers. Similarly, Media Servers which feed to Users might be placed on or close to networks which have a large number of subscribers to minimize the distance and number of data streams being transmitted.

Control Servers **50** are responsible for keeping track of which Users are listening to which channels and for directing the Media Servers to start and stop streams of information to those Users. The Control Servers are also responsible for handling other interactions among the various components of the system as will be described in more detail below. Each Control Server is responsible for managing a cluster of Media Servers; and each Media Server is managed by a single Control Server at any given time. As a result, the Control Servers are distributed throughout the Internet, preferably located close to the Media Servers.

The Administration Server **60** is responsible for registering new Users, authenticating Users who want to log onto the system, and maintaining audit logs for how many Users are listening to which channels and at which times. Maintaining audit logs and gathering statistics are features critical to monitoring the delivery of paid commercial messages as well as for other purposes. For example, for purposes of assessing copyright royalties, the audit logs can record the number of listeners for each musical or video selection that is distributed by the system. Another application is to determine the percentage of listeners who are interested in listening to a particular musical selection by determining how many listen to the entire selection and how many turn it off.

The system of the present invention can be considered a distribution architecture integrated with a control architecture. The distribution architecture handles scalable real-time delivery of information to any number of Users on a packet switched network, such as the Internet.

The control architecture represents a second scalable system integrated with the distribution architecture for managing and administering the delivery of that information.

The remainder of this description is divided into three sections. In the next section the distribution architecture will be described in more detail. Following that, the control architecture will be described. In the third section the User interface will be illustrated.

I. Distribution Architecture

The distribution architecture provides for the delivery of real-time information to any number of Users distributed throughout a network. As will be described in detail below, the distribution architecture is scalable to allow for efficient delivery of multiple simultaneous information channels in real-time to a large number of Users.

In the preferred embodiment, the information which is being distributed consists of high-quality audio in addition to other information. It should be appreciated that the basic architecture and other general principles set forth herein would also apply to the delivery of video, graphics, text or any other type of information that can be delivered over a digital network. In addition, it should be appreciated that an information stream can consist of audio with supplemental information such as text and graphic images and commands to control software running on the User's computer.

The source of information in the preferred embodiment is the Network Control Center **10**, depicted in the schematic diagram of FIG. **2**. Control Centers of this type of design are available from Broadcast Electronics, Inc. and are similar to what would be found in a conventional radio station serving multiple frequencies.

Referring to FIG. **2**, the incoming signal can be received in a variety of ways such as from a satellite, over-the-air broadcast, cable or hard disk. It is then processed by Receiver/Decoder **110**, which decodes the signal and provides an incoming audio stream. Routing Switcher **120** is responsible for routing the incoming audio feed from the Receiver to either Delay Recording Workstation **140** or to one of the Playback/Control Workstations **130**. Real-time insertion of paid commercial advertising takes place at the Playback/Control Workstations and the resulting integrated audio stream is delivered to the Primary Servers. The Delay Recording Workstation is responsible for recording an incoming broadcast so that it can be played back at a later time.

Supervisory Workstation **150** is responsible for managing and controlling the Playback/Control Workstations, Delay Recording Workstations and other computers as may be connected to the local area network within the Network Control Center. Production Workstation **160** and Audio-VAULTNFS Server **170** are used to manipulate audio samples, such as commercial messages for use by the Playback/Control Workstations. The audio being delivered can consist of syndicated TV or radio programs, such as would be received over satellite or cable and delivered as described above. These can be delivered live and/or played back at a later time. It is also possible for the delivery of information, such as music, to take place from information that is all stored locally such as on a hard disk. A new play list and its associated music data can then be downloaded periodically to update the channel. Additionally, it is possible to deliver commercial-free programming, for example public service announcements or label-specific music.

In the preferred embodiment the Primary Servers are responsible for compressing the audio stream using an advanced perceptual technique developed and licensed by AT&T Corp. and Lucent Technologies, Inc. This highly sophisticated algorithm is used to maximize the benefit of the bandwidth available. Advantageously, two bitrates are available, a first rate of approximately 20Kbps and a second rate of approximately 56Kbps. Using the perceptual technique, the quality of the first rate is similar to FM monaural (with a sampling rate of approximately 22.000 16-bit samples per second) and the second rate is close to

CD quality stereo (with a sampling rate of approximately 32.000 16-bit samples in stereo each second). The signals at the two different bitrates comprise two different audio channels and thus require two different compression processes.

The computational requirements of compressing an audio stream in real time using techniques such as the advanced perceptual technique are approximately 100% of a Pentium-Pro 200Mhz computer and the computational requirements of decompressing an audio stream in real time are approximately 30% of a Pentium 75Mhz computer. Future improvements and/or changes to the algorithm could significantly change these requirements. For the present, a dedicated computer is required within the Primary Server to compress the audio stream. The decompression process takes place on end Users' computers and preferably would use only a portion of the computers' computational requirements, allowing the computers to be used for other tasks while they are processing the audio stream.

It is important to appreciate that the compression and decompression techniques employed by the present invention are not critical to the overall operation of the system and the advantages obtained therefrom could be obtained with other compression methodologies. Advantageously, the identity of the compression technique used can be encoded into the audio stream in the packet header. This makes it possible to identify to the receiver the nature of the decompression algorithm to use; and thereby make it possible for the computer within the Primary Server to select an optimum compression algorithm depending on the nature of the audio stream to be compressed.

The remainder of the distribution architecture comprises the multilevel hierarchy of data transmission originating at the Primary Server **20** and terminating at the Users **40** as shown in FIG. 3. In the preferred embodiment, the network is the global connected Internet. It can also include private networks which are connected to the Internet and it could be implemented on any packet switched network, cable-modem-based or satellite-based cable system. It is possible that certain links within the overall system, for example, the link between the Primary Server and the first level of Media Servers, are private data links which carry only data associated with this system. This could also be true of other data transmission paths in the distribution architecture. The User receiving the information preferably can be anyone who has access to the Internet with sufficient bandwidth to receive the resulting audio data.

It should be appreciated that the distribution architecture of the present invention provides for scalability. Using such a structure, any number of Users, and as widely distributed as necessary, can be accommodated. In the preferred embodiment, the fan-out at each level of Media Server (given the state of technology today) is on the order of ten, but the same structure could be applied with other fan-outs. The location and fan-out of the Media Servers is chosen to minimize overall network bandwidth consumed.

The flow of information from Primary Server **20** through network to User **40** is based on the delivery of a continuous sequence of individual pieces of information, or packets. Thus the distribution architecture implements a form of multicast packet delivery to a group. The group in this case is the set of all Users who are listening to a given channel at a given time. Group membership is dynamic, Users can start and stop listening to a channel at any time.

Multicasting can be implemented in a variety of ways, any or all of which can be used in the present invention. In the preferred embodiment, the Media Servers receive unicast packet streams and they then duplicate these streams into more unicast streams to other Media Servers which are in the membership group for that stream. The lowest level Media Servers use hardware broadcast, multicast and/or unicast to reach all Users served by that Media Server.

If the Media Server is directly connected to the same physical network as the User, hardware broadcast or multicast can be used to transmit the packet stream to all Users listening at that time on that network. In this case the Media Servers can translate the incoming packets into broadcast or multicast packets for transmission on the local network. Only a single packet is transmitted at-a-time on the local network and any computer directly connected to the local network can receive that packet. Hardware multicast is built into most networks and it is lower in overall overhead than hardware broadcast since computers not interested in a transmission do not have to process the packets. In the case that a Media Server is serving a User who is not on the same physical network, a unicast transmission is used to reach that User, which requires a separate packet transmission for each User so connected. In the preferred embodiment, the assignment of Users to Media Servers is done using control transactions among the User **40**, Control Servers **50**, and Administration Server **60**. This system will be described more fully in the following section. Multicasting can also be implemented within the Internet at the IP level using IP class D addresses and the IGMP group control protocol. FIG. **4** illustrates how the multilevel hierarchical distribution architecture would operate using IP multicast delivery. Under this system, a packet is transmitted with a multicast address for a destination and each router maintains group membership lists for each interface that it is connected to and will forward packets across the Internet to other routers such that all Users within the global group eventually receive a copy of the packet. Unless and until all routers within the Internet understand multicasting in this way, it is necessary to supplement it with IP tunneling in which multicast packets are encapsulated in unicast packets and routed by unicast routers to a multicast routers. The present invention can and will be able to take advantage of IP multicasting as it becomes widely available. Each channel of information would be given its own class D address and the Media Server would then simply transmit packets using the appropriate IP destination address. In this case no Media Servers would be used as this function would be accomplished by the routers in use to store and forward other IP packets. Thus it can be appreciated that the implementation of the multicast delivery structure can be implemented using a combination of IP unicast, IP multicast and hardware multicast or any other system which provides for distributed delivery of information to a specific group of destinations. It is expected that special relationships with Internet providers will be established so that delivery of the audio steams can take place with a guaranteed bandwidth and in the most efficient way possible.

In the preferred embodiment, packets of information for distribution use the UDP protocol under IP rather than the TCP protocol. TCP provides for reliable stream delivery but at the cost of retransmission and delays. For real-time information, it is usually more appropriate to use UDP since the information is time critical and low latency is more important that reliability. Since TCP is a point-to-point protocol, it is incompatible with IP multicasting. However, TCP could be used on the IP unicast links between Media Servers which are expected to have very low packet loss. In order to handle out of order, lost, duplicate and corrupted packets, the UDP packets are serialized.

In the preferred embodiment the size of the audio packets being transmitted is variable and can change on a packet by packet basis. It is expected that when using compression schemes that have a fixed bit rate, such as ADPCM, all packets for that stream would be the same size. Alternatively when using a variable bit rate compression algorithm, it is expected that packet size would vary so as to establish approximately the same amount of time for each sample. For example, if each packet corresponds to a 20 millisecond segment of speech, this could correspond to 100 bytes during one time period and 200 bytes during another.

Additionally, the Media Server may choose to dynamically vary the packet size to accommodate changes in network conditions.

Since the resulting playback of audio information is sensitive to packet loss and network congestion, software running on the various computers which make up this system monitor the ongoing situation and adapt to it in the best possible way. This may involve using different Media Servers and/or lowering the data rate to the User. For example, similar to analog dynamic signal quality negotiation present in many analog radio receivers, the User software may request a lower bitrate until the situation is improved. Also, note that the audio information being delivered to the User is preferably interleaved so that a contiguous segment of the audiostream is distributed for transmission over several packets. As a result, the loss of one packet is spread out over multiple audio samples and causes minimal degradation in audio. Advantageously, a small degree of redundancy may be incorporated within the audio stream to further guard against packet loss.

Preferably, there are two bitrate options available to the User for audio delivery. These are approximately 20Kbps for standard audio and approximately 56Kbps for high quality audio. Thus, a 28.8Kbps modem connection over an analog phone line is sufficient to listen to standard audio broadcasts. To listen to high quality audio, an ISDN connection to the Internet is required, or some other connection with greater than 56Kbps bandwidth. It should be appreciated that higher bandwidths are currently becoming available to end Users. In particular the use of cable modems and residential fiber networks are enhancing the bandwidths available to Users and thus making broadcasts of higher bitrates more practical. In addition to the content of the audio channel being delivered, it is also possible to deliver out of band of side-bar information such as graphics, images and text.

This side-bar information is synchronized with the audio channel. This may only involve small increases in bandwidth requirements, such as 1–2Kbps. For example a music program could deliver images of an album cover, the text of song lyrics, or URLs for use by a Web browser. The User can preferably choose to have the side-bar information show up automatically or be hidden. It is also possible to incorporate two-way interaction into the system, such that for example Users can participate in a global chat session during the audio broadcast. These and other details are explained in more detail below under the description of the User interface.

The delivery of paid commercial advertising information is an important aspect of the present invention. Advertising may be incorporated into the audio stream within the Network Control Center as described above. It may also be incorporated into the audio stream at the User level, or at some intermediate point in the distribution architecture. In addition, the side-bar information discussed above can also include advertising content. FIG. 5 illustrates the provision to the User of two separate streams 32, 34 of packets, one of which may be used for advertising. In this case the insertion of the stream of commercial advertising into the non-commercial stream occurs on the User's computer. FIG. 5 also illustrates packet stream 36 which identifies the User to the system. This enables the system to monitor which Users are listening to which channels and also allows the system to vary, for example, the advertising content delivered to a User.

One advantage of this alternative is to allow targeted commercial delivery based on the individual User.

That is, an individual User would receive the main audio feed plus a particular advertising stream unique to his demographic group. Note that the advertising stream typically is lower in overall bitrate and generally does not require real-time delivery, thus lowering the overall load on the network. For example, the advertising stream could be delivered to the User in advance of the regular programming, stored in a buffer in the User's computer and inserted into the stream of regular programming upon receipt of a cueing signal embedded in the stream of regular programming. Thus, a substantial number of targeted groups, perhaps 10 or 100 or even more could be accommodated without an impractical increase in network load.

II. Control Architecture

The control architecture described in this section is responsible for managing and administering the Users who are receiving the information being delivered by the distribution architecture described in the previous section. The control architecture handles new User registration, User login, the starting and stopping of audio streams and the monitoring of ongoing transmissions. The control architecture is scalable just as is the distribution architecture so that any number of Users can be managed.

This section describes the control protocol, which consists of the format and sequence of control messages that are exchanged among Users, Control Servers, Media Servers, Primary Servers and the Administration Server. These messages are in the form of objects, which have specific data formats. Objects are exchanged preferably using the TCP protocol although other options are possible. Below we describe the sequence of objects passed among the various computers and detail the internal structure of each object.

The major objects used in the present embodiment of the invention are set forth in Table 1. For each object, Table 1 provides a brief description of its function, identification of the names of the fields in the object, their types and a brief description of their function.

TABLE 1

Field Name	Field Type	Remarks
Channel Activation Object		
Contains information used for channel activation/deactivation. It is sent to Media and Primary Servers to tell them to carry or stop carrying a specific channel. Media Servers get the channel from another server in the system hierarchy and Primary Servers get and encode the feed from the actual input source.		
Token	Security Token Object	
Moniker	Moniker Object	unique channel identifier
Activate	Int	action flag (activate/deactivate)
CompressType	Int	type of compression to use
Host	Host Object	host carrying the channel

TABLE 1-continued

Field Name	Field Type	Remarks
Channel Guide Object		
Contains analytical and descriptive information for an item requested that is uniquely identified by a moniker. It is usually the reply to a Channel Guide Request object.		
Token	Security Token Object	
Type	Int	type of content
Result		the content data itself
Channel Guide Request Object		
Conveys a request for analytical and descriptive information about an item uniquely identified by the contained moniker. The reply is in the form of a Channel Guide object.		
Token	Security Token Object	inherited from base class
Type	Int	type of content
Moniker	Moniker Object	unique identifier
Host Object		
Encapsulates the attributes of a networked computer related to the operation or services it offers or requests.		
Token	Security Token Object	
HostName	String	computer name and domain
PortNumber	Int	port number for service
DisplayName	String	descriptive computer name
Login Information Object		
Encapsulates the name and password by which a User is known to the system.		
Token	Security Token Object	
Login	String	User's system login name
Password	String	User's system password (possibly encrypted)
Media Control Interface (MCI) Request Object		
Encapsulates a multimedia control command, such as play and stop, and any extra information that may be necessary to perform the requested service.		
Token	Security Token Object	
Command	Int	multimedia command
String	String	command-specific extra info
Moniker Object		
A moniker encapsulates the name of an object or process with the intelligence necessary to work with that name. In other words, it provides naming and binding services. The Moniker Object is used in the system for unique identification of various components, parts or features, such as a channel, a directory, or a computer list.		
Token	Security Token Object	
ID	String	unique string identifier
DisplayName	String	User-readable name
Ping Object		
Ping is the name given to the "Are-You-Alive?" operation useful in determining if a specific computer is up and running. This object is used in the system when a server has to be queried for its operational status. It can also provide timing information for statistical purposes and quality of service evaluations.		
Token	Security Token Object	
Date	Date	system date
Time	Time	system time
Protocol List Object		
Encapsulates a general purpose collection object.		
Token	Security Token Object	
Type	Int	type of object list
Result Message Object		
Acts as the acknowledgment for a requested service successfully carried that out or reports errors that occur in the system during a client/server transaction.		
Token	Security Token Object	
Code	Int	result code
Message	String	message corresponding to code
Security Token Object		
Contains the authorization key for a transaction. The key must be validated before any service is performed.		
ID	String	authorization key/ transaction ID.
Server Activation Object		
Contains information used in the server activation/deactivation process. Used for announcement as well as command purposes (e.g., a server can notify the administration database that is now activated or a server can be instructed to manage someone else).		
Token	Security Token Object	
Active	Int	action flag (activate/ deactivate)
Manage	Int	control flag (manage/ associate)
Type	Int	server type
Host	Host Object	host to be controlled
Server List Request Object		
Encapsulates a request for a list of available server resources for an identified service (e.g., a request for a list of Control Servers for a specified channel).		
Token	Security Token Object	
Type	Int	type of service
Moniker	Moniker Object	content/channel unique identifier
Host	Host Object	local host information
Statistics Object		
Contains system-related information that can be used by load-balancing algorithms and for statistical purposes.		
Token	Security Token Object	
Load	Int	load on the system
Threads	Int	number of threads running
Users	Int	number of Users being serviced
Uptime	Int	amount of time running
NumberManaged	Int	number of managed servers
NumberAssociated	Int	number of associated servers
Statistics Request Object		
Encapsulates a request for system-related information that can be used by load-balancing algorithms and statistical purposes.		
Token	Security Token Object	
Load	Int	request flag (on/off)
Threads	Int	request flag (on/off)
Users	Int	request flag (on/off)
Uptime	Int	request flag (on/off)
NumberManaged	Int	request flag (on/off)
NumberAssociated	Int	request flag (on/off)
User Object		
Users and Servers use this object to register themselves with the administration database. They provide the information for subsequent logins (name, password) and other system-related info. The end-Users provide personal, demographic, and system-related information.		
Token	Security Token Object	
Login	Login Information Object	login information(name, password)
FirstName	String	User's first name
LastName	String	User's last name
Title	String	User's job title
Company	String	User's employer
Address1	String	User's home street address
Address2	String	User's address extra
City	String	city, village
State	String	state, province or foreign country
ZipCode	String	zip or postal code
Age	String	User's age

TABLE 1-continued

Field Name	Field Type	Remarks
Gender	String	User's gender
PhoneNumber	String	telephone number
FaxNumber	String	fax number
Email	String	email address
Demographics	Dictionary	market-targeting extra User info
SystemInfo	Dictionary	system-related information
Version Object		
All components of the system use this object to report their versioning information to the party they transact with in order to use a protocol they both understand. They are also given the chance to update themselves if a newer version exists.		
Token	Security Token Object	
Major	Int	major protocol version number
Minor	Int	minor protocol version number
Type	Int	sender type
Client	Version	client version information

Unlike traditional protocols based on state computers, the control protocol of the present invention is a light-weight, stateless protocol comprising simple sequences of objects. It is light-weight in that in most sequences only two objects are involved in the transaction and after a sequence is completed the connection can be reused. It is also stateless in that the server maintains no information about the client. Every transaction is handled independently of the previous ones. States exist in the lower levels, for example within the TCP layer, to express logical states of a network connection but they are not actually part of the control protocol.

In the preferred embodiment, the software running on the Control Servers, Media Servers and Primary Servers is programmed for Windows NT and UNIX environment using the OLE environment. In addition, COM interfaces are used between components. The Rogue Wave system is used to transfer objects between the applications running on the various computers. The software running on the User computer is preferably programmed for a Windows 32-bit environment, so it will run on a Windows 95 or Windows NT computer. Alternatively, Macintosh and UNIX environments can be accommodated by other User software.

The basic process of a control transaction consists of a version sequence followed by one or more protocol sequences. The version sequence starts after the computer initiating the transaction, the client, has established a connection with the computer completing the transaction, the server. The client sends a Version Object (defined in Table 1) and in response the server then sends back its own Version Object. This version sequence is used so that both client and server are aware of the version numbers of the software they are using. If a version number is older than expected, either client or server can choose to conform to the previous version or abort the transaction, depending on its needs and capabilities. If a version number is newer than expected, in most cases the current transaction can be completed since the software systems are designed to be fully backward compatible with previous versions. Additionally, in the case that the server of the transaction is the Administration Server, the client receives information about what the latest version number is and thus the client can be informed that a software update is needed. The process of handling automatic updating of User software is described more fully below.

After the version sequence, one or more protocol sequences occur in which other objects are exchanged between client and server. When a particular protocol sequence is completed, another independent protocol sequence can be serviced. The protocol sequences that are part of the control architecture of the present invention are summarized in Table 2 and described below in conjunction with FIGS. 6–17.

TABLE 2

Summary of Protocol Sequences

Control Sequence	Client	Server	Main Objects Exchanged
User Registration and Login (see Fig. 6)	User	Administration	Version Object User Object Channel Guide Object
User Login (see Fig. 7)	User	Administration	Version Object Login Information Object Channel Guide Object
Channel Play (see Figs 8a, 8B, 8C)	User	Administration	Version Object Server List Object
		Control	Version Object Server List Object
		Media	Version Object MCI Objects - OPEN/PLAY/ STOP/CLOSE Ping Objects (TCP connection stays open)
Token Validation (see Figs. 9A, 9B)	Control or Media or Primary	Administration or Control	Version Object Security Token Object
Server Registration and Login (see Fig. 10)	Media or Control	Administration	Version Object User Object Server Activation Object
Server Login (see Fig. 11)	Media or Control	Administration	Version Object Login Object Server Activation Object
Control Server Activation (see Fig. 12)	Administration	Control	Version Object Server Activation Object
Media Server Activation (see Fig. 13)	Control	Media	Version Object Server Activation Object Ping Objects (TCP connection stays open)
Control Channel Activation (see Fig. 14)	Administration	Control	Version Object Channel Activation Object
Media Channel Activation (see Fig. 15)	Control	Media	(open TCP connection) Channel Activation Objects
Distribution Activation (see Fig. 16)	Media	Media or Primary	Version Object MCI Objects - OPEN/PLAY/ STOP/CLOSE Ping Objects (TCP connection stays open)
Statistics Request (see Fig. 17)	Administration	Control or Media	Version Object Statistics Object

The User registration and login sequences are the processes by which a new User registers with the system, logs in and retrieves programming information. The channel play sequence takes place when a User asks to listen to a particular channel. The token validation sequence is used to verify that a computer requesting a service is authorized to

do so. The Server registration, login and activation sequences are used by Control and Media Servers when they become active. The Control Server and Media Server activation sequences are used to manage the Control and Media Servers. The control channel, media channel and distribution activation sequences are used to cause a channel to be distributed to a Media Server. Finally, the statistics request is used for administrative purposes.

FIG. 6 illustrates the User registration and login sequence in more detail. This sequence takes place after the User has installed the User software on his/her computer. It is expected that the User will download the software from the Internet and then invoke it which in the preferred embodiment will use the Windows Wizard interface. This will guide the User through the installation process including filling out the registration form, which we will describe more fully in the next section. After the User has selected a name and password and selected the option to register, the User computer opens a TCP connection to the Administration Server. Advantageously, the full domain name of the Administration Server is embedded into the User software, although it could be discovered in other ways. The User and Administration Server then exchange version objects with the Administration Server as described above. If the version numbers meet expectations, the User sends a User Object to the Administration Server. The format of the User Object is shown in Table 1. Once the Administration Server receives the User Object, it verifies that the information is filled in properly and that the selected User name is unique. If the User Object is invalid for any reason, the Administration Server returns a Result Message Object with a code indicating the reason. The format of the Result Message Object is shown in Table 1. If the User information is valid, the Administration Server updates the global database of User names and passwords and then generates a security token for that User. This security token is then returned to the User in a Result Message Object. Upon receiving the Result Message Object, the User saves the security token for future use. This token is an identifier that allows the User to request services from the Administration Server and other computers within the overall system. The security token is not saved permanently or registered on the User computer. Normally, the User software then immediately sends a Channel Guide Request Object to the Administration Server and a Channel Guide Object is returned.

The format of these objects is also shown in Table 1. Note that in principle, this is a separate transaction and could take place in a separate TCP connection to the Administration Server. In particular, once the User has registered and logged in, he/she can request the Channel Guide Object again since it may have been updated since the previous request.

At this point the TCP connection to the Administration server is closed.

The process of User registration only needs to take place once for each User. However anyone can re-register at any time, even after the software has been installed. In particular, it is expected that if multiple persons use a computer, each person will register and obtain his/her own User name and password. If the registration process is not completed successfully, the User software saves the registration information and ask the User if they would like to try again the next time the software is invoked.

Since the security token is not permanently saved by the User software, it is lost when the User software is closed, and the security token must again be retrieved from the Administration Server the next time the User wants to use the system. This process is the purpose of the login sequence illustrated in FIG. 7. This sequence is used if a User has already registered and needs only to retrieve a valid security token. In this case the sequence consists of the User's sending a Login Information Object to the Administration Server. The Administration Server then queries the User database to validate the login name and password. If the login name and password are correct, then a security token is returned to the User. Normally the receipt of the security token will immediately be followed by a channel information request sequence, just as in the registration sequence described previously.

The control sequence that takes place when a User initiates a channel play operation is illustrated in FIGS. 8A, 8B and 8C. First the User software requests a Control Server List from the Administration Server. Note that the Server List Request Object, illustrated in Table 1 contains a channel identifier. The Administration Server generates a sorted list of Control Servers based on overall system load and the location of the User on the network and returns this list to the User using a Protocol List Object. Once the Control Server List is returned to the User, the Administration Server is no longer needed and the TCP connection is closed.

The User software then searches the list of Control Servers and opens a TCP connection to the first host listed.

If that host computer does not respond, then the next Control Server on the list is tested and so forth in succession.

Upon obtaining a response from a Control Server, the User software uses a Server List Request Object to requests a Media Server List from the Control Server. If the Control Server is too busy to service the User, it returns a Result Message Object so indicating and the User software tries the next Control Server on the list. However, in the likely scenario that the Control Server is able to handle the User's request, a sorted list of Media Servers is generated and returned to the User computer using a Protocol List Object. The TCP connection to the Control Server is then closed by the User software.

At this point the User software initiates a TCP connection to the first Media Server on the list provided by the Control Server. As in the previous case, it attempts to connect to the first host on the list and if unsuccessful tries the next hosts in succession. Once the Version Objects are exchanged, the User software sends an MCI Request Object to the Media Server. An MCI Request Object can be used for four basic commands: OPEN, PLAY, STOP and CLOSE. The User software must first send an OPEN command for the desired channel. If the returned Result Message Object indicates success, the User software then sends a PLAY command. When the Media Server receives a valid PLAY command, it initiates the delivery of audio information to the User as described in the previous section. Note that this could be in the form of broadcast, multicast or unicast packets to a specific UDP port. The TCP connection through which the MCI Request Objects were sent stays open during the audio play operation. In addition, Ping Objects are sent to the User on a periodic basis to verify that the computer is still working and active. When the User software receives a Ping Object, it simply returns it. The Media Server uses the Ping Objects to measure round trip time and also to determine when a User's computer has terminated abnormally. In that case the audio stream is terminated.

In the case of normal termination of the audio stream, the User makes an explicit selection to stop and this causes a STOP command to be sent to the Media Server in an MCI Request Object. The Media Server then terminates the audio

stream to that User. When the User closes the application software or selects another channel to play, the User software will send a CLOSE command to the Media Server in an MCI Request Object and the TCP connection is closed.

The initiation of the audio stream by the Media Server causes a log entry to be generated and sent to the Administration Server. This information is important so that the Administration Server can update its database to indicate which Users are listening to which channels. The security token is used to identify the User initiating the audio stream. Additionally, when the audio stream is terminated to any User, another log message is generated and sent to the Administration Server.

FIG. 9A illustrates the process by which security tokens are validated. The Administration Server is the only server that can validate a security token. Thus, when a User requests services from a Control Server or from a Media Server, that server must go back to the Administration Server with a token validation sequence. However, Control Servers and Media Servers are allowed to cache validations of security tokens so that they do not have to validate tokens repeatedly once they have validated it the first time. In the case where a Media Server receives a request, the token will be validated with the Control Server that is managing that Media Server. FIG. 9B identifies the various token validation scenarios.

FIG. 10 illustrates the process by which a new Server is registered. This process is similar to new User registration. It is expected, however, that the server installation will be through a Web interface rather than a Wizard. The Administration Server, upon receiving a User Object from a Media Server or Control Server validates the User name and password and generate a security token just as in the case of User registration. Normally the Server then immediately sends back a Server Activation Object indicating that it is ready to be used as a system resource. Once this process has been completed, the TCP connection to the Administration Server is closed.

If a Media Server or Control Server that has sent a Server Activation Object to the Administration Server becomes inactive, it will send another Server Activation Object indicating this condition. In the case of a Media Server, this object is sent to the managing Control Server. In the case of a Control Server, this object sent to the Administration Server. As in the case of User registration, Media Server and Control Server registration needs only take place once per computer. However, if the computer is restarted, the server must login and again retrieve a security token. This is the server login and activation sequence shown in FIG. 11.

Once a Control Server has indicated to the Administration Server that it is ready, the Administration Server can activate that Control Server by sending the Control Server a Server Activation Object as illustrated in FIG. 12. This is a separate transaction and is used to tell the Control Server which Media Servers it is supposed to manage. Recall that a Control Server and a number of Media Servers form a cluster of Media Servers. The single Control Server that manages that cluster must be given a list of host computers corresponding to the Media Servers in that cluster.

The process by which a Control Server activates the Media Servers that it manages is illustrated in FIG. 13. The Control Server sends a Server Activation Object to the Media Server indicating that it is responsible for channel management. This TCP connection between the Control Server and the Media Server stays open during the time that both servers are active. The Control Server periodically sends Ping Objects to the Media Server across this open TCP connection to verify that the Media Server is still running.

FIG. 14 illustrates the process by which a given channel is activated by the Administration Server. The Administration Server opens a connection to a Control Server that its wishes to have carry a given channel and provide a Channel Activation Object. This object indicates to the Control Server which Media or Primary Server the Control Server should direct its Media Servers to get the feed from. At this point the Control Server is said to be carrying that channel and it will be a valid host on a list of Control Servers requested by a Channel Play sequence.

FIG. 15 illustrates what happens when a Control Server needs to provide a channel. First it sends a Channel Activation Object to one of the Media Servers that it manages across the open TCP connection described previously. This object indicates to the Media Server that it should start receiving the channel identified and from where it should receive it.

In FIGS. 16A and 16B depict how the Media Server requests distribution of an audio channel from another Media Server or from a Primary Server. This sequence is much the same as that in which a User requests the distribution of audio information from a Media Server. Note that a Media Server receives a single incoming stream for each channel that it is carrying and will then redistributes this stream to all Users or other Media Servers that request it.

Finally, FIG. 17 illustrates the statistics request sequence. This sequence is used by the Administration Server to gather information from the Media Servers and Control Servers in order to manage the overall system. It can use this information to detect failures and to balance load as the dynamic conditions change. As indicated above, it can also use this information to monitor which Users are listening to which channel or whether Users stop listening to a channel at any time, such as during the play of a particular song. It can also use this information to control the advertising content that is downloaded to a particular User in advance of receipt of regular audio programming and/or monitor the delivery of advertising to the Users.

The control architecture described in this section is scalable to handle any number of Users. Note that the User registration process only happens once for each subscriber and the login process only happens once per session. These interactions, which require the Administration Server are expected to constitute a very small percentage of the overall system bandwidth. If the Administration Server were to become a bottleneck, however, it would be possible to duplicate it and to have the database it maintains distributed and automatically updated to guarantee consistency.

The Control Servers are distributed throughout the network and can handle the lower level interactions with the Users and the Media Servers. A single Control Server can handle preferably on the order of ten Media Servers up to several hundred Users. The bitrate among the Users, the Control Servers and the Media Servers is expected to be small in comparison to the audio transmission bitrate. The Ping Objects normally only involve the User and the nearest Media Server. They are also low in overhead since they are small and only get transmitted infrequently.

III. User Interface

The User interface is provided by the client application running on an individual computer and its associated graphical interface. In the preferred embodiment the User interface is available for 32-bit Windows (95 and NT), Macintosh and

UNIX platforms. Preferably anyone on the Internet can freely download a copy of the client software and install it in their computer.

FIG. **18** illustrates the main User screen in the preferred embodiment. The screen is composed of three sections: channel guide (upper left frame), program guide (upper right frame), and multimedia frame (lower half of screen). The channel guide lists, as a tree hierarchy, the channels that are available from the system. The User selects a channel from the list of those displayed on the channel guide. The program guide provides information pertaining to the channel selected. This information can be a detailed schedule of the programming that has played or will be playing on the channel selected. Additionally, other relevant information will be displayed in this frame, for example, a notice regarding an upcoming special event on another channel. The multimedia frame provides an integrated web browser that displays information via a series of tabbed sections.

The information contained in the channel guide, program guide, and the tabs of the multimedia frame is dynamically transmitted to the client. For example, if a new channel begins operation, the client application can immediately display it as being available. Furthermore, the tabs displayed can be specifically relevant depending on what song is playing. For example, tabs displaying the album cover, information on the artist, song lyrics, tour dates can be displayed. Additionally, as shown in the example in FIG. **18**, a tab can be available allowing the User to place an order for the CD or allowing the User to participate in a chat session related to the channel.

FIG. **19** illustrates the key pull-down menus available in the main User screen in the preferred embodiment. Table 3 provides a description of each of the functions available through the pull down menus, as shown in FIG. **19**.

As will be apparent to those skilled in the art, numerous modifications may be made within the spirit and scope of the invention.

TABLE 3

Pull-Down Menu Functions

Menu Choice	Menu Sub-Choice	Description
File	Login	Allows the User to login to the system.
	Logout	Allows the User to logout from the system.
	Register	Brings up a dialog so that the User can register with the system for the first time.
	Close	Minimizes the screen.
Edit	Copy	Allows the User to copy the selection on to the clipboard.
	Properties	Allows the User to set various properties.
Audio	Play	Begins playing the selected channel.
	Stop	Stops playing the selected channel.
	Mute	Stops the playing of audio
View	Tool Bar	Display or hide the tool bar (providing access to pull-down menu functions).
	Status Bar	Display or hide the status bar normally situated at bottom of the screen.
	Web Bar	Display or hide the tool bar section that provides access to the web browser functions.
Help	Help Topics	Brings up a list of available online help topics.
	About. . .	Displays summary information regarding this application, such as version number, copyright information, and so on.

What is claimed is:

1. A method for transmitting message packets over a communications network comprising the steps of:

converting a plurality of streams of audio and/or visual information into a plurality of streams of addressed digital packets complying with the specifications of a network communication protocol,

for each stream, routing such stream to one or more users,

controlling the routing of the stream of packets in response to selection signals received from the users, and

monitoring the reception of packets by the users and accumulating records that indicate which streams of packets were received by which users, wherein at least one stream of Rackets comprises an audio and/or visual selection and the records that are accumulated indicate the time that a user starts receiving the audio and/or visual selection and the time that the user stops receiving the audio and/or visual selection.

2. The method of claim **1** further comprising the step of including in at least one stream of packets at least some advertising information.

3. The method of claim **2** further comprising the step of varying the content of the advertising information with the identity of the user to whom the advertising information is provided.

4. The method of claim **2** wherein the advertising information is inserted into the stream of audio and/or visual information before such stream is converted into a stream of packets.

5. The method of claim **2** wherein the records that are accumulated indicate how many users received specific advertising information.

6. The method of claim **2** wherein the records that are accumulated indicate which users received specific advertising information.

7. The method of claim **1** further comprising the step of generating an audio output and/or a visual display from the stream of packets received by the user.

8. The method of claim **1** further comprising the steps of:

storing a first stream of packets received by the user at a first time and at a later time, inserting the first stream of packets into a second stream of packets received at the user.

9. The method of claim **8** further comprising the step of converting the combined first and second streams of packets into an audio output and/or visual display.

10. The method of claim **8** wherein the first stream of packets contains advertising information.

11. The method of claim **8** wherein the content of the advertising information is varied depending on the identity of the user.

12. The method of claim 1 wherein at least one stream of packets comprises copyrighted music selections and the records that are accumulated indicate how many users received specific music selections.

13. The method of claim 1 wherein at least one stream of packets comprises music selections and the records that are accumulated indicate how many users did or did not listen to the entire selection.

14. The method of claim 1 further comprising the steps of:

compressing the stream of packets in their passage from source to user, and

decompressing the stream of packets near the user.

15. The method of claim 14 wherein the compressing step uses a compression algorithm that is selected in accordance with the content of the information being communicated in the stream of packets.

16. The method of claim 15 wherein the compressing step inserts into each packet an identification of the compression algorithm used and the decompressing step monitors each packet to read such identification and to vary its decompression algorithm in response thereto.

17. The method of claim 1 wherein at least one stream of packets comprises copyrighted music selections and the records that are accumulated indicate which users received specific music selections.

18. The method of claim 1 further comprising the steps of:

storing a first stream of packets received by the user at a first time and

inserting the first stream of packets into a plurality of streams of packets received at the user at a plurality of later times.

19. A method for transmitting at least one stream of audio and/or visual information over a communications network to a plurality of users comprising the steps of:

controlling the routing of the stream of information through the network in response to selection signals received from the users, and

monitoring the reception of the stream of information by the users and accumulating records relating to the reception of the stream of information by the users wherein at least one stream of information comprises an audio and/or visual selection and the records that are accumulated indicate the time that a user starts receiving the audio and/or visual selection and the time that the user stops receiving the audio and/or visual selection.

20. The method of claim 19 further comprising the step of including in at least one stream of information at least some advertising information.

21. The method of claim 20 further comprising the step of varying the content of the advertising information with the identity of the user to whom the advertising information is provided.

22. The method of claim 20 wherein the records that are accumulated indicate how many users received specific advertising information.

23. The method of claim 20 wherein at least one stream of information comprises copyrighted music selections and the records that are accumulated indicate how many users received specific music selections.

24. The method of claim 20 wherein at least one stream of information comprises music selections and the records that are accumulated indicate how many users did or did not listen to he entire selection.

25. The method of claim 20 further comprising the steps of:

compressing the stream of information in its passage from source to user, and

decompressing the stream of information near the user.

26. The method of claim 25 wherein the compressing step uses a compression algorithm that is selected in accordance with the content of the information being communicated in the stream of information.

27. The method of claim 20 wherein the records that are accumulated indicate which users received specific advertising information.

28. The method of claim 19 further comprising the steps of:

storing a first stream of information received by the user at a first time and

at a later time, inserting the first stream of information into a second stream of information received by the user.

29. The method of claim 28 wherein the first stream of information contains advertising information.

30. The method of claim 19 wherein multiple streams of audio and/or visual information are transmitted over the communications network and the user can select which stream to receive.

31. The method of claim 19 wherein at least one stream of information comprises copyrighted music selections and the records that are accumulated indicate which users received specific music selections.

32. The method of claim 19 further comprising the steps of:

storing a first stream of information received by the user at a first time and

inserting the first stream of information into a plurality of streams of information received at the user at a plurality of later times.

33. A communication system comprising:

means for converting at least one stream of audio and/or visual information into a stream of addressed digital packets complying with the specifications of a network communication protocol,

means for routing such stream via a communication network to selected users,

means for controlling the routing of the stream of packets in response to selection signals received from the users, and means for monitoring the reception of packets by the user and for accumulating records that indicate which streams of packets were received by which users, wherein at least one stream of Rackets comprises an audio and/or visual selection, and the means for monitoring further includes means for accumulating records that indicate the time that a user starts receiving the audio and/or visual selection and the time that the user stops receiving the audio and/or visual selection.

34. The communication system of claim 33 further comprising means for including in the stream of packets at least some advertising information.

35. The communication system of claim 34 further comprising means for varying the content of the advertising information with the identity of the user to whom the advertising information is provided.

36. The communication system of claim 34 wherein the means for monitoring further accumulates records that indicate which users received specific advertising information.

37. The communication system of claim 33 wherein at least one stream of packets comprises copyrighted music

selections and the means for monitoring further accumulates records that indicate which users received specific music selections.

38. The method of claim 33 further comprising means for storing packets received at the user during a first time period and means for inserting such packets into other packets received at the user at a plurality of later time periods.

39. The communication system of claim 33 further comprising means for generating from the stream of packets received at the user an audio output and/or a visual display.

40. The communication system of claim 33 further comprising means for storing packets received at the user during a first time period and means for inserting such packets into other packets received at the user at a later time period.

41. The communication system of claim 40 wherein the stream of packets received during the first time period contains advertising information.

42. The communication system of claim 41 wherein the cntent of the advertising information is varied depending on the identity of the user.

43. The communication system of claim 33 further comprising:

means for compressing the stream of packets in their passage from source to user, and

downstream of the compressing means, means for decompressing the stream of packets.

44. The communication system of claim 43 wherein the compressing means is located near the converting means and the decompressing means is located at the user.

45. The communication system of claim 43 wherein the compressing means uses a compression algorithm that is selected in accordance with the content of the information being communicated in the stream of packets.

46. The communication system of claim 43 wherein the compressing means inserts into each packet an identification of the compression algorithm used and the decompressing means monitors each packet to read such identification and to vary its decompression algorithm in response thereto.

47. A method for transmitting message packets over a communications network comprising the steps of:

converting a plurality of streams of audio and/or visual information into a plurality of streams of addressed digital packets complying with the specifications of a network communication protocol,

for each stream, routing such stream to one or more users,

controlling the routing of the stream of packets in response to selection signals received from the users, and

monitoring the reception of packets by the users and accumulating records that indicate which streams of packets were received by which users, wherein at least one stream of packets comprises music selections and the records that are accumulated indicate how many users did or did not listen to the entire selection.

48. A method for transmitting at least one stream of audio and/or visual information over a communications network to a plurality of users comprising the steps of:

controlling the routing of the stream of information through the network in response to selection signals received from the users, and

monitoring the reception of the stream of information by the users and accumulating records relating to the reception of the stream of information by the users, wherein at least one stream of information comprises music selections and the records that are accumulated indicate how many users did or did not listen to the entire selection.

49. A method for transmitting message packets over a communications network comprising the steps of:

converting a plurality of streams of audio and/or visual information into a plurality of streams of addressed digital packets complying with the specifications of a network communication protocol,

for each stream, routing such stream to one or more users,

controlling the routing of the stream of packets in response to selection signals received from the users, and

monitoring the reception of packets by the users and accumulating records that indicate which streams of packets were received by which users, wherein at least one stream of packets comprises an audio and/or visual selection and the records that are accumulated indicate the elapsed time that a user received the audio and/or visual selection.

50. A method for transmitting at least one stream of audio and/or visual information over a communications network to a plurality of users comprising the steps of:

controlling the routing of the stream of information through the network in response to selection signals received from the users, and

monitoring the reception of the stream of information by the users and accumulating records relating to the reception of the stream of information by the users, wherein at least one stream of information comprises an audio and/or visual selection and the records that are accumulated indicate the elapsed time that a user received the audio and/or visual selection.

51. A communication system comprising:

means for converting at least one stream of audio and/or visual information into a stream of addressed digital packets complying with the specifications of a network communication protocol,

means for routing such stream via a communication network to selected users,

means for controlling the routing of the stream of packets in response to selection signals received from the users, and

means for monitoring the reception of packets by the user and for accumulating records that indicate which streams of packets were received by which users, wherein at least one stream of packets comprises an audio and/or visual selection, and the means for monitoring further includes means for accumulating records that indicate the elapsed time that a user received the audio and/or visual selection.

* * * * *

US005983005A

United States Patent [19]

Monteiro et al.

[11] **Patent Number: 5,983,005**

[45] **Date of Patent: Nov. 9, 1999**

[54] **MULTICASTING METHOD AND APPARATUS**

[75] Inventors: **Antonio M Monteiro; James F Butterworth**, both of New York, N.Y.

[73] Assignee: **Netcast Communications Corp.**, New York, N.Y.

[21] Appl. No.: **09/110,369**

[22] Filed: **Jul. 6, 1998**

Related U.S. Application Data

[63] Continuation of application No. 08/644,072, May 9, 1996, Pat. No. 5,778,187.

[51] **Int. Cl.**[6] **H04L 12/00**

[52] **U.S. Cl.** **395/200.61**

[58] **Field of Search** 395/200.61, 200.47, 395/200.49, 200.54, 200.57

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Microsoft, Spry and Spryglass to Include RealAudio—Apr. 12, 1995.

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24–Hour ABC News on the Net—Aug. 15, 1995.

Ziff–Davis Adds RealAudio to ZD Net—Aug. 16, 1995.

Progressive Networks' RealAudio Player has exclusive with Microsoft's Internet Explorer—Aug. 17, 1995.

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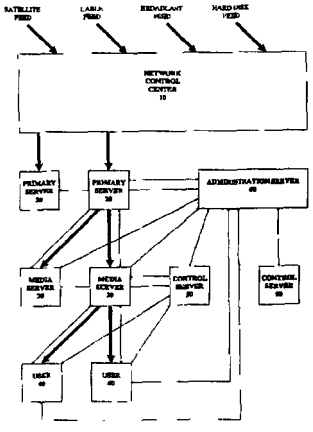
Primary Examiner—Thomas R. Peeso

Attorney, Agent, or Firm—Pennie & Edmonds LLP

[57] **ABSTRACT**

A scalable architecture is disclosed for delivery of real-time information over a communications network. Embedded into the architecture is a control mechanism that provides for the management and administration of users who are to receive the real-time information. In the preferred embodiment, the information being delivered is high-quality audio. However, it could also be video, graphics, text or any other type of information that can be transmitted over a digital network. Preferably, there are multiple channels of information available simultaneously to be delivered to users, each channel consisting of an independent stream of information. A user chooses to tune in or tune out a particular channel, but does not choose the time at which the channel distributes its information. Advantageously, interactive (two-way) information can be incorporated into the system, multiple streams of information can be integrated for delivery to a user, and certain portions of the information being delivered can be tailored to the individual user.

68 Claims, 23 Drawing Sheets



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CheckPoint Software Breaks the Sound Barrier with Integrated Support for RealAudio—Dec. 5, 1995.
Progressive Networks Introduces Version 2.0 of the RealAudio System—Oct. 30,1995.
Atlantic Records, CDnow, Elektra Records, InTouch, Group INc. MCA Records, Muzak and Warner Bros. Records among first users of Progressive Networks' RealAudio version 2.0—Dec. 4, 1995.
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Border Network Technologies Provides Secure Support for RealAudio—Jan. 24, 1996.
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Bruce Jacobsen named President and Chief Operating Officer of Progressive Networks—Feb. 21, 1996.
GTA Announces RealAudio Support for the GFX Internet Firewall System—Mar. 1, 1996.
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Progressive Networks and Microsoft Announce Streaming Media Agreement—Mar. 12, 1996.
Progressive Networks Announces RealAudio Firewall Proxy Kit—Apr. 2, 1996.
Progressive Networks Launches RealAudio 2.0 Intranet Offerings with Corporate Licensing Program and Intranet Server Pricing—Apr. 2, 1996.
Progressive Networks Ships Final Version of RealAudio System 2.0 with Open Architecture Enhancements and Ability to Deliver Synchronized Multimedia Capabilities—Apr. 2, 1996.
Progressive Networks Launches Timecast: The RealAudio Guide—Apr. 29, 1996.
RealAudio Wins Internet World Magazine Outstanding Software Product of the Year Aware—Apr. 30, 1996.

FIGURE 1

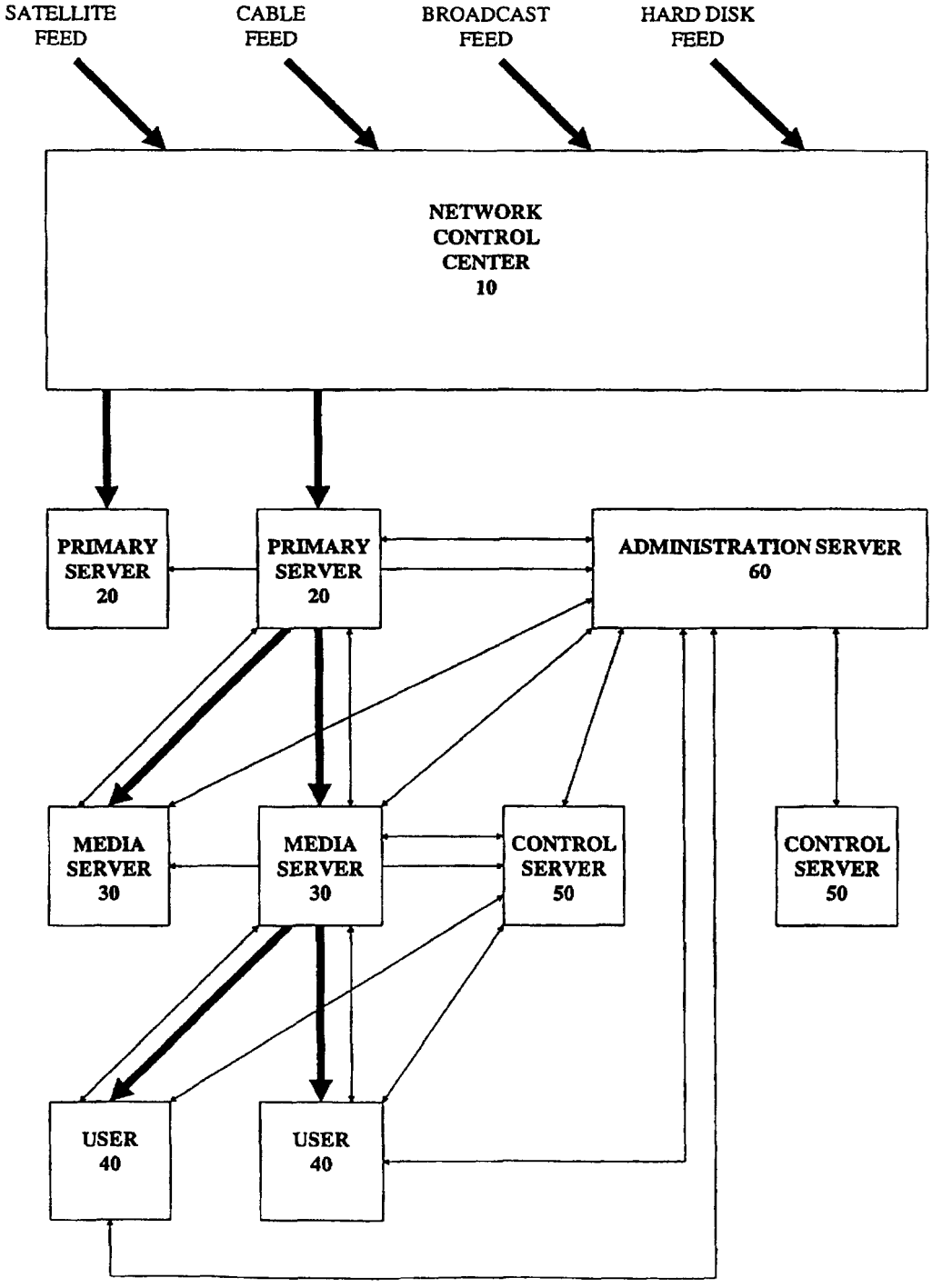

SATELLITE FEED
CABLE FEED
BROADCAST FEED
HARD DISK FEED
NETWORK CONTROL CENTER 10
PRIMARY SERVER 20
PRIMARY SERVER 20
ADMINISTRATION SERVER 60
MEDIA SERVER 30
MEDIA SERVER 30
CONTROL SERVER 50
CONTROL SERVER 50
USER 40
USER 40

FIGURE 2

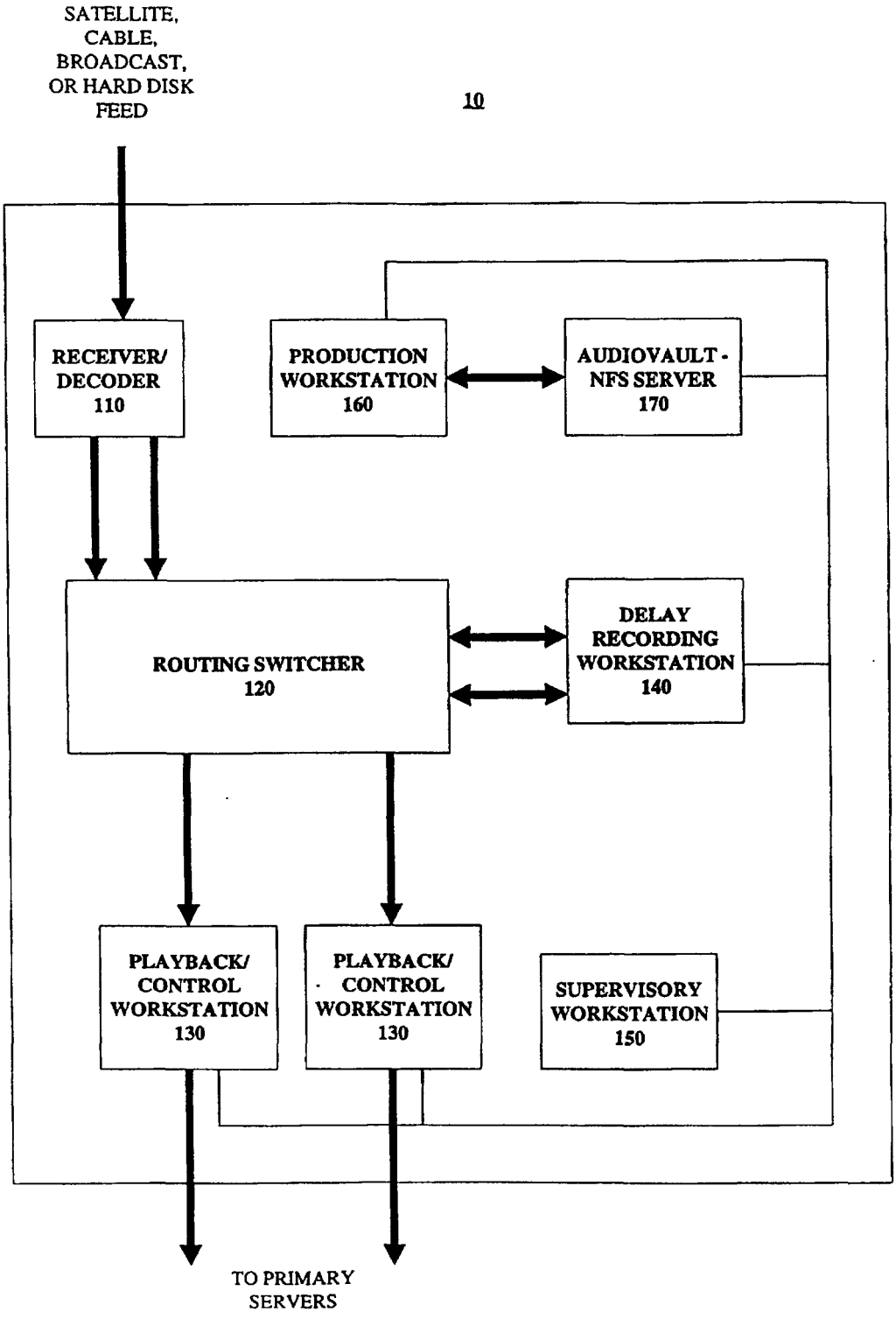

SATELLITE, CABLE, BROADCAST, OR HARD DISK FEED
10
RECEIVER/ DECODER 110
PRODUCTION WORKSTATION 160
AUDIOVAULT - NFS SERVER 170
ROUTING SWITCHER 120
DELAY RECORDING WORKSTATION 140
PLAYBACK/ CONTROL WORKSTATION 130
PLAYBACK/ CONTROL WORKSTATION 130
SUPERVISORY WORKSTATION 150
TO PRIMARY SERVERS

FIGURE 3

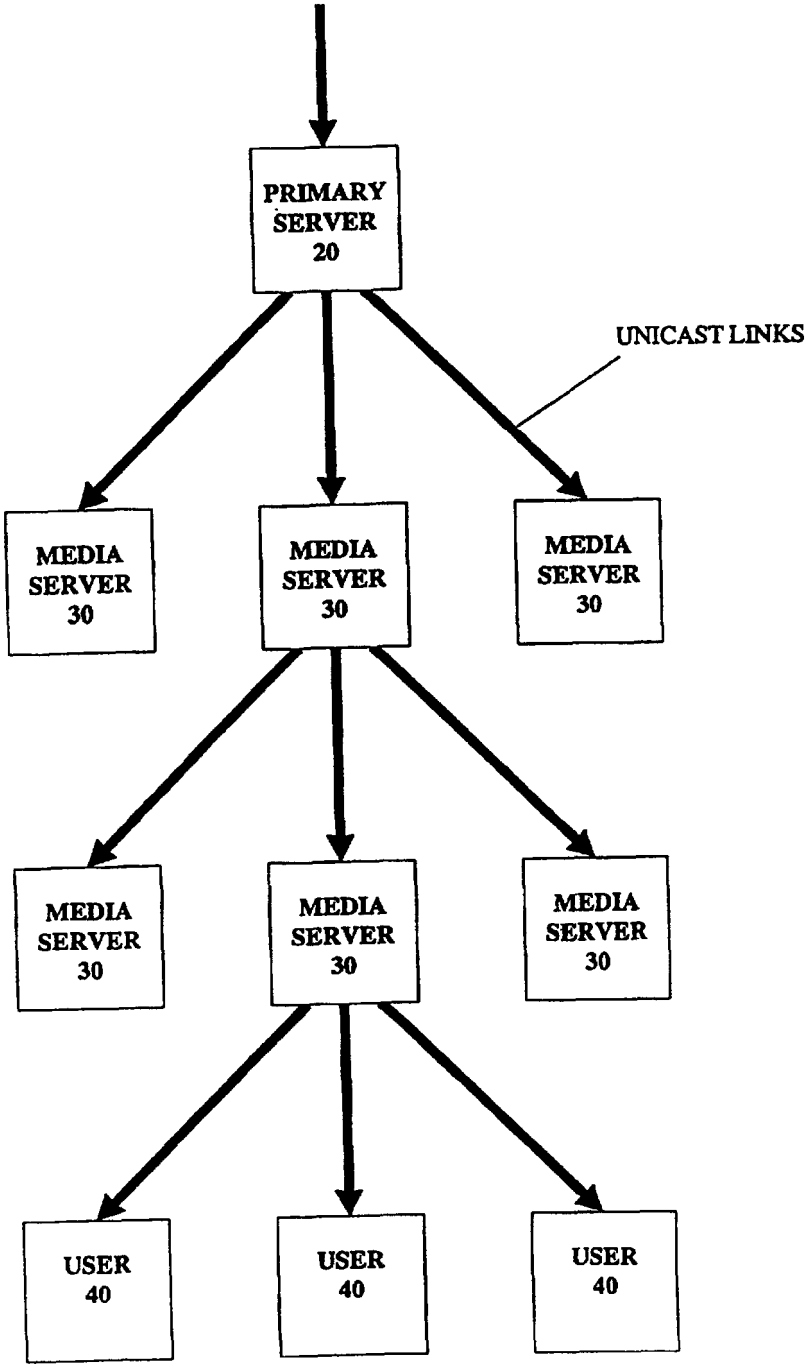

PRIMARY SERVER 20
UNICAST LINKS
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
USER 40
USER 40
USER 40

FIGURE 4

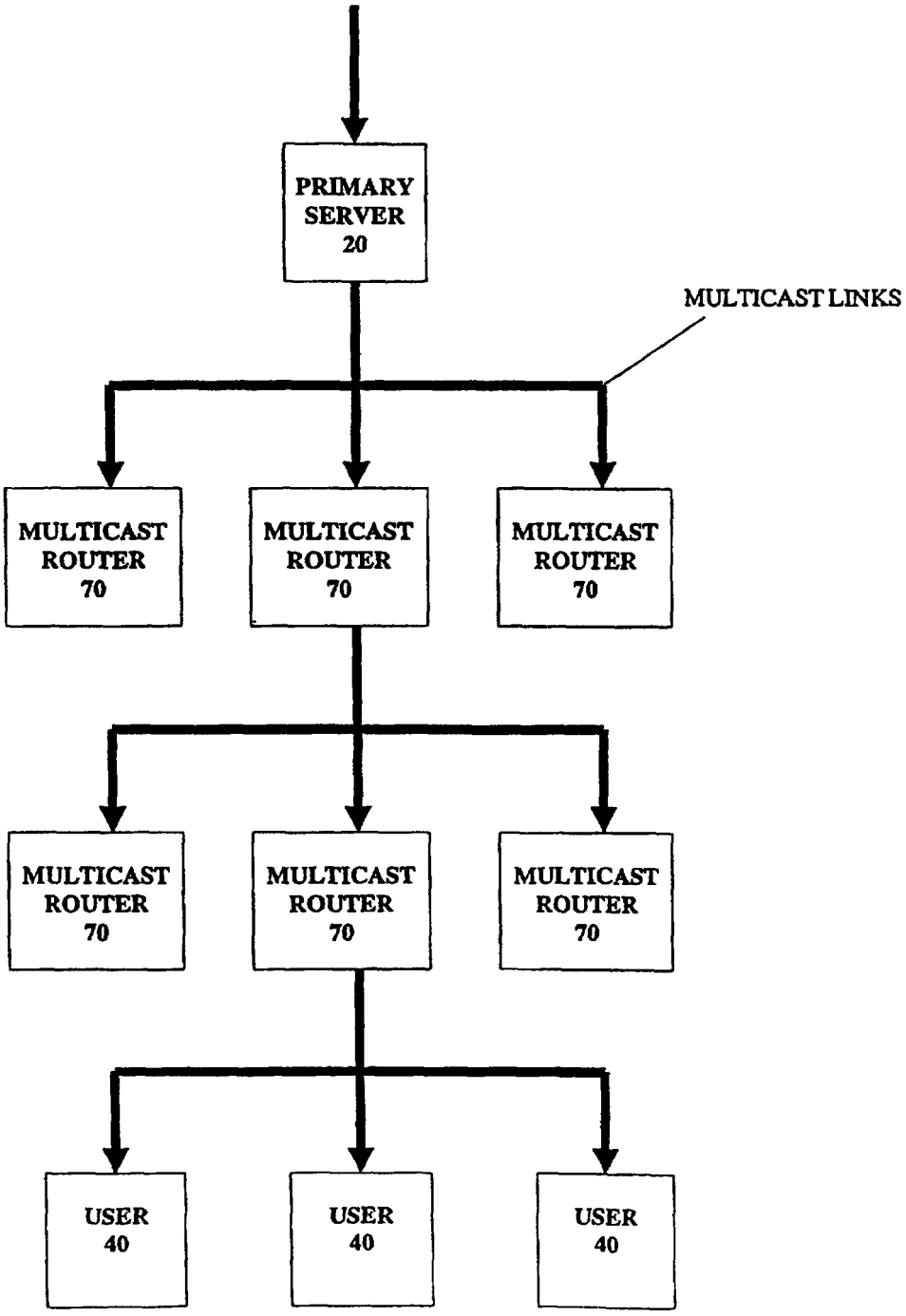
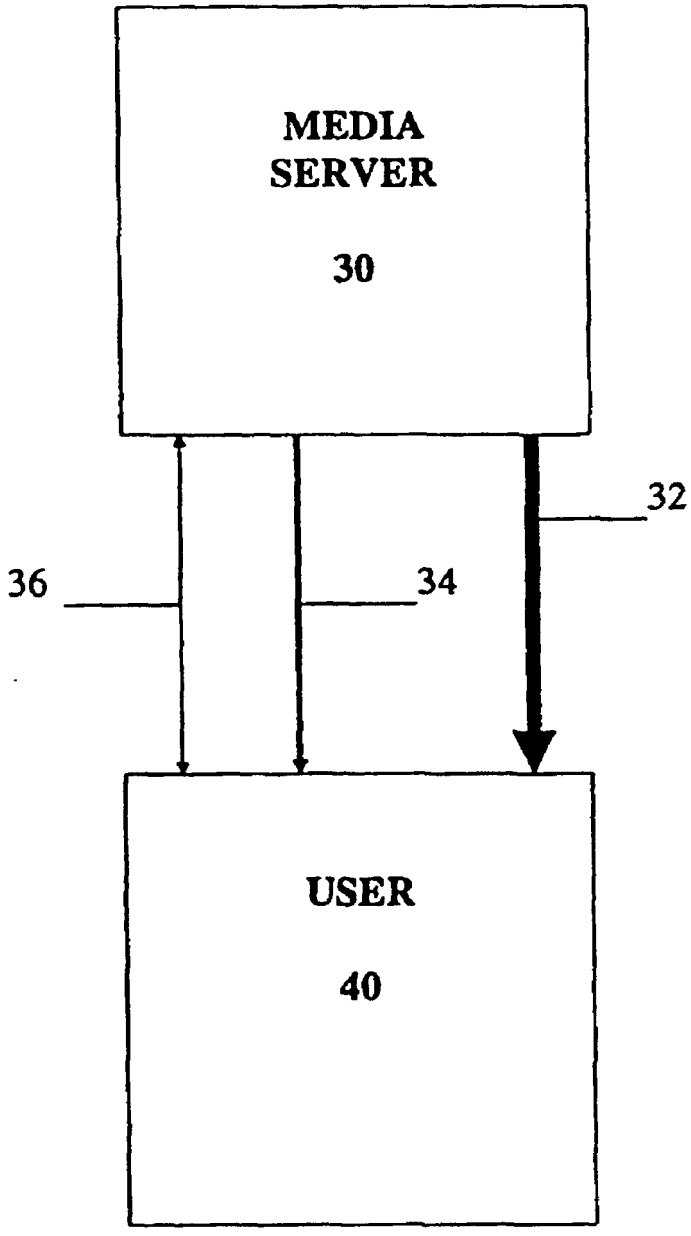

PRIMARY SERVER 20
MULTICAST LINKS
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
USER 40
USER 40
USER 40

FIGURE 5



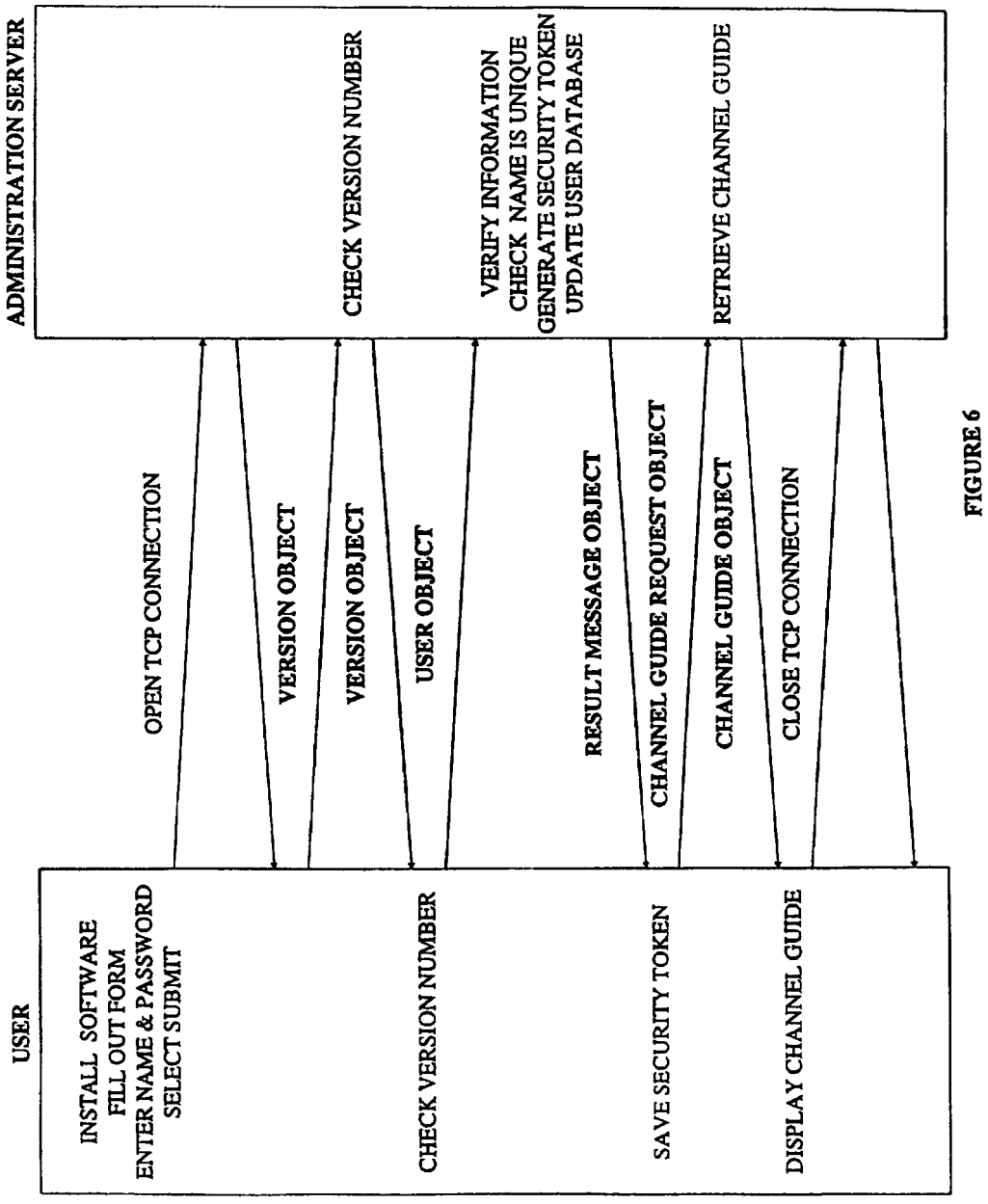

ADMINISTRATION SERVER
USER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
USER OBJECT
RESULT MESSAGE OBJECT
CHANNEL GUIDE REQUEST OBJECT
CHANNEL GUIDE OBJECT
CLOSE TCP CONNECTION
INSTALL SOFTWARE
FILL OUT FORM
ENTER NAME & PASSWORD
SELECT SUBMIT
CHECK VERSION NUMBER
VERIFY INFORMATION
CHECK NAME IS UNIQUE
GENERATE SECURITY TOKEN
UPDATE USER DATABASE
CHECK VERSION NUMBER
SAVE SECURITY TOKEN
RETRIEVE CHANNEL GUIDE
DISPLAY CHANNEL GUIDE

FIGURE 6

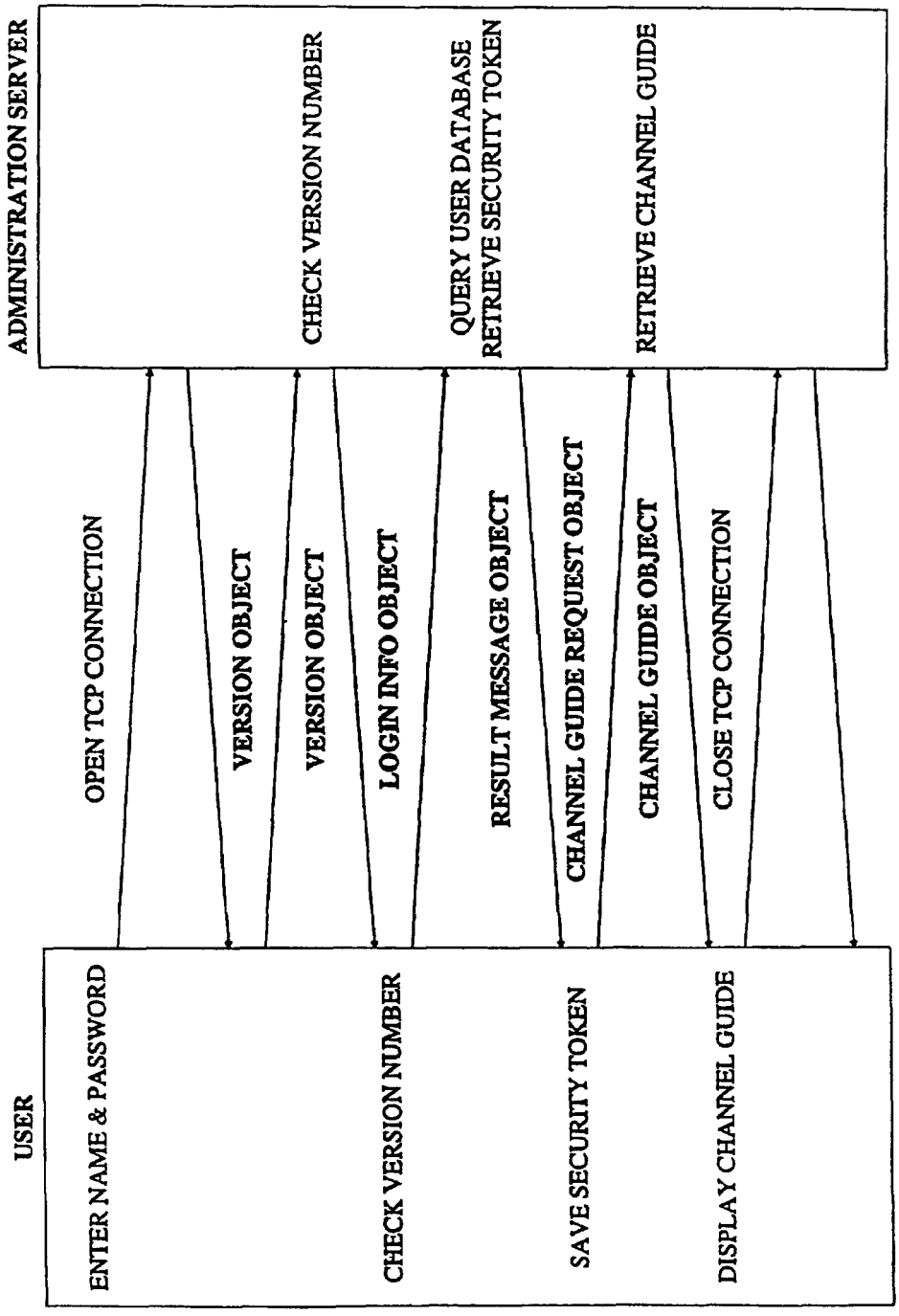

ADMINISTRATION SERVER
CHECK VERSION NUMBER
QUERY USER DATABASE
RETRIEVE SECURITY TOKEN
RETRIEVE CHANNEL GUIDE
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
LOGIN INFO OBJECT
RESULT MESSAGE OBJECT
CHANNEL GUIDE REQUEST OBJECT
CHANNEL GUIDE OBJECT
CLOSE TCP CONNECTION
USER
ENTER NAME & PASSWORD
CHECK VERSION NUMBER
SAVE SECURITY TOKEN
DISPLAY CHANNEL GUIDE

FIGURE 7

FIGURE 8A

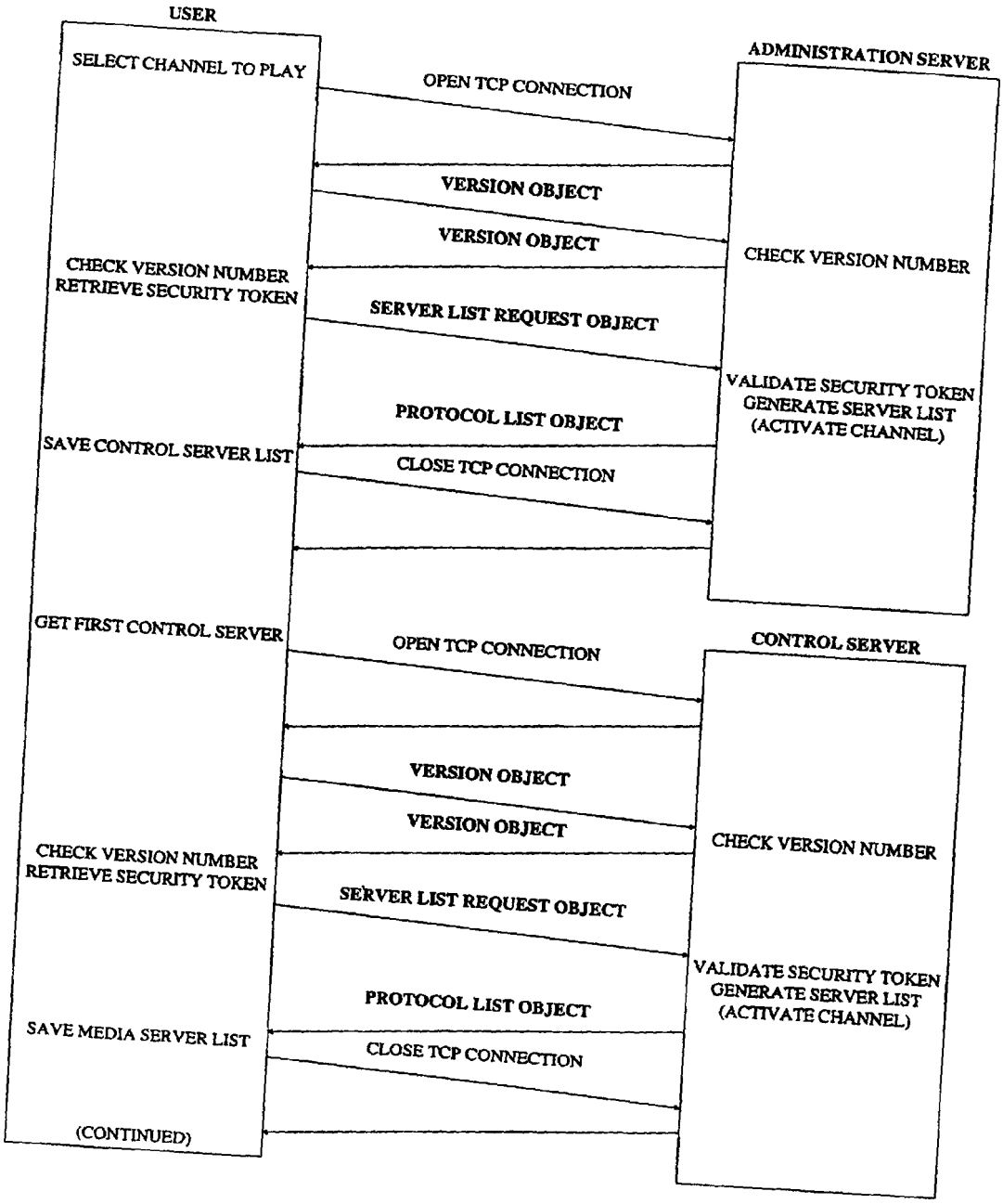
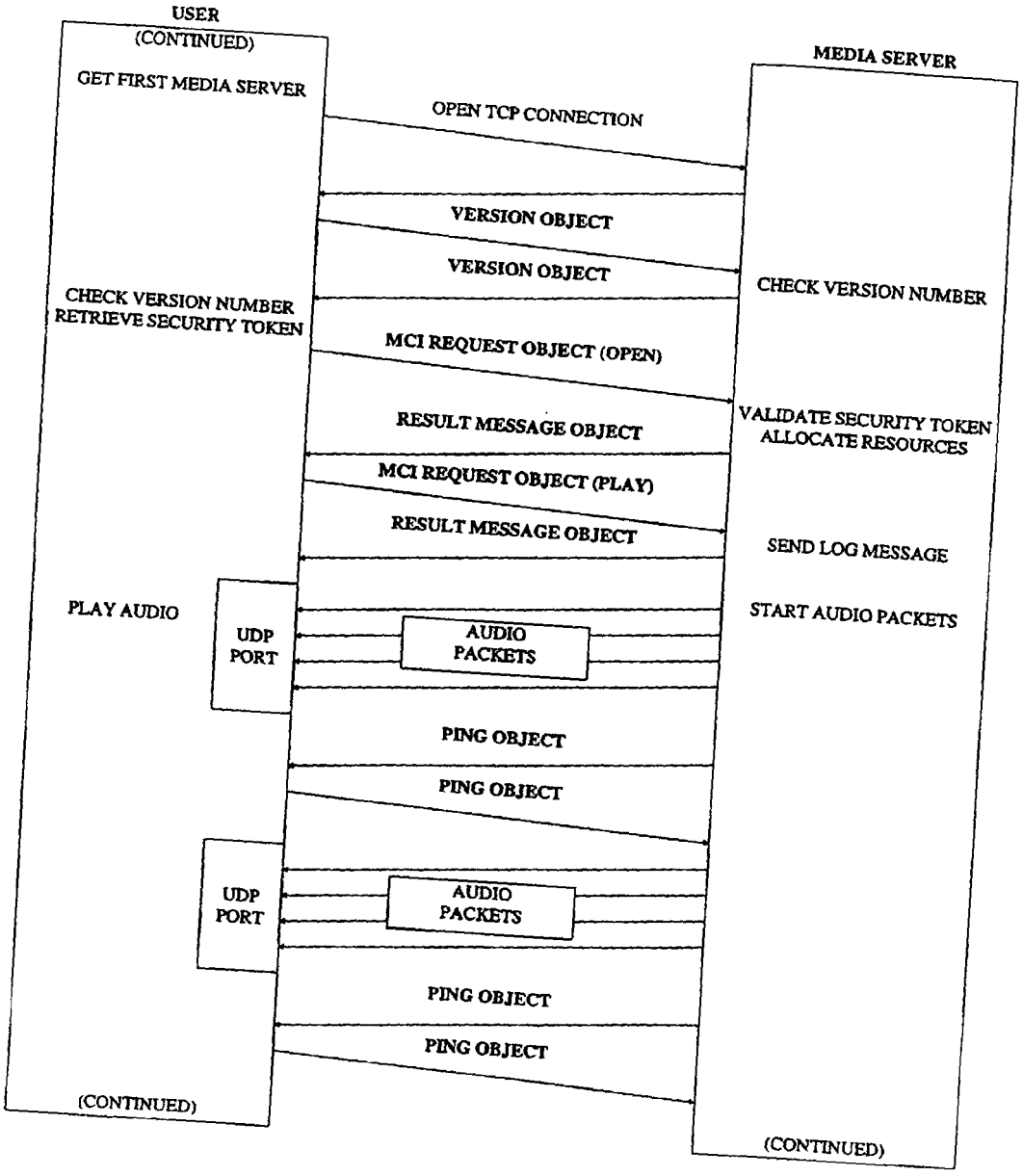

USER
ADMINISTRATION SERVER
SELECT CHANNEL TO PLAY
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
SERVER LIST REQUEST OBJECT
VALIDATE SECURITY TOKEN
GENERATE SERVER LIST
(ACTIVATE CHANNEL)
PROTOCOL LIST OBJECT
SAVE CONTROL SERVER LIST
CLOSE TCP CONNECTION
GET FIRST CONTROL SERVER
CONTROL SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
SERVER LIST REQUEST OBJECT
VALIDATE SECURITY TOKEN
GENERATE SERVER LIST
(ACTIVATE CHANNEL)
PROTOCOL LIST OBJECT
SAVE MEDIA SERVER LIST
CLOSE TCP CONNECTION
(CONTINUED)

FIGURE 8B


USER
(CONTINUED)
MEDIA SERVER
GET FIRST MEDIA SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
MCI REQUEST OBJECT (OPEN)
RESULT MESSAGE OBJECT
VALIDATE SECURITY TOKEN
ALLOCATE RESOURCES
MCI REQUEST OBJECT (PLAY)
RESULT MESSAGE OBJECT
SEND LOG MESSAGE
PLAY AUDIO
UDP PORT
START AUDIO PACKETS
AUDIO PACKETS
PING OBJECT
PING OBJECT
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
(CONTINUED)
(CONTINUED)

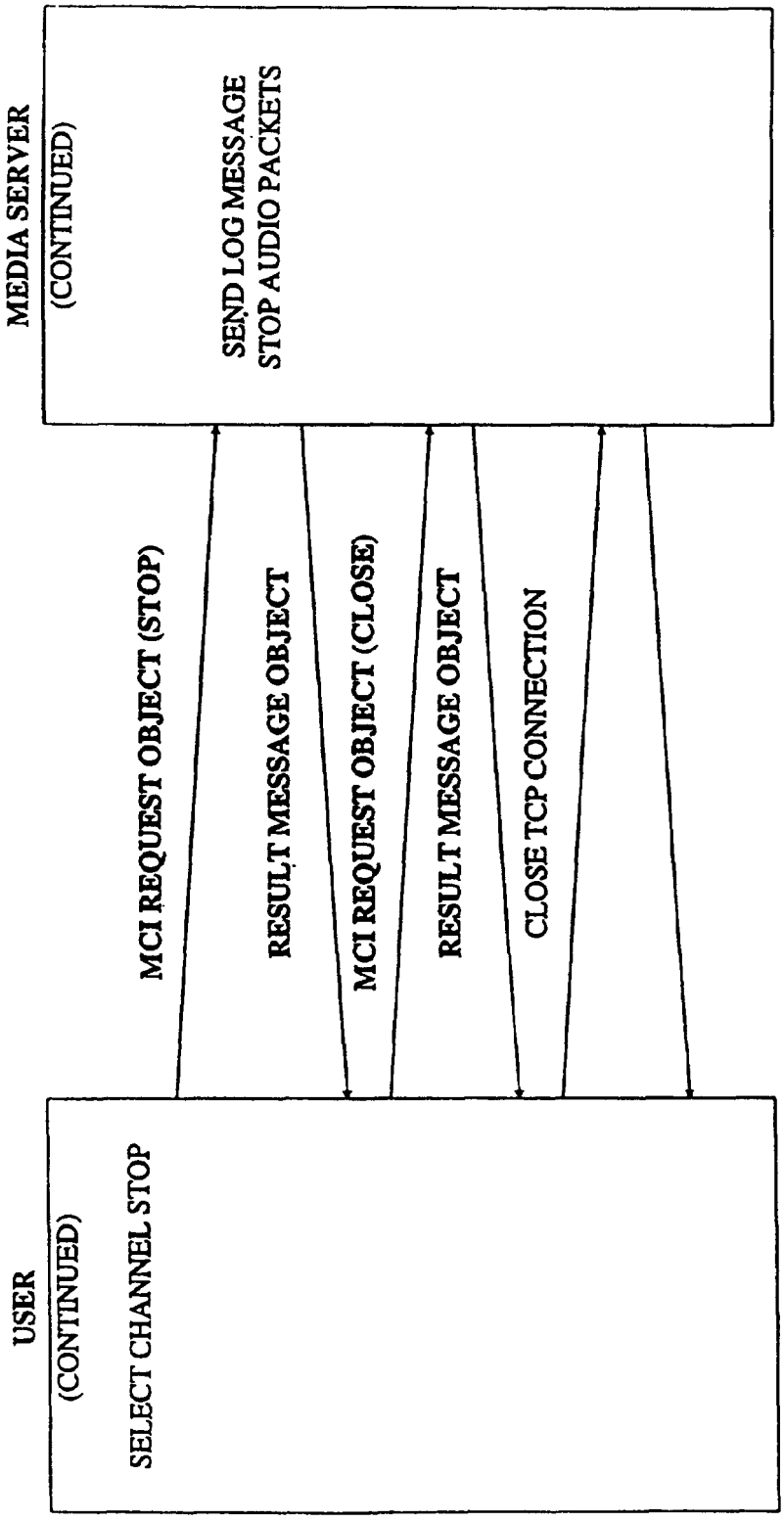

MEDIA SERVER
(CONTINUED)
SEND LOG MESSAGE
STOP AUDIO PACKETS
MCI REQUEST OBJECT (STOP)
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (CLOSE)
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
USER
(CONTINUED)
SELECT CHANNEL STOP

FIGURE 8C

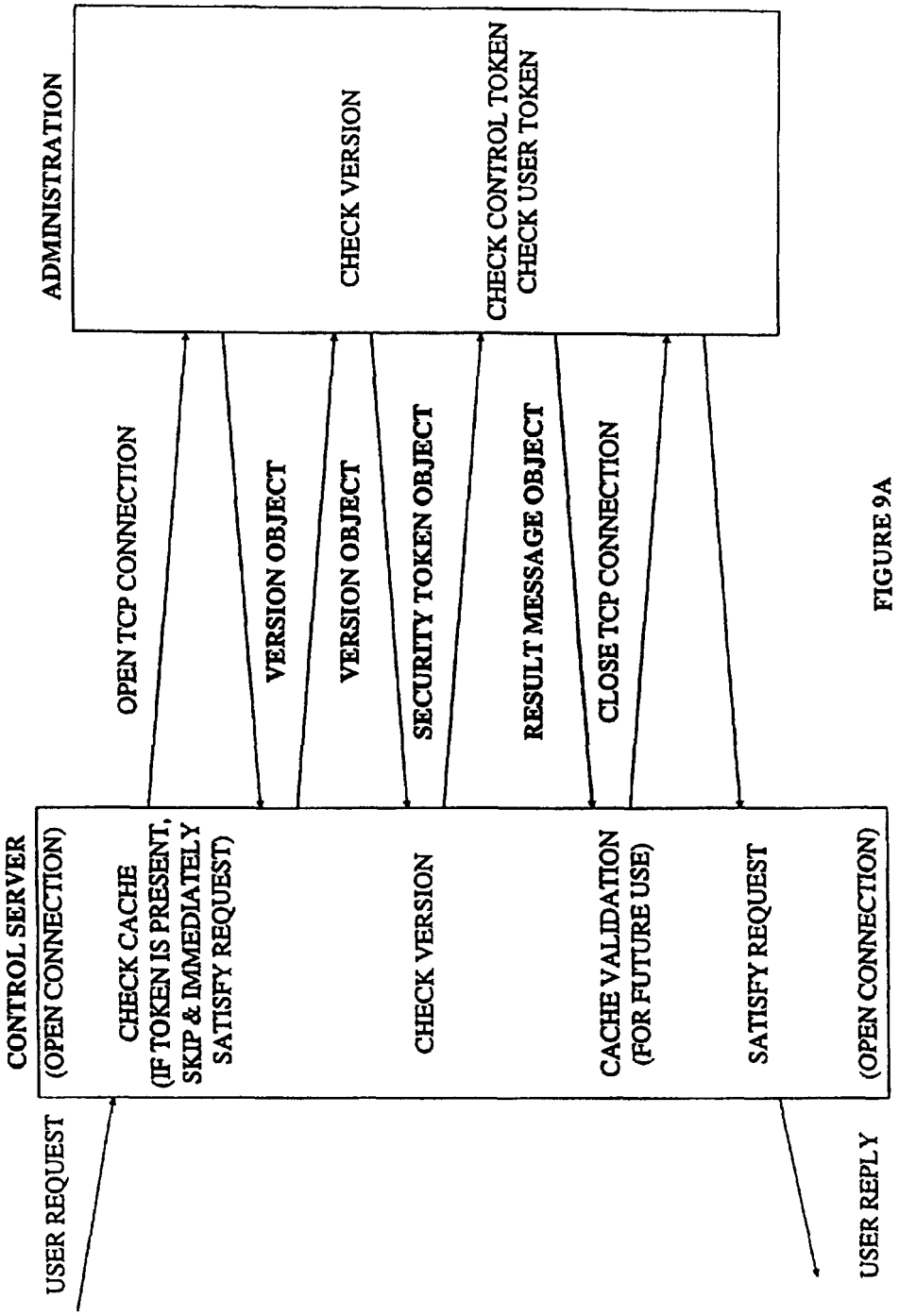

ADMINISTRATION
CHECK VERSION
CHECK CONTROL TOKEN
CHECK USER TOKEN
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
SECURITY TOKEN OBJECT
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
CONTROL SERVER
(OPEN CONNECTION)
CHECK CACHE
(IF TOKEN IS PRESENT,
SKIP & IMMEDIATELY
SATISFY REQUEST)
CHECK VERSION
CACHE VALIDATION
(FOR FUTURE USE)
SATISFY REQUEST
(OPEN CONNECTION)
USER REQUEST
USER REPLY

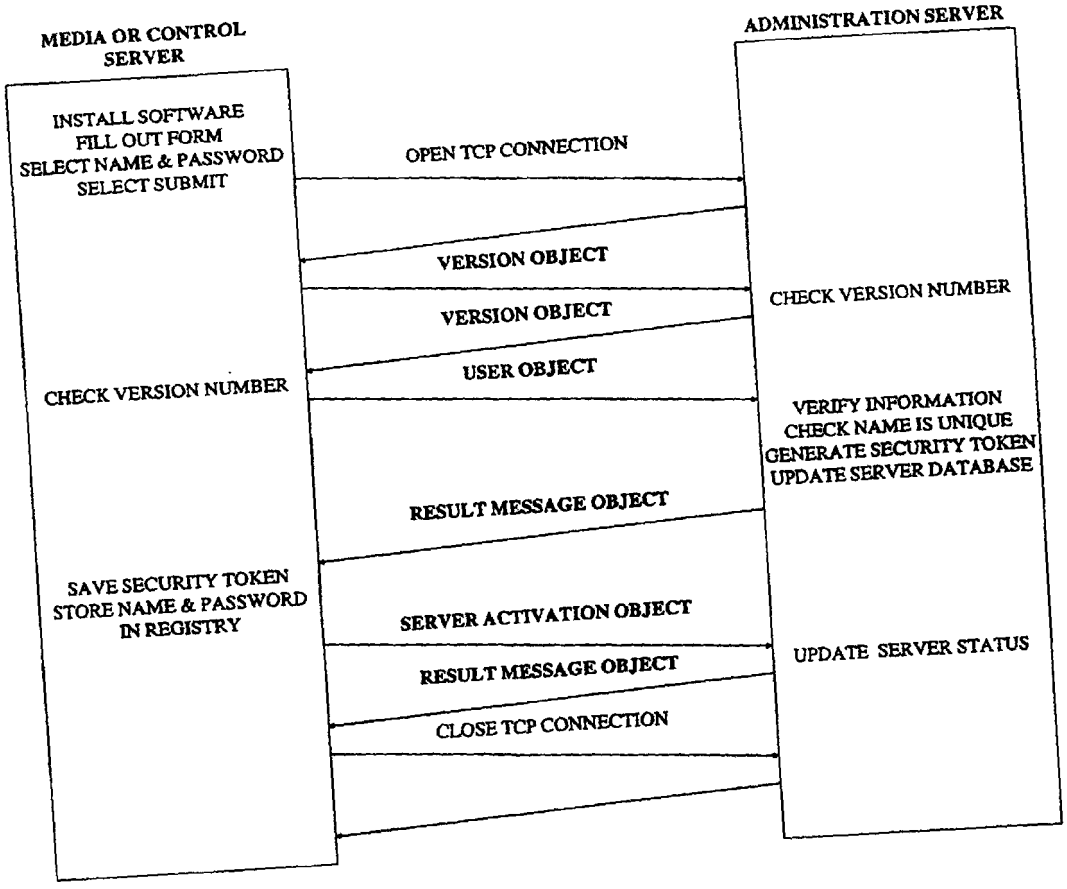
FIGURE 9A

FIGURE 9B

(SHOWN ABOVE)

REQUEST FROM	REQUEST TO	VALIDATION WITH
USER	CONTROL SERVER	ADMINISTRATION SERVER
USER	MEDIA SERVER	CONTROL SERVER
MEDIA SERVER	MEDIA SERVER	CONTROL SERVER
MEDIA SERVER	PRIMARY SERVER	ADMINISTRATION SERVER
MEDIA SERVER	CONTROL SERVER	ADMINISTRATION SERVER
CONTROL SERVER	MEDIA SERVER	ADMINISTRATION SERVER

FIGURE 10


MEDIA OR CONTROL SERVER
ADMINISTRATION SERVER
INSTALL SOFTWARE
FILL OUT FORM
SELECT NAME & PASSWORD
SELECT SUBMIT
OPEN TCP CONNECTION
VERSION OBJECT
CHECK VERSION NUMBER
VERSION OBJECT
USER OBJECT
CHECK VERSION NUMBER
VERIFY INFORMATION
CHECK NAME IS UNIQUE
GENERATE SECURITY TOKEN
UPDATE SERVER DATABASE
RESULT MESSAGE OBJECT
SAVE SECURITY TOKEN
STORE NAME & PASSWORD
IN REGISTRY
SERVER ACTIVATION OBJECT
UPDATE SERVER STATUS
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION

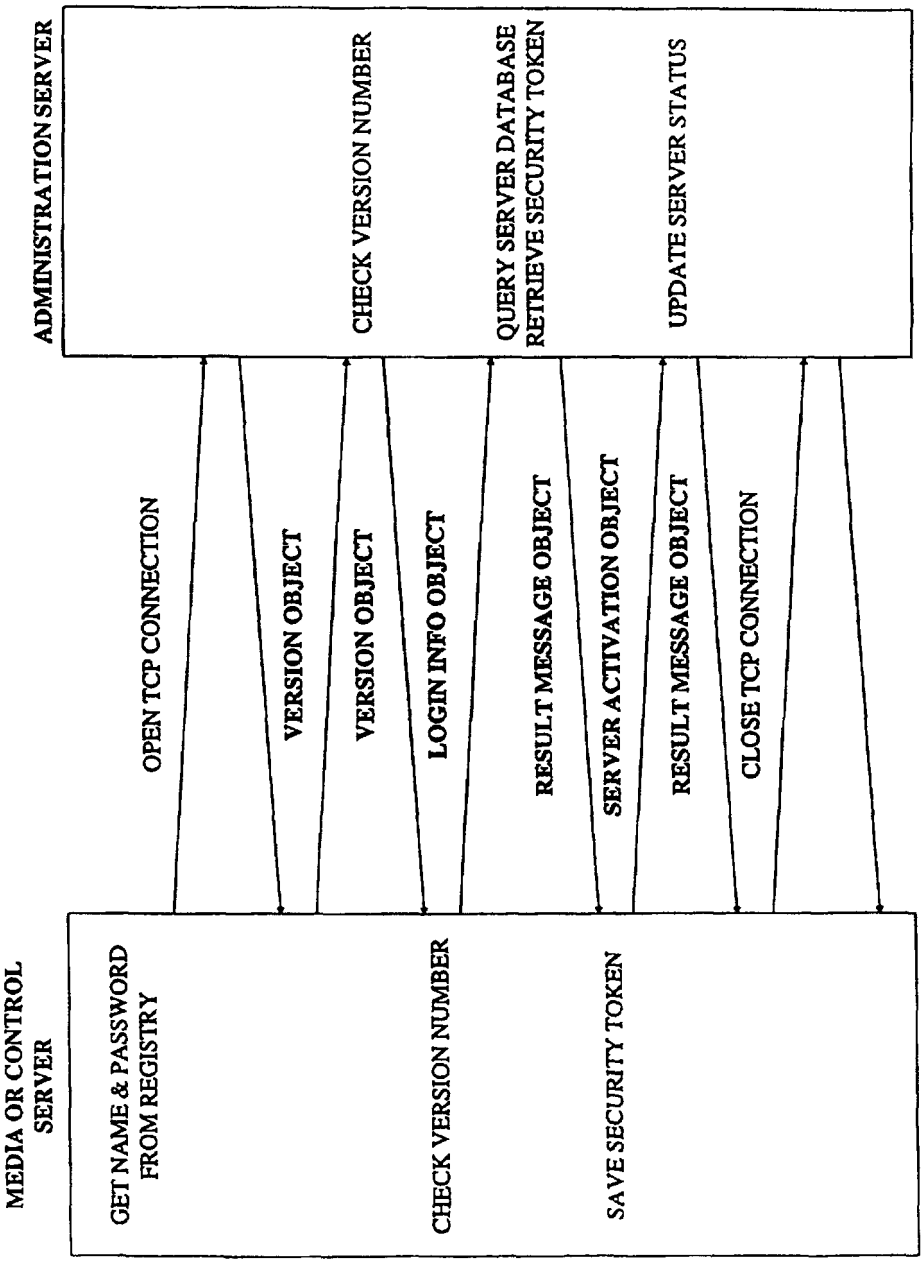

ADMINISTRATION SERVER
MEDIA OR CONTROL SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
LOGIN INFO OBJECT
RESULT MESSAGE OBJECT
SERVER ACTIVATION OBJECT
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
GET NAME & PASSWORD FROM REGISTRY
CHECK VERSION NUMBER
QUERY SERVER DATABASE RETRIEVE SECURITY TOKEN
UPDATE SERVER STATUS
CHECK VERSION NUMBER
SAVE SECURITY TOKEN

FIGURE 11

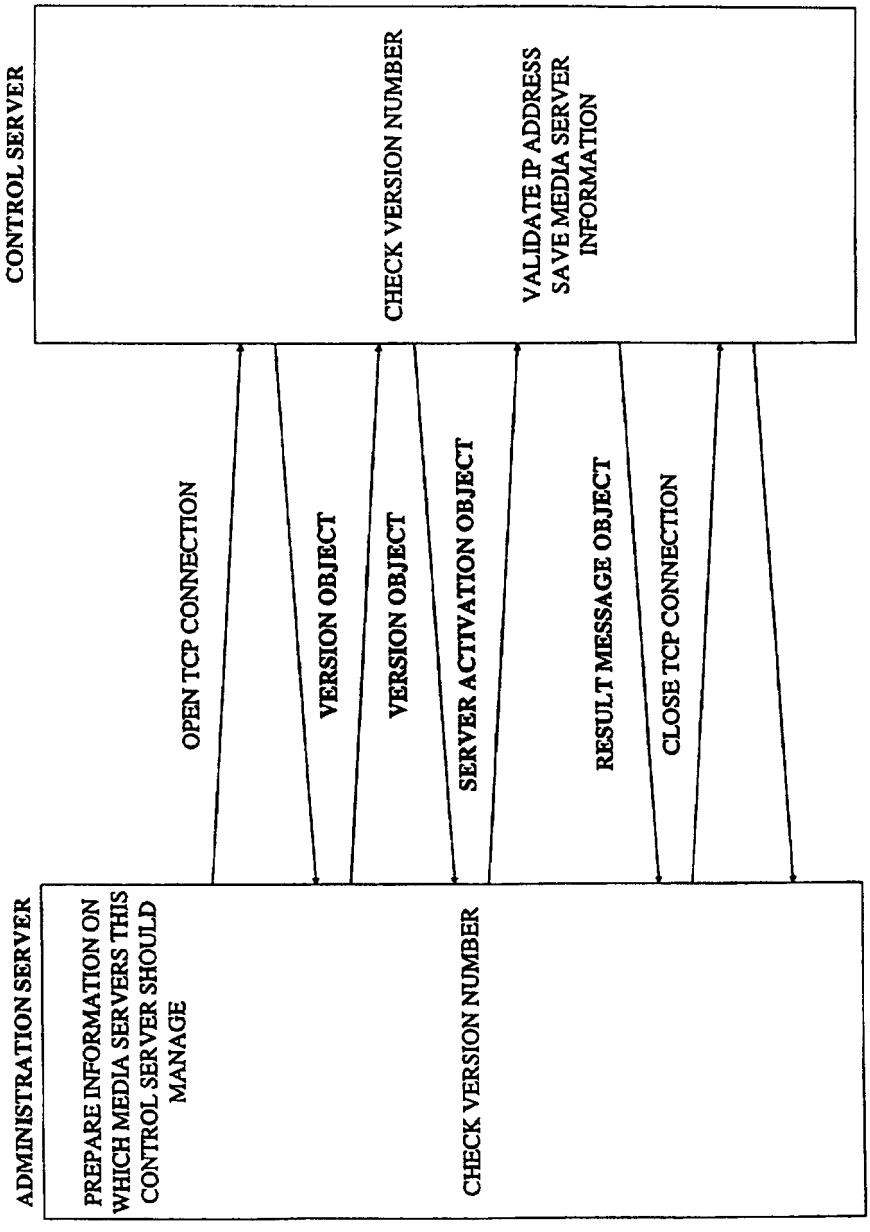
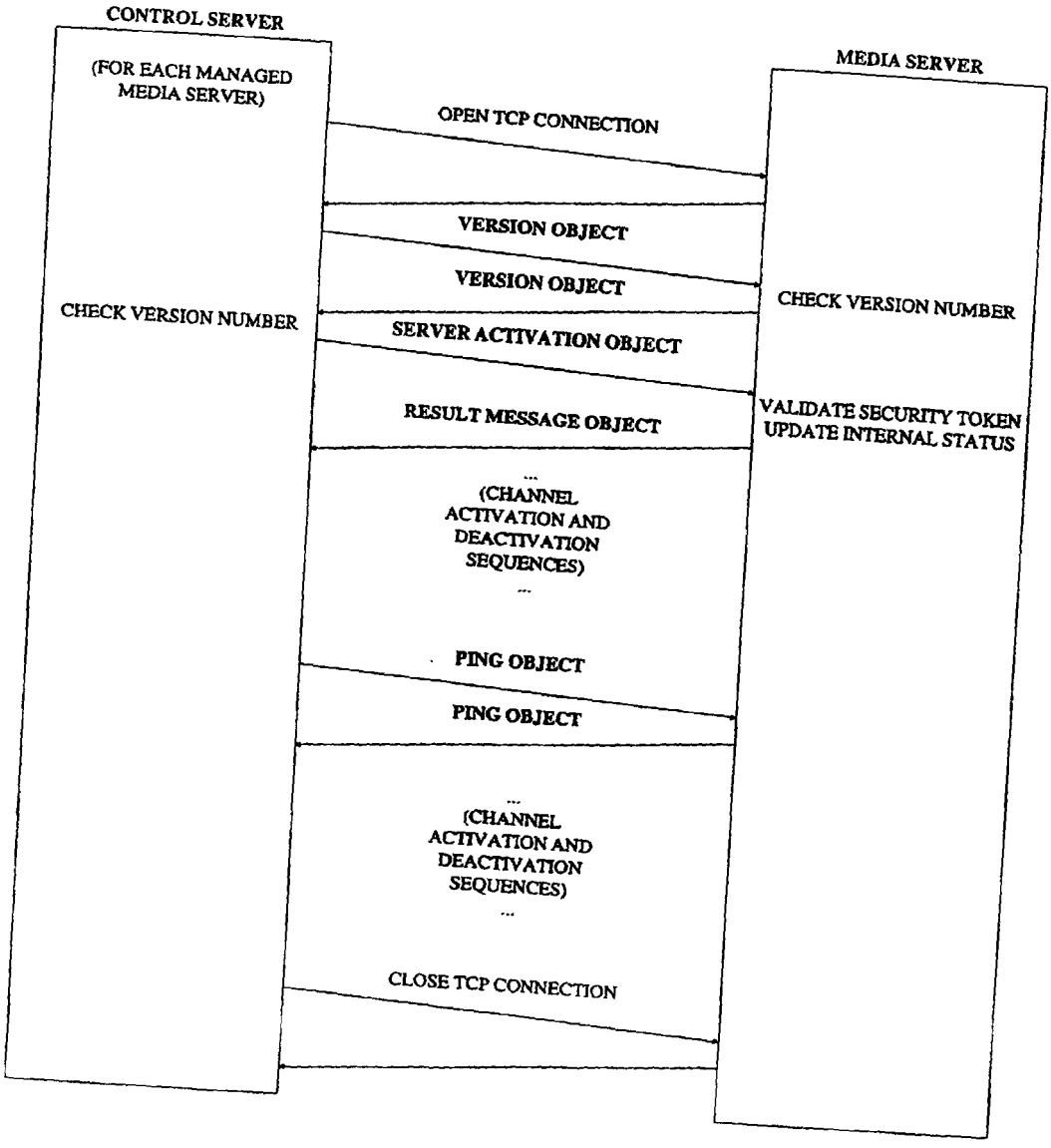

CONTROL SERVER
ADMINISTRATION SERVER
PREPARE INFORMATION ON WHICH MEDIA SERVERS THIS CONTROL SERVER SHOULD MANAGE
OPEN TCP CONNECTION
VERSION OBJECT
CHECK VERSION NUMBER
VERSION OBJECT
CHECK VERSION NUMBER
SERVER ACTIVATION OBJECT
VALIDATE IP ADDRESS SAVE MEDIA SERVER INFORMATION
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION

FIGURE 12

FIGURE 13


CONTROL SERVER
(FOR EACH MANAGED MEDIA SERVER)
MEDIA SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
SERVER ACTIVATION OBJECT
RESULT MESSAGE OBJECT
VALIDATE SECURITY TOKEN
UPDATE INTERNAL STATUS
...
(CHANNEL ACTIVATION AND DEACTIVATION SEQUENCES)
...
PING OBJECT
PING OBJECT
...
(CHANNEL ACTIVATION AND DEACTIVATION SEQUENCES)
...
CLOSE TCP CONNECTION

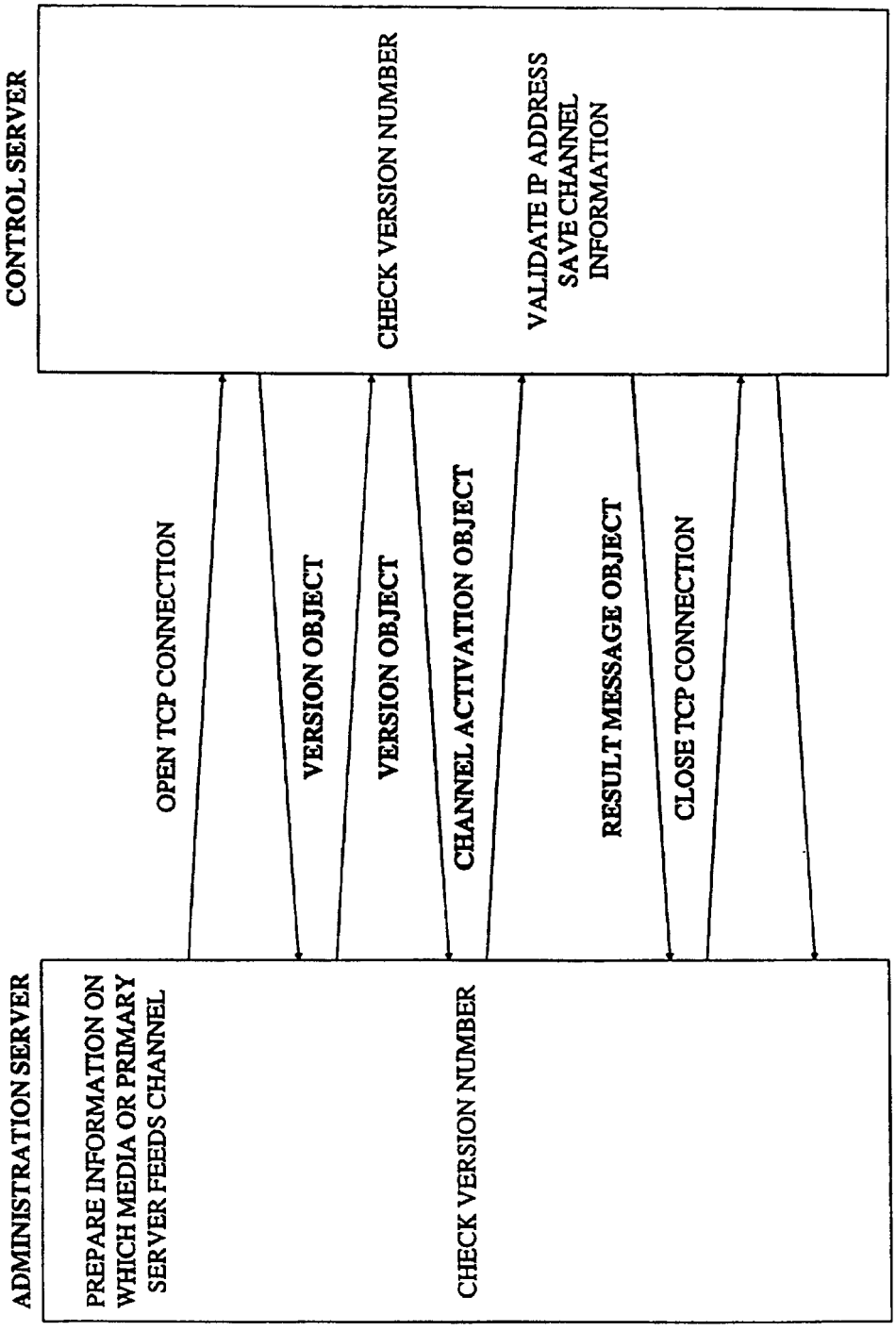

CONTROL SERVER
ADMINISTRATION SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHANNEL ACTIVATION OBJECT
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
CHECK VERSION NUMBER
VALIDATE IP ADDRESS SAVE CHANNEL INFORMATION
PREPARE INFORMATION ON WHICH MEDIA OR PRIMARY SERVER FEEDS CHANNEL
CHECK VERSION NUMBER

FIGURE 14

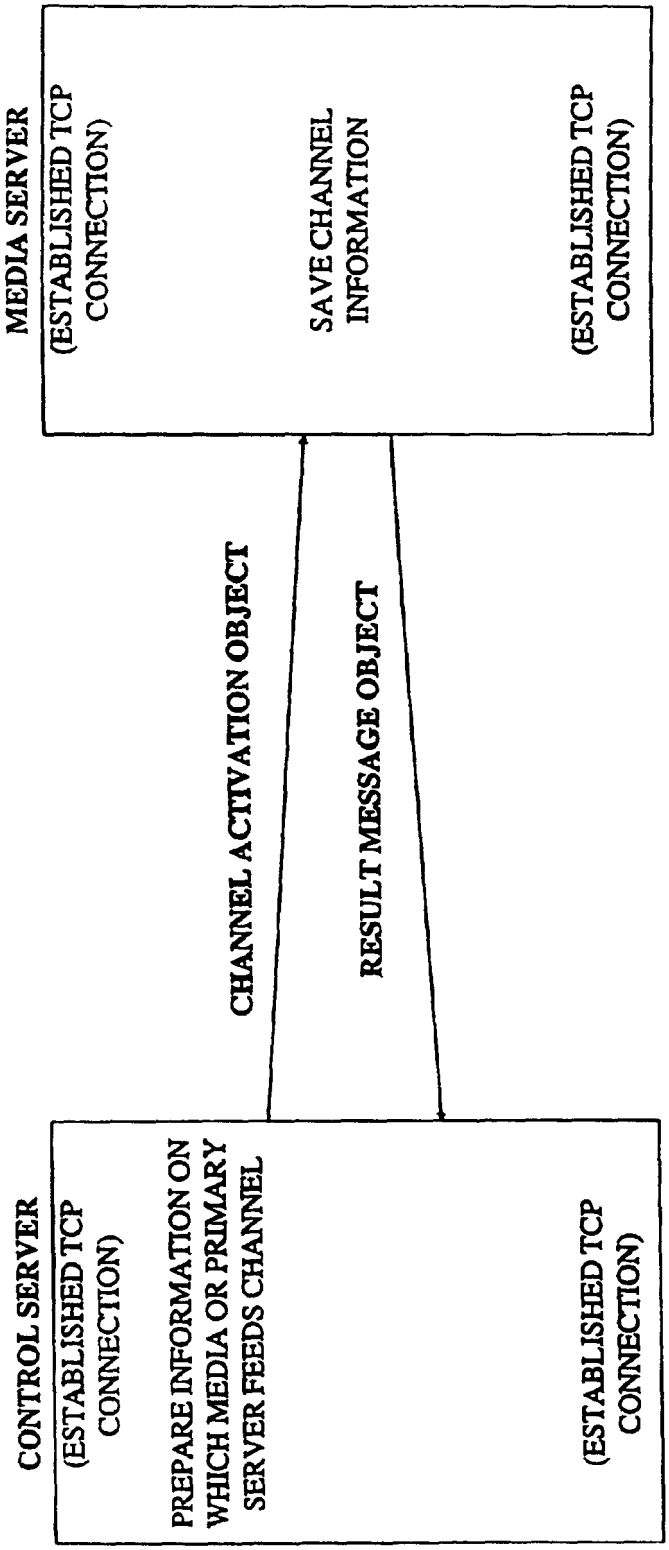
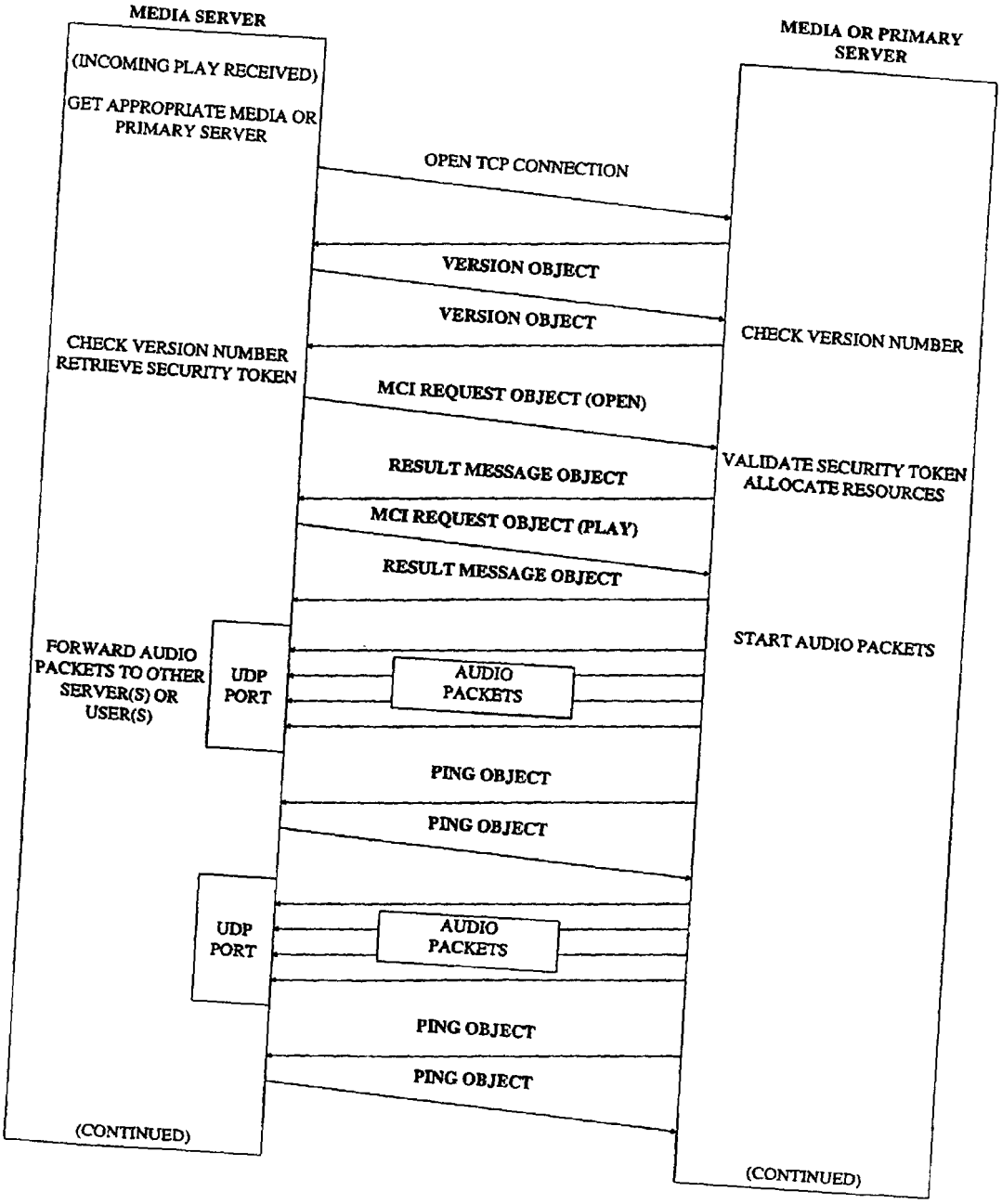

MEDIA SERVER
(ESTABLISHED TCP CONNECTION)
SAVE CHANNEL INFORMATION
(ESTABLISHED TCP CONNECTION)
CHANNEL ACTIVATION OBJECT
RESULT MESSAGE OBJECT
CONTROL SERVER
(ESTABLISHED TCP CONNECTION)
PREPARE INFORMATION ON WHICH MEDIA OR PRIMARY SERVER FEEDS CHANNEL
(ESTABLISHED TCP CONNECTION)

FIGURE 15

FIGURE 16A


MEDIA SERVER
MEDIA OR PRIMARY SERVER
(INCOMING PLAY RECEIVED)
GET APPROPRIATE MEDIA OR PRIMARY SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER RETRIEVE SECURITY TOKEN
MCI REQUEST OBJECT (OPEN)
RESULT MESSAGE OBJECT
VALIDATE SECURITY TOKEN ALLOCATE RESOURCES
MCI REQUEST OBJECT (PLAY)
RESULT MESSAGE OBJECT
START AUDIO PACKETS
FORWARD AUDIO PACKETS TO OTHER SERVER(S) OR USER(S)
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
(CONTINUED)
(CONTINUED)

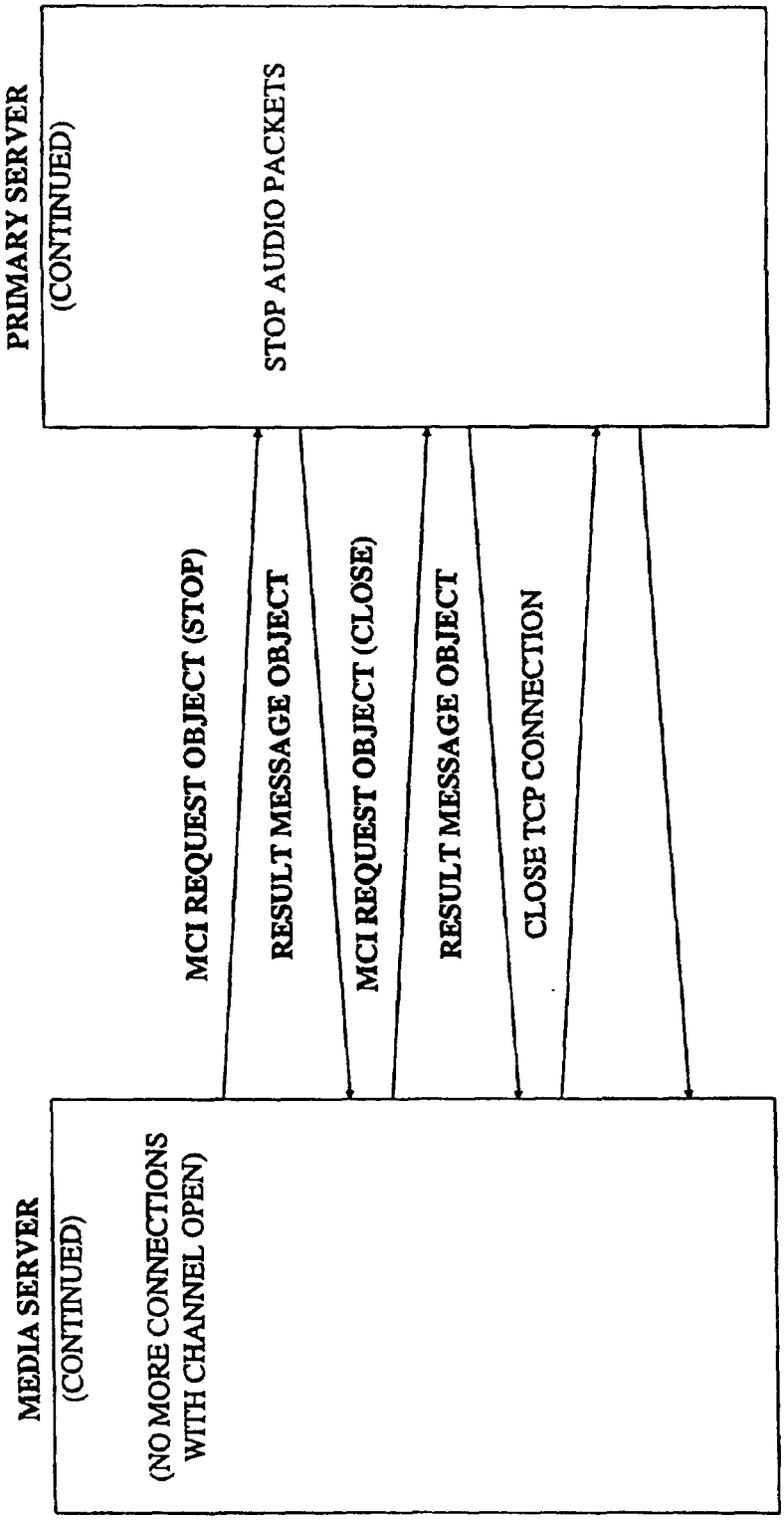

PRIMARY SERVER
(CONTINUED)
STOP AUDIO PACKETS
MCI REQUEST OBJECT (STOP)
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (CLOSE)
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION
MEDIA SERVER
(CONTINUED)
(NO MORE CONNECTIONS
WITH CHANNEL OPEN)

FIGURE 16B

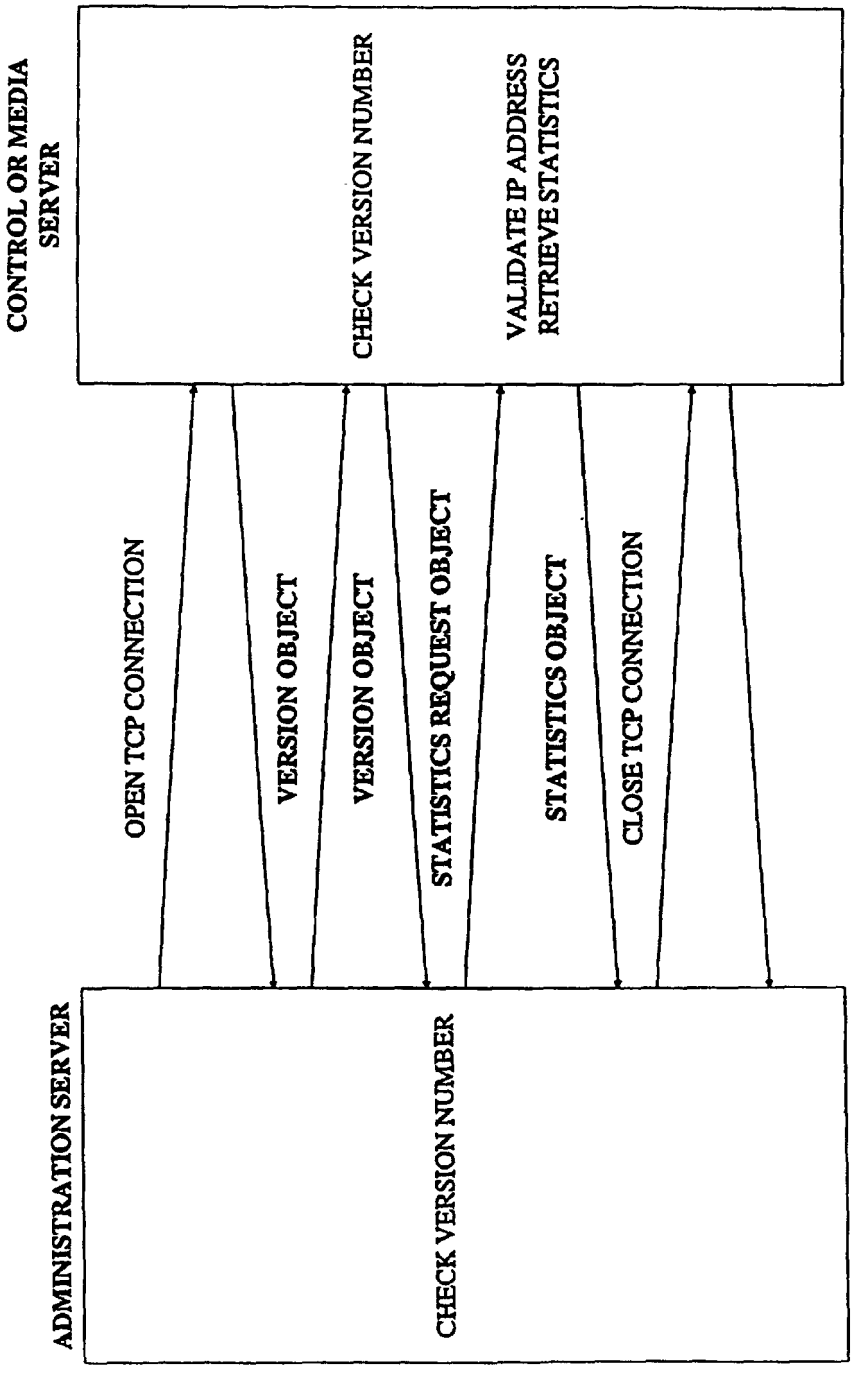

CONTROL OR MEDIA SERVER
CHECK VERSION NUMBER
VALIDATE IP ADDRESS
RETRIEVE STATISTICS
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
STATISTICS REQUEST OBJECT
STATISTICS OBJECT
CLOSE TCP CONNECTION
ADMINISTRATION SERVER
CHECK VERSION NUMBER

FIGURE 17

FIG. 18

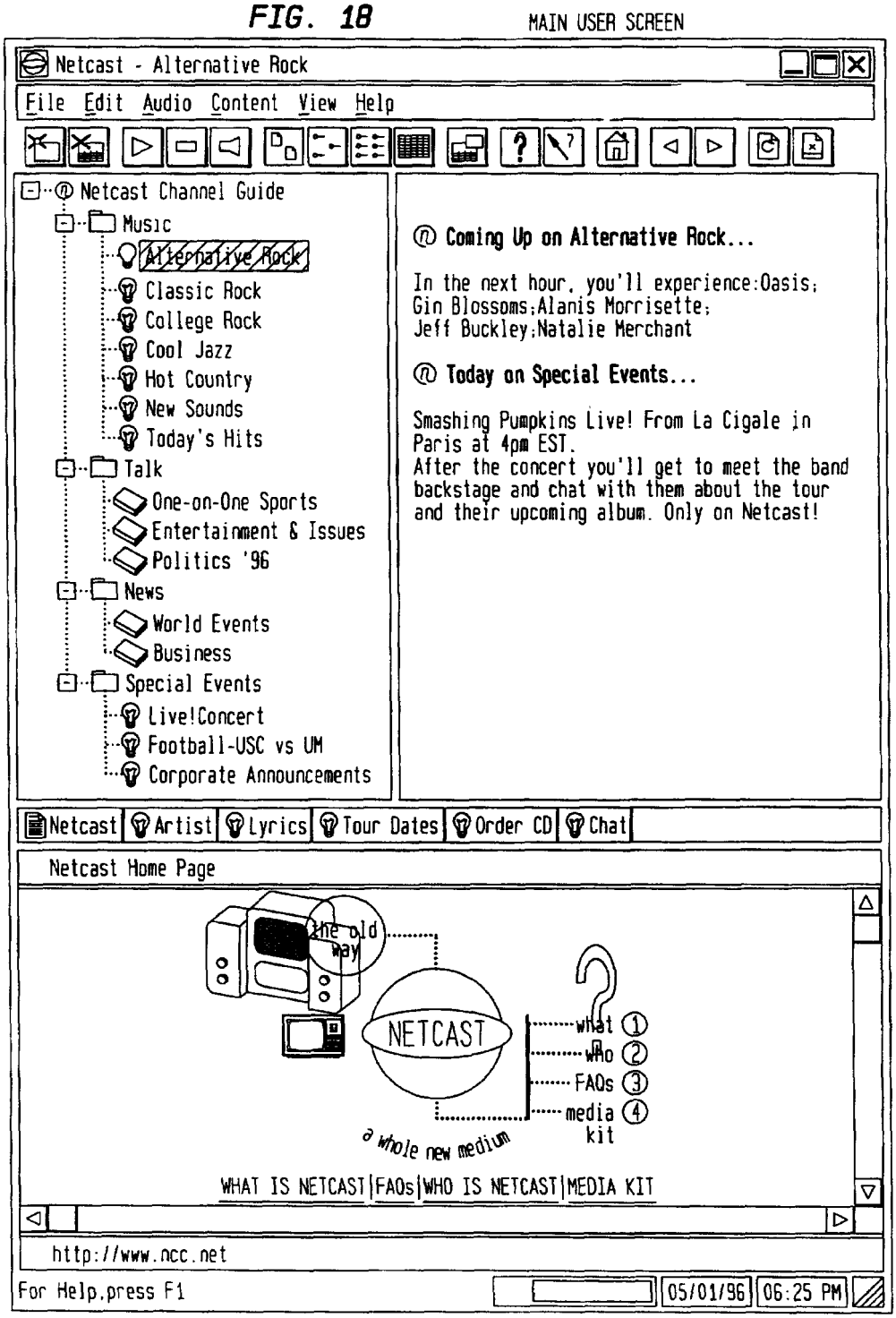
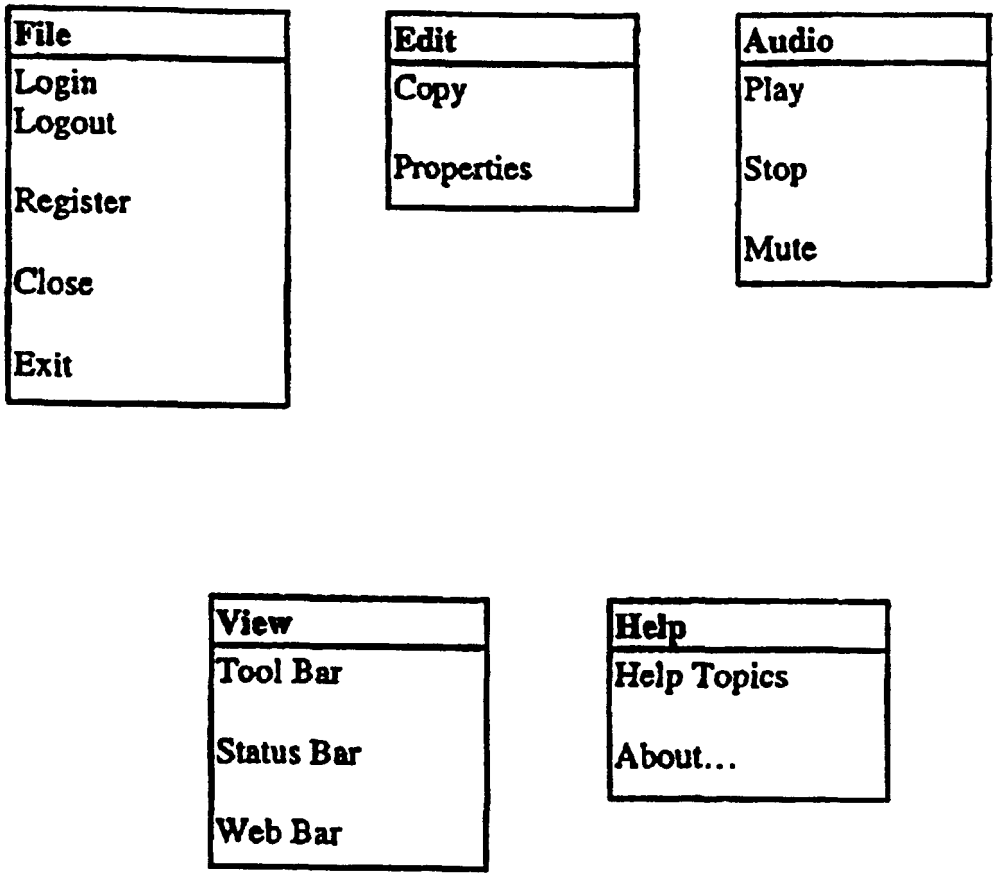

MAIN USER SCREEN
Netcast - Alternative Rock
File Edit Audio Content View Help
Netcast Channel Guide
Music
Alternative Rock
Classic Rock
College Rock
Cool Jazz
Hot Country
New Sounds
Today's Hits
Talk
One-on-One Sports
Entertainment & Issues
Politics '96
News
World Events
Business
Special Events
Live!Concert
Football-USC vs UM
Corporate Announcements
Coming Up on Alternative Rock...
In the next hour, you'll experience:Oasis;
Gin Blossoms;Alanis Morrisette;
Jeff Buckley;Natalie Merchant
Today on Special Events...
Smashing Pumpkins Live! From La Cigale in
Paris at 4pm EST.
After the concert you'll get to meet the band
backstage and chat with them about the tour
and their upcoming album. Only on Netcast!
Netcast
Artist
Lyrics
Tour Dates
Order CD
Chat
Netcast Home Page
the old way
NETCAST
what 1
who 2
FAQs 3
media kit 4
a whole new medium
WHAT IS NETCAST | FAQs | WHO IS NETCAST | MEDIA KIT
http://www.ncc.net
For Help,press F1
05/01/96
06:25 PM

Figure 19
Key Pull-Down Menus on Main User Screen



MULTICASTING METHOD AND APPARATUS

This is a continuation of application Ser. No. 08/644,072, filed May 9, 1996, now U.S. Pat. No. 5,778,187 and such application is hereby incorporated by reference.

FIELD OF THE INVENTION

This relates to a method and apparatus for providing audio and/or visual communication services, in real-time to a multiplicity of identifiable users on a communications network, such as the Internet. In a preferred embodiment, the invention monitors which users are receiving signals on which one of a plurality of channels and modifies the content of at least some signals in response thereto. A particular application is to provide services akin to multi-channel radio or television with commercial programming content adjusted in accordance with the identity of the individual user.

BACKGROUND OF THE INVENTION

Systems such as the Internet typically are point-to-point (or unicast) systems in which a message is converted into a series of addressed packets which are routed from a source node through a plurality of routers to a destination node. In most communication protocols the packet includes a header which contains the addresses of the source and the destination nodes as well as a sequence number which specifies the packet's order in the message.

In general, these systems do not have the capability of broadcasting a message from a source node to all the other nodes in the network because such a capability is rarely of much use and could easily overload the network. However, there are situations where it is desirable for one node to communicate with some subset of all the nodes. For example, multi-party conferencing capability analogous to that found in the public telephone system and broadcasting to a limited number of nodes are of considerable interest to users of packet-switched networks. To satisfy such demands, packets destined for several recipients have been encapsulated in a unicast packet and forwarded from a source to a point in a network where the packets have been replicated and forwarded on to all desired recipients. This technique is known as IP Multicasting and the network over which such packets are routed is referred to as the Multicast Backbone or MBONE. More recently, routers have become available which can route the multicast addresses (class D addresses) provided for in communication protocols such as TCP/IP and UDP/IP. A multicast address is essentially an address for a group of host computers who have indicated their desire to participate in that group. Thus, a multicast packet can be routed from a source node through a plurality of multicast routers (or mrouters) to one or more devices receiving the multicast packets. From there the packet is distributed to all the host computers that are members of the multicast group.

These techniques have been used to provide on the Internet audio and video conferencing as well as radio-like broadcasting to groups of interested parties. See, for example, K. Savetz et al. *MBONE Multicasting Tomorrow's Internet* (IDG Books WorldWide Inc., 1996).

Further details concerning technical aspects of multicasting may be found in the Internet documents Request for Comments (RFC) 1112 and 1458 which are reproduced at Appendices A and B of the Savetz book and in D. P. Brutaman et al., "MBONE provides Audio and Video Across the Internet," *IEEE Computer,* Vol. 27, No. 4, pp. 30–36 (April 1994), all of which are incorporated herein by reference.

Citation of the foregoing documents is not to be construed as an admission that any of such documents is a prior art publication relative to the present invention.

SUMMARY OF THE INVENTION

The present invention is a scalable architecture for delivery of real-time information over a communications network. Embedded into the architecture is a control mechanism that provides for the management and administration of users who are to receive the real-time information.

In the preferred embodiment, the information being delivered is high-quality audio. However, it could also be video, graphics, text or any other type of information that can be transmitted over a digital network. This information is delivered in real-time to any number of widely distributed users. It is real-time in that for a given channel of information, approximately the same information is being sent at approximately the same time to everyone who is enabled to receive the information.

Preferably, there are multiple channels of information available simultaneously to be delivered to users, each channel consisting of an independent stream of information. A user chooses to tune in or tune out a particular channel, but does not choose the time at which the channel distributes its information. Advantageously, interactive (two-way) information can be incorporated into the system, multiple streams of information can be integrated for delivery to a user, and certain portions of the information being delivered can be tailored to the individual user.

BRIEF DESCRIPTION OF THE DRAWING

These and other objects, features and advantages of our invention will be more readily apparent from the following Detailed Description of a Preferred Embodiment of our invention in which

FIG. **1** is a schematic diagram depicting an overview of the system of the present invention;

FIG. **2** is a schematic diagram depicting the network control center for the system of FIG. **1**;

FIG. **3** is a schematic diagram depicting a unicast distribution structure;

FIG. **4** is a schematic diagram depicting a multicast distribution structure;

FIG. **5** is a schematic diagram depicting the connection between the media server and the user in the system of FIG. **1**;

FIGS. **6–17** are timing diagrams which depict various aspects of the operation of the system of FIG. **1**; and

FIGS. **18** and **19** depict the user interface for control of the system of FIG. **1**.

Where the same reference numerals appear in multiple drawings, the numerals refer to the same or corresponding structure in such drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1**, the system of the present invention comprises a Network Control Center **10**, a plurality of Primary Servers **20**, Media Servers **30**, Users **40** and Control Servers **50** and an Administration Server **60**. The servers are interconnected by a communications network, which in the preferred embodiment is the global connected internetwork known as the Internet. The Network Control Center **10** is the source of the information being distributed. It receives audio

feeds from satellite, over the air broadcast or in other ways and processes this information for delivery over the network on multiple channels of information. This processing consists of optionally recording the information for future broadcast and dynamically inserting paid commercial advertisements.

For each channel of information, there is a Primary Server **20** that receives the stream of information from the Network Control Center **10** and compresses the information stream to allow for more efficient transmission. The Primary Servers **20** are directly connected to the network.

The Primary Servers forward information via the network to a number of Media Servers **30**. There may be a large number of Media Servers and in fact there may be many levels of Media Servers. For example, a Media Server which receives a stream of information from a Primary Server may forward that stream via the network to another Media Server which then forwards it to a User **40**. This multilevel hierarchical structure is described in more detail below.

The topology of the Internet dictates the ideal placement of Media Servers, the fan-out of each Media Server and the number of levels of Media Servers between the Primary Server and Users. For example, the Media Servers which feed from a Primary Server might be placed at a major points of presence (POPs) of each of the large Internet service providers. These Media Servers might also be placed near clouds which serve as high bandwidth exchange points between the major carriers. Similarly, Media Servers which feed to Users might be placed on or close to networks which have a large number of subscribers to minimize the distance and number of data streams being transmitted.

Control Servers **50** are responsible for keeping track of which Users are listening to which channels and for directing the Media Servers to start and stop streams of information to those Users. The Control Servers are also responsible for handling other interactions among the various components of the system as will be described in more detail below. Each Control Server is responsible for managing a cluster of Media Servers; and each Media Server is managed by a single Control Server at any given time. As a result, the Control Servers are distributed throughout the Internet, preferably located close to the Media Servers.

The Administration Server **60** is responsible for registering new Users, authenticating Users who want to log onto the system, and maintaining audit logs for how many Users are listening to which channels and at which times. Maintaining audit logs and gathering statistics are features critical to monitoring the delivery of paid commercial messages as well as for other purposes. For example, for purposes of assessing copyright royalties, the audit logs can record the number of listeners for each musical or video selection that is distributed by the system. Another application is to determine the percentage of listeners who are interested in listening to a particular musical selection by determining how many listen to the entire selection and how many turn it off.

The system of the present invention can be considered a distribution architecture integrated with a control architecture. The distribution architecture handles scalable real-time delivery of information to any number of Users on a packet switched network, such as the Internet. The control architecture represents a second scalable system integrated with the distribution architecture for managing and administering the delivery of that information.

The remainder of this description is divided into three sections. In the next section the distribution architecture will be described in more detail. Following that, the control architecture will be described. In the third section the User interface will be illustrated.

Distribution Architecture

The distribution architecture provides for the delivery of real-time information to any number of Users distributed throughout a network. As will be described in detail below, the distribution architecture is scalable to allow for efficient delivery of multiple simultaneous information channels in real-time to a large number of Users.

In the preferred embodiment, the information which is being distributed consists of high-quality audio in addition to other information. It should be appreciated that the basic architecture and other general principles set forth herein would also apply to the delivery of video, graphics, text or any other type of information that can be delivered over a digital network. In addition, it should be appreciated that an information stream can consist of audio with supplemental information such as text and graphic images and commands to control software running on the User's computer.

The source of information in the preferred embodiment is the Network Control Center **10**, depicted in the schematic diagram of FIG. **2**. Control Centers of this type of design are available from Broadcast Electronics, Inc. and are similar to what would be found in a conventional radio station serving multiple frequencies.

Referring to FIG. **2**, the incoming signal can be received in a variety of ways such as from a satellite, over-the-air broadcast, cable or hard disk. It is then processed by Receiver/Decoder **110**, which decodes the signal and provides an incoming audio stream. Routing Switcher **120** is responsible for routing the incoming audio feed from the Receiver to either Delay Recording Workstation **140** or to one of the Playback/Control Workstations **130**. Real-time insertion of paid commercial advertising takes place at the Playback/Control Workstations and the resulting integrated audio stream is delivered to the Primary Servers. The Delay Recording Workstation is responsible for recording an incoming broadcast so that it can be played back at a later time.

Supervisory Workstation **150** is responsible for managing and controlling the Playback/Control Workstations, Delay Recording Workstations and other computers as may be connected to the local area network within the Network Control Center. Production Workstation **160** and AudioVAULT-NFS Server **170** are used to manipulate audio samples, such as commercial messages for use by the Playback/Control Workstations. The audio being delivered can consist of syndicated TV or radio programs, such as would be received over satellite or cable and delivered as described above. These can be delivered live and/or played back at a later time. It is also possible for the delivery of information, such as music, to take place from information that is all stored locally such as on a hard disk. A new play list and its associated music data can then be downloaded periodically to update the channel. Additionally, it is possible to deliver commercial-free programming, for example public service announcements or label-specific music.

In the preferred embodiment the Primary Servers are responsible for compressing the audio stream using an advanced perceptual technique developed and licensed by AT&T Corp. and Lucent Technologies, Inc. This highly sophisticated algorithm is used to maximize the benefit of the bandwidth available. Advantageously, two bitrates are available, a first rate of approximately 20 Kbps and a second

rate of approximately 56 Kbps. Using the perceptual technique, the quality of the first rate is similar to FM monaural (with a sampling rate of approximately 22,000 16-bit samples per second) and the second rate is close to CD quality stereo (with a sampling rate of approximately 32,000 16-bit samples in stereo each second). The signals at the two different bitrates comprise two different audio channels and thus require two different compression processes.

The computational requirements of compressing an audio stream in real time using techniques such as the advanced perceptual technique are approximately 100% of a Pentium-Pro 200 Mhz computer and the computational requirements of decompressing an audio stream in real time are approximately 30% of a Pentium 75 Mhz computer. Future improvements and/or changes to the algorithm could significantly change these requirements. For the present, a dedicated computer is required within the Primary Server to compress the audio stream. The decompression process takes place on end Users' computers and preferably would use only a portion of the computers' computational requirements, allowing the computers to be used for other tasks while they are processing the audio stream.

It is important to appreciate that the compression and decompression techniques employed by the present invention are not critical to the overall operation of the system and the advantages obtained therefrom could be obtained with other compression methodologies. Advantageously, the identity of the compression technique used can be encoded into the audio stream in the packet header. This makes it possible to identify to the receiver the nature of the decompression algorithm to use; and thereby make it possible for the computer within the Primary Server to select an optimum compression algorithm depending on the nature of the audio stream to be compressed.

The remainder of the distribution architecture comprises the multilevel hierarchy of data transmission originating at the Primary Server **20** and terminating at the Users **40** as shown in FIG. **3**. In the preferred embodiment, the network is the global connected Internet. It can also include private networks which are connected to the Internet and it could be implemented on any packet switched network, cable-modem-based or satellite-based cable system. It is possible that certain links within the overall system, for example, the link between the Primary Server and the first level of Media Servers, are private data links which carry only data associated with this system. This could also be true of other data transmission paths in the distribution architecture. The User receiving the information preferably can be anyone who has access to the Internet with sufficient bandwidth to receive the resulting audio data.

It should be appreciated that the distribution architecture of the present invention provides for scalability. Using such a structure, any number of Users, and as widely distributed as necessary, can be accommodated. In the preferred embodiment, the fan-out at each level of Media Server (given the state of technology today) is on the order of ten, but the same structure could be applied with other fan-outs. The location and fan-out of the Media Servers is chosen to minimize overall network bandwidth consumed.

The flow of information from Primary Server **20** through network to User **40** is based on the delivery of a continuous sequence of individual pieces of information., or packets. Thus the distribution architecture implements a form of multicast packet delivery to a group. The group in this case is the set of all Users who are listening to a given channel at a given time. Group membership is dynamic, Users can start and stop listening to a channel at any time.

Multicasting can be implemented in a variety of ways, any or all of which can be used in the present invention. In the preferred embodiment, the Media Servers receive unicast packet streams and they then duplicate these streams into more unicast streams to other Media Servers which are in the membership group for that stream. The lowest level Media Servers use hardware broadcast, multicast and/or unicast to reach all Users served by that Media Server.

If the Media Server is directly connected to the same physical network as the User, hardware broadcast or multicast can be used to transmit the packet stream to all Users listening at that time on that network. In this case the Media Servers can translate the incoming packets into broadcast or multicast packets for transmission on the local network. Only a single packet is transmitted at-a-time on the local network and any computer directly connected to the local network can receive that packet. Hardware multicast is built into most networks and it is lower in overall overhead than hardware broadcast since computers not interested in a transmission do not have to process the packets. In the case that a Media Server is serving a User who is not on the same physical network, a unicast transmission is used to reach that User, which requires a separate packet transmission for each User so connected. In the preferred embodiment, the assignment of Users to Media Servers is done using control transactions among the User **40**, Control Servers **50**, and Administration Server **60**. This system will be described more fully in the following section.

Multicasting can also be implemented within the Internet at the IP level using IP class D addresses and the IGMP group control protocol. FIG. **4** illustrates how the multilevel hierarchical distribution architecture would operate using IP multicast delivery. Under this system, a packet is transmitted with a multicast address for a destination and each router maintains group membership lists for each interface that it is connected to and will forward packets across the Internet to other routers such that all Users within the global group eventually receive a copy of the packet. Unless and until all routers within the Internet understand multicasting in this way, it is necessary to supplement it with IP tunneling in which multicast packets are encapsulated in unicast packets and routed by unicast routers to a multicast routers. The present invention can and will be able to take advantage of IP multicasting as it becomes widely available. Each channel of information would be given its own class D address and the Media Server would then simply transmit packets using the appropriate IP destination address. In this case no Media Servers would be used as this function would be accomplished by the routers in use to store and forward other IP packets.

Thus it can be appreciated that the implementation of the multicast delivery structure can be implemented using a combination of IP unicast, IP multicast and hardware multicast or any other system which provides for distributed delivery of information to a specific group of destinations. It is expected that special relationships with Internet providers will be established so that delivery of the audio steams can take place with a guaranteed bandwidth and in the most efficient way possible.

In the preferred embodiment, packets of information for distribution use the UDP protocol under IP rather than the TCP protocol. TCP provides for reliable stream delivery but at the cost of retransmission and delays. For real-time information, it is usually more appropriate to use UDP since the information is time critical and low latency is more important that reliability. Since TCP is a point-to-point protocol, it is incompatible with IP multicasting. However,

TCP could be used on the IP unicast links between Media. Servers which are expected to have very low packet loss. In order to handle out of order, lost, duplicate and corrupted packets, the UDP packets are serialized.

In the preferred embodiment the size of the audio packets being transmitted is variable and can change on a packet by packet basis. It is expected that when using compression schemes that have a fixed bit rate, such as ADPCM, all packets for that stream would be the same size. Alternatively when using a variable bit rate compression algorithm, it is expected that packet size would vary so as to establish approximately the same amount of time for each sample. For example, if each packet corresponds to a 20 millisecond segment of speech, this could correspond to 100 bytes during one time period and 200 bytes during another. Additionally, the Media Server may choose to dynamically vary the packet size to accommodate changes in network conditions.

Since the resulting playback of audio information is sensitive to packet loss and network congestion, software running on the various computers which make up this system monitor the ongoing situation and adapt to it in the best possible way. This may involve using different Media Servers and/or lowering the data rate to the User. For example, similar to analog dynamic signal quality negotiation present in many analog radio receivers, the User software may request a lower bitrate until the situation is improved. Also, note that the audio information being delivered to the User is preferably interleaved so that a contiguous segment of the audiostream is distributed for transmission over several packets. As a result, the loss of one packet is spread out over multiple audio samples and causes minimal degradation in audio. Advantageously, a small degree of redundancy may be incorporated within the audio stream to further guard against packet loss.

Preferably, there are two bitrate options available to the User for audio delivery. These are approximately 20 Kbps for standard audio and approximately 56 Kbps for high quality audio. Thus, a 28.8 Kbps modem connection over an analog phone line is sufficient to listen to standard audio broadcasts. To listen to high quality audio, an ISDN connection to the Internet is required, or some other connection with greater than 56 Kbps bandwidth. It should be appreciated that higher bandwidths are currently becoming available to end Users. In particular the use of cable modems and residential fiber networks are enhancing the bandwidths available to Users and thus making broadcasts of higher bitrates more practical.

In addition to the content of the audio channel being delivered, it is also possible to deliver out of band of side-bar information such as graphics, images and text. This side-bar information is synchronized with the audio channel. This may only involve small increases in bandwidth requirements, such as 1–2 Kbps. For example a music program could deliver images of an album cover, the text of song lyrics, or URLs for use by a Web browser. The User can preferably choose to have the side-bar information show up automatically or be hidden. It is also possible to incorporate two-way interaction into the system, such that for example Users can participate in a global chat session during the audio broadcast. These and other details are explained in more detail below under the description of the User interface.

The delivery of paid commercial advertising information is an important aspect of the present invention. Advertising may be incorporated into the audio stream within the Network Control Center as described above. It may also be incorporated into the audio stream at the User level, or at some intermediate point in the distribution architecture. In addition, the side-bar information discussed above can also include advertising content. FIG. **5** illustrates the provision to the User of two separate streams **32, 34** of packets, one of which may be used for advertising. In this case the insertion of the stream of commercial advertising into the non-commercial stream occurs on the User's computer. FIG. **5** also illustrates packet stream **36** which identifies the User to the system. This enables the system to monitor which Users are listening to which channels and also allows the system to vary, for example, the advertising content delivered to a User.

One advantage of this alternative is to allow targeted commercial delivery based on the individual User. That is, an individual User would receive the main audio feed plus a particular advertising stream unique to his demographic group. Note that the advertising stream typically is lower in overall bitrate and generally does not require real-time delivery, thus lowering the overall load on the network. For example, the advertising stream could be delivered to the User in advance of the regular programming, stored in a buffer in the User's computer and inserted into the stream of regular programming upon receipt of a cueing signal embedded in the stream of regular programming. Thus, a substantial number of targeted groups, perhaps 10 or 100 or even more could be accommodated without an impractical increase in network load.

Control Architecture

The control architecture described in this section is responsible for managing and administering the Users who are receiving the information being delivered by the distribution architecture described in the previous section. The control architecture handles new User registration, User login, the starting and stopping of audio streams and the monitoring of ongoing transmissions. The control architecture is scalable just as is the distribution architecture so that any number of Users can be managed.

This section describes the control protocol, which consists of the format and sequence of control messages that are exchanged among Users, Control Servers, Media Servers, Primary Servers and the Administration Server. These messages are in the form of objects, which have specific data formats. Objects are exchanged preferably using the TCP protocol although other options are possible. Below we describe the sequence of objects passed among the various computers and detail the internal structure of each object.

The major objects used in the present embodiment of the invention are set forth in Table 1. For each object, Table 1 provides a brief description of its function, identification of the names of the fields in the object, their types and a brief description of their function.

TABLE 1

Channel Activation Object
Contains information used for channel activation/deactivation. It is sent to Media and Primary Servers to tell them to carry or stop carrying a specific channel. Media Servers get the channel from another server in the system hierarchy and Primary Servers get and encode the feed from the actual input source

Field Name	Field Type	Remarks
Token	Security Token Object	
Moniker	Moniker Object	unique channel identifier
Activate	Int	action flag (activate/de-activate)

TABLE 1-continued

CompressType	Int	type of compression to use
Host	Host Object	host carrying the channel

Channel Guide Object
Contains analytical and descriptive information for an item requested that is uniquely identified by a moniker. It is usually the reply to a Channel Guide Request object.

Field Name	Field Type	Remarks
Token	Security Token Object	
Type	Int	type of content
Result		the content data itself

Channel Guide Request Object
Conveys a request for analytical and descriptive information about an item uniquely identified by the contained moniker. The reply is in the form of a Channel Guide object.

Field Name	Field Type	Remarks
Token	Security Token Object	inherited from base class
Type	Int	type of content
Moniker	Moniker Object	unique identifier

Host Object
Encapsulates the attributes of a networked computer related to the operation or services it offers or requests.

Field Name	Field Type	Remarks
Token	Security Token Object	
HostName	String	computer name and domain
PortNumber	Int	port number for service
DisplayName	String	descriptive computer name

Login Information Object
Encapsulates the name and password by which a User is known to the system.

Field Name	Field Type	Remarks
Token	Security Token Object	
Login	String	User's system login name
Password	String	User's system password (possibly encrypted)

Media Control Interface (MCI) Request Object
Encapsulates a multimedia control command, such as play and stop, and any extra information that may be necessary to perform the requested service.

Field Name	Field Type	Remarks
Token	Security Token Object	
Command	Int	multimedia command
String	String	command-specific extra info

Moniker Object
A moniker encapsulates the name of an object or process with the intelligence necessary to work with that name. In other words, it provides naming and binding services. The Moniker Object is used in the system for unique identification of various components, parts or features, such as a channel, a directory, or a computer list.

Field Name	Field Type	Remarks
Token	Security Token Object	
ID	String	unique string identifier
DisplayName	String	User-readable name

TABLE 1-continued

Ping Object
Ping is the name given to the "Are-You-Alive?" operation useful in determining if a specific computer is up and running. This object is used in the system when a server has to be queried for its operational status. It can also provide timing information for statistical purposes and quality of service evaluations.

Field Name	Field Type	Remarks
Token	Security Token Object	
Date	Date	system date
Time	Time	system time

Protocol List Object
Encapsulates a general purpose collection object.

Field Name	Field Type	Remarks
Token	Security Token Object	
Type	Int	type of object list

Result Message Object
Acts as the acknowledgment for a requested service successfully carried that out or reports errors that occur in the system during a client/server transaction.

Field Name	Field Type	Remarks
Token	Security Token Object	
Code	Int	result code
Message	String	message corresponding to code

Security Token Object
Contains the authorization key for a transaction. The key must be validated before any service is performed.

Field Name	Field Type	Remarks
ID	String	authorization key/transaction ID.

Server Activation Object
Contains information used in the server activation/deactivation process. Used for announcement as well as command purposes (e.g., a server can notify the administration database that is now activated or a server can be instructed to manage someone else).

Field Name	Field Type	Remarks
Token	Security Token Object	
Active	Int	action flag (activate/deactivate)
Manage	Int	control flag (manage/associate)
Type	Int	server type
Host	Host Object	host to be controlled

Service List Request Object
Encapsulates a request for a list of available server resources for an identified service (e.g., a request for a list of Control Servers for a specified channel).

Field Name	Field Type	Remarks
Token	Security Token Object	
Type	Int	type of service
Moniker	Moniker Object	content/channel unique identifier
Host	Host Object	local host information

Statistics Object
Contains system-related information that can be used by load-balancing algorithms and for statistical purposes.

Field Name	Field Type	Remarks
Token	Security Token Object	
Load	Int	load on the system
Threads	Int	number of threads

TABLE 1-continued

		running
Users	Int	number of Users being serviced
Uptime	Int	amount of time running
NumberManaged	Int	number of managed servers
NumberAssociated	Int	number of associated servers

Statistics Request Object

Encapsulates a request for system-related information that can be used by load-balancing algorithms and statistical purposes.

Field Name	Field Type	Remarks
Token	Security Token Object	
Load	Int	request flag (on/off)
Threads	Int	request flag (on/off)
Users	Int	request flag (on/off)
Uptime	Int	request flag (on/off)
NumberManaged	Int	request flag (on/off)
NumberAssociated	Int	request flag (on/off)

User Object

Users and Servers use this object to register themselves with the administration database. They provide the information for subsequent logins (name, password) and other system-related info. The end-Users provide personal, demographic, and system-related information.

Field Name	Field Type	Remarks
Token	Security Token Object	
Login	Login Information Object	login information (name, password)
FirstName	String	User's first name
LastName	String	User's last name
Title	String	User's job title
Company	String	User's employer
Address1	String	User's home street address
Address2	String	User's address extra
City	String	city, village
State	String	state, province or foreign country
ZipCode	String	zip or postal code
Age	String	User's age
Gender	String	User's gender
PhoneNumber	String	telephone number
FaxNumber	String	fax number
Email	String	email address
Demographics	Dictionary	market-targeting extra User info
SystemInfo	Dictionary	system-related information

Version Object

All components of the system use this object to report their versioning information to the party they transact with in order to use a protocol they both understand. They are also given the chance to update themselves if a newer version exists.

Field Name	Field Type	Remarks
Token	Security Token Object	
Major	Int	major protocol version number
Minor	Int	minor protocol version number
Type	Int	sender type
Client	Version	client version information

Unlike traditional protocols based on state computers, the control protocol of the present invention is a light-weight, stateless protocol comprising simple sequences of objects. It is light-weight in that in most sequences only two objects are involved in the transaction and after a sequence is completed the connection can be reused. It is also stateless in that the server maintains no information about the client. Every transaction is handled independently of the previous ones. States exist in the lower levels, for example within the TCP layer, to express logical states of a network connection but they are not actually part of the control protocol.

In the preferred embodiment, the software running on the Control Servers, Media Servers and Primary Servers is programmed for Windows NT and UNIX environment using the OLE environment. In addition, COM interfaces are used between components. The Rogue Wave system is used to transfer objects between the applications running on the various computers. The software running on the User computer is preferably programmed for a Windows 32-bit environment, so it will run on a Windows 95 or Windows NT computer. Alternatively, Macintosh and UNIX environments can be accommodated by other User software.

The basic process of a control transaction consists of a version sequence followed by one or more protocol sequences. The version sequence starts after the computer initiating the transaction, the client, has established a connection with the computer completing the transaction, the server. The client sends a Version Object (defined in Table 1) and in response the server then sends back its own Version Object. This version sequence is used so that both client and server are aware of the version numbers of the software they are using. If a version number is older than expected, either client or server can choose to conform to the previous version or abort the transaction, depending on its needs and capabilities. If a version number is newer than expected, in most cases the current transaction can be completed since the software systems are designed to be fully backward compatible with previous versions. Additionally, in the case that the server of the transaction is the Administration Server, the client receives information about what the latest version number is and thus the client can be informed that a software update is needed. The process of handling automatic updating of User software is described more fully below.

After the version sequence, one or more protocol sequences occur in which other objects are exchanged between client and server. When a particular protocol sequence is completed, another independent protocol sequence can be serviced. The protocol sequences that are part of the control architecture of the present invention are summarized in Table 2 and described below in conjunction with FIGS. **6–17**.

TABLE 2

Summary of Protocol Sequences

Control Sequence	Client	Server	Main Objects Exchanged
User Registration and Login (see FIG. 6)	User	Administration	Version Object User Object Channel Guide Object
User Login (see FIG. 7)	User	Administration	Version Object Login Information Object Channel Guide Object
Channel Play (see FIGS. 8a, 8B, 8C)	User	Administration	Version Object Server List Object
		Control	Version Object Server List Object
		Media	Version Object MCI Objects - OPEN/PLAY/STOP/CLOSE Ping Objects (TCP connection stays open)
Token Validation	Control or	Adminis-	Version Object

TABLE 2-continued

Summary of Protocol Sequences

Control Sequence	Client	Server	Main Objects Exchanged
(see FIGS. 9A, 9B)	Media or Primary	tration or Control	Security Token Object
Server Registration and Login (see FIG. 10)	Media or Control	Adminis-tration	Version Object User Object Server Activation Object
Server Login (see FIG. 11)	Media or Control	Adminis-tration	Version Object Login Object Server Activation Object
Control Server Activation (see FIG. 12)	Adminis-tration	Control	Version Object Server Activation Object
Media Server Activation (see FIG 13)	Control	Media	Version Object Server Activation Object Ping Objects (TCP connection stays open)
Control Channel Activation (see FIG. 14)	Adminis-tration	Control	Version Object Channel Activation Object
Media Channel Activation (see FIG. 15)	Control	Media	(open TCP connection) Channel Activation Objects
Distribution Activation (see FIG. 16)	Media	Media or Primary	Version Object MCI Objects - OPEN/PLAY/STOP/CLOSE Ping Objects (TCP connection stays open)
Statistics Request (see FIG. 17)	Adminis-tration	Control or Media	Version Object Statistics Object

The User registration and login sequences are the processes by which a new User registers with the system, logs in and retrieves programming information. The channel play sequence takes place when a User asks to listen to a particular channel. The token validation sequence is used to verify that a computer requesting a service is authorized to do so. The Server registration, login and activation sequences are used by Control and Media Servers when they become active. The Control Server and Media Server activation sequences are used to manage the Control and. Media Servers. The control channel, media channel and distribution activation sequences are used to cause a channel to be distributed to a Media Server. Finally, the statistics request is used for administrative purposes.

FIG. **6** illustrates the User registration and login sequence in more detail. This sequence takes place after the User has installed the User software on his/her computer. It is expected that the User will download the software from the Internet and then invoke it which in the preferred embodiment will use the Windows Wizard interface. This will guide the User through the installation process including filling out the registration form, which we will describe more fully in the next section. After the User has selected a name and password and selected the option to register, the User computer opens a TCP connection to the Administration Server. Advantageously, the full domain name of the Administration Server is embedded into the User software, although it could be discovered in other ways. The User and Administration Server then exchange version objects with the Administration Server as described above. If the version numbers meet expectations, the User sends a User Object to the Administration Server. The format of the User Object is shown in Table 1. Once the Administration Server receives the User Object, it verifies that the information is filled in properly and that the selected User name is unique. If the User Object is invalid for any reason, the Administration Server returns a Result Message Object with a code indicating the reason. The format of the Result Message Object is shown in Table 1. If the User information is valid, the Administration Server updates the global database of User names and passwords and then generates a security token for that User. This security token is then returned to the User in a Result Message Object.

Upon receiving the Result Message Object, the User saves the security token for future use. This token is an identifier that allows the User to request services from the Administration Server and other computers within the overall system. The security token is not saved permanently or registered on the User computer. Normally, the User software then immediately sends a Channel Guide Request Object to the Administration Server and a Channel Guide Object is returned. The format of these objects is also shown in Table 1. Note that in principle, this is a separate transaction and could take place in a separate TCP connection to the Administration Server. In particular, once the User has registered and logged in, he/she can request the Channel Guide Object again since it may have been updated since the previous request. At this point the TCP connection to the Administration server is closed.

The process of User registration only needs to take place once for each User. However anyone can re-register at any time, even after the software has been installed. In particular, it is expected that if multiple persons use a computer, each person will register and obtain his/her own User name and password. If the registration process is not completed successfully, the User software saves the registration information and ask the User if they would like to try again the next time the software is invoked.

Since the security token is not permanently saved by the User software, it is lost when the User software is closed, and the security token must again be retrieved from the Administration Server the next time the User wants to use the system. This process is the purpose of the login sequence illustrated in FIG. **7**. This sequence is used if a User has already registered and needs only to retrieve a valid security token. In this case the sequence consists of the User's sending a Login Information Object to the Administration Server. The Administration Server then queries the User database to validate the login name and password. If the login name and password are correct, then a security token is returned to the User. Normally the receipt of the security token will immediately be followed by a channel information request sequence, just as in the registration sequence described previously.

The control sequence that takes place when a User initiates a channel play operation is illustrated in FIGS. **8**A, **8**B and **8**C. First the User software requests a Control Server List from the Administration Server. Note that the Server List Request Object, illustrated in Table 1 contains a channel identifier. The Administration Server generates a sorted list of Control Servers based on overall system load and the location of the User on the network and returns this list to the User using a Protocol List Object. Once the Control Server List is returned to the User, the Administration Server is no longer needed and the TCP connection is closed.

The User software then searches the list of Control Servers and opens a TCP connection to the first host listed. If that host computer does not respond, then the next Control Server on the list is tested and so forth in succession. Upon obtaining a response from a Control Server, the User software uses a Server List Request Object to requests a Media Server List from the Control Server. If the Control Server is

too busy to service the User, it returns a Result Message Object so indicating and the User software tries the next Control Server on the list. However, in the likely scenario that the Control Server is able to handle the User's request, a sorted list of Media Servers is generated and returned to the User computer using a Protocol List Object. The TCP connection to the Control Server is then closed by the User software.

At this point the User software initiates a TCP connection to the first Media Server on the list provided by the Control Server. As in the previous case, it attempts to connect to the first host on the list and if unsuccessful tries the next hosts in succession. Once the Version Objects are exchanged, the User software sends an MCI Request Object to the Media Server. An MCI Request Object can be used for four basic commands: OPEN, PLAY, STOP and CLOSE. The User software must first send an OPEN command for the desired channel. If the returned Result Message Object indicates success, the User software then sends a PLAY command.

When the Media Server receives a valid PLAY command, it initiates the delivery of audio information to the User as described in the previous section. Note that this could be in the form of broadcast, multicast or unicast packets to a specific UDP port. The TCP connection through which the MCI Request Objects were sent stays open during the audio play operation. In addition, Ping Objects are sent to the User on a periodic basis to verify that the computer is still working and active. When the User software receives a Ping Object, it simply returns it. The Media Server uses the Ping Objects to measure round trip time and also to determine when a User's computer has terminated abnormally. In that case the audio stream is terminated.

In the case of normal termination of the audio stream, the User makes an explicit selection to stop and this causes a STOP command to be sent to the Media Server in an MCI Request Object. The Media Server then terminates the audio stream to that User. When the User closes the application software or selects another channel to play, the User software will send a CLOSE command to the Media Server in an MCI Request Object and the TCP connection is closed.

The initiation of the audio stream by the Media Server causes a log entry to be generated and sent to the Administration Server. This information is important so that the Administration Server can update its database to indicate which Users are listening to which channels. The security token is used to identify the User initiating the audio stream. Additionally, when the audio stream is terminated to any User, another log message is generated and sent to the Administration Server.

FIG. **9A** illustrates the process by which security tokens are validated. The Administration Server is the only server that can validate a security token. Thus, when a User requests services from a Control Server or from a Media Server, that server must go back to the Administration Server with a token validation sequence. However, Control Servers and Media Servers are allowed to cache validations of security tokens so that they do not have to validate tokens repeatedly once they have validated it the first time. In the case where a Media Server receives a request, the token will be validated with the Control Server that is managing that Media Server. FIG. **9B** identifies the various token validation scenarios.

FIG. **10** illustrates the process by which a new Server is registered. This process is similar to new User registration. It is expected, however, that the server installation will be through a Web interface rather than a Wizard. The Administration Server, upon receiving a User Object from a Media Server or Control Server validates the User name and password and generate a security token just as in the case of User registration. Normally the Server then immediately sends back a Server Activation Object indicating that it is ready to be used as a system resource. Once this process has been completed, the TCP connection to the Administration Server is closed.

If a Media Server or Control Server that has sent a Server Activation Object to the Administration Server becomes inactive, it will send another Server Activation Object indicating this condition. In the case of a Media Server, this object is sent to the managing Control Server. In the case of a Control Server, this object sent to the Administration Server. As in the case of User registration, Media Server and Control Server registration needs only take place once per computer. However, if the computer is restarted, the server must login and again retrieve a security token. This is the server login and activation sequence shown in FIG. **11**.

Once a Control Server has indicated to the Administration Server that it is ready, the Administration Server can activate that Control Server by sending the Control Server a Server Activation Object as illustrated in FIG. **12**. This is a separate transaction and is used to tell the Control Server which Media Servers it is supposed to manage. Recall that a Control Server and a number of Media Servers form a cluster of Media Servers. The single Control Server that manages that cluster must be given a list of host computers corresponding to the Media Servers in that cluster.

The process by which a Control Server activates the Media Servers that it manages is illustrated in FIG. **13**. The Control Server sends a Server Activation Object to the Media Server indicating that it is responsible for channel management. This TCP connection between the Control Server and the Media Server stays open during the time that both servers are active. The Control Server periodically sends Ping Objects to the Media Server across this open TCP connection to verify that the Media Server is still running.

FIG. **14** illustrates the process by which a given channel is activated by the Administration Server. The Administration Server opens a connection to a Control Server that its wishes to have carry a given channel and provide a Channel Activation Object. This object indicates to the Control Server which Media or Primary Server the Control Server should direct its Media Servers to get the feed from. At this point the Control Server is said to be carrying that channel and it will be a valid host on a list of Control Servers requested by a Channel Play sequence.

FIG. **15** illustrates what happens when a Control Server needs to provide a channel. First it sends a Channel Activation Object to one of the Media Servers that it manages across the open TCP connection described previously. This object indicates to the Media Server that it should start receiving the channel identified and from where it should receive it.

In FIGS. **16A** and **16B** depict how the Media Server requests distribution of an audio channel from another Media Server or from a Primary Server. This sequence is much the same as that in which a User requests the distribution of audio information from a Media Server. Note that a Media Server receives a single incoming stream for each channel that it is carrying and will then redistributes this stream to all Users or other Media Servers that request it.

Finally, FIG. **17** illustrates the statistics request sequence. This sequence is used by the Administration Server to gather information from the Media Servers and Control Servers in

order to manage the overall system. It can use this information to detect failures and to balance load as the dynamic conditions change. As indicated above, it can also use this information to monitor which Users are listening to which channel or whether Users stop listening to a channel at any time, such as during the play of a particular song. It can also use this information to control the advertising content that is downloaded to a particular User in advance of receipt of regular audio programming and/or monitor the delivery of advertising to the Users.

The control architecture described in this section is scalable to handle any number of Users. Note that the User registration process only happens once for each subscriber and the login process only happens once per session. These interactions, which require the Administration Server are expected to constitute a very small percentage of the overall system bandwidth. If the Administration Server were to become a bottleneck, however, it would be possible to duplicate it and to have the database it maintains distributed and automatically updated to guarantee consistency.

The Control Servers are distributed throughout the network and can handle the lower level interactions with the Users and the Media Servers. A single Control Server can handle preferably on the order of ten Media Servers up to several hundred Users. The bitrate among the Users, the Control Servers and the Media Servers is expected to be small in comparison to the audio transmission bitrate. The Ping Objects normally only involve the User and the nearest Media Server. They are also low in overhead since they are small and only get transmitted infrequently.

User Interface

The User interface is provided by the client application running on an individual computer and its associated graphical interface. In the preferred embodiment the User interface is available for 32-bit Windows (95 and NT), Macintosh and UNIX platforms. Preferably anyone on the Internet can freely download a copy of the client software and install it in their computer.

FIG. **18** illustrates the main User screen in the preferred embodiment. The screen is composed of three sections: channel guide (upper left frame), program guide (upper right frame), and multimedia frame (lower half of screen). The channel guide lists, as a tree hierarchy, the channels that are available from the system. The User selects a channel from the list of those displayed on the channel guide. The program guide provides information pertaining to the channel selected. This information can be a detailed schedule of the programming that has played or will be playing on the channel selected. Additionally, other relevant information will be displayed in this frame, for example, a notice regarding an upcoming special event on another channel. The multimedia frame provides an integrated web browser that displays information via a series of tabbed sections.

The information contained in the channel guide, program guide, and the tabs of the multimedia frame is dynamically transmitted to the client. For example, if a new channel begins operation, the client application can immediately display it as being available. Furthermore, the tabs displayed can be specifically relevant depending on what song is playing. For example, tabs displaying the album cover, information on the artist, song lyrics, tour dates can be displayed. Additionally, as shown in the example in FIG. **18**, a tab can be available allowing the User to place an order for the CD or allowing the User to participate in a chat session related to the channel.

FIG. **19** illustrates the key pull-down menus available in the main User screen in the preferred embodiment. Table 3 provides a description of each of the functions available through the pull down menus, as shown in FIG. **19**.

As will be apparent to those skilled in the art, numerous modifications may be made within the spirit and scope of the invention.

TABLE 3

Pull-Down Menu Functions

Menu Choice	Menu Sub-Choice	Description
File	Login	Allows the User to login to the system.
	Logout	Allows the User to logout from the system.
	Register	Brings up a dialog so that the user can register with the system for the first time.
	Close	Minimizes the screen.
Edit	Copy	Allows the User to copy the selection on to the clipboard.
	Properties	Allows the User to set various properties.
Audio	Play	Begins playing the selected channel.
	Stop	Stops playing the selected channel.
	Mute	Stops the playing of audio
View	Tool Bar	Display or hide the tool bar (providing access to pull-down menu functions).
	Status Bar	Display or hide the status bar normally situated at bottom of the screen.
	Web Bar	Display or hide the tool bar section that provides access to the web browser functions.
Help	Help Topics	Brings up a list of available online help topics
	About . . .	Displays summary infirmation regarding this application, such as version number, copyright information, and so on.

What is claimed is:

1. A method for transmitting message packets over a communications network comprising the steps of:

converting at least one stream of audio and/or visual information into at least one stream of addressed digital packets complying with the specifications of a network communication protocol,

for each stream, routing such stream to one or more users,

controlling the routing of the stream of packets in response to selection signals received from the users, and

monitoring the reception of packets by the users and accumulating records that indicate which streams of packets ware received by which users, wherein at least one stream of packets comprises an audio and/or visual selection and the records that are accumulated indicate the time that a user starts receiving the audio and/or visual selection.

2. The method of claim **1** further comprising the stop of varying the information content of at least one stream of packets with the identity of the user to whom the at least one stream of packets are delivered.

3. The method of claim **2** wherein the varied information content is inserted into the stream of audio and/or visual information before such stream is converted into a stream of packets.

4. The method of claim 2 wherein the varied information contains advertising information.

5. The method of claim 4 wherein the records that are accumulated indicate how many users received specific advertising information.

6. The method of claim 1 further comprising the step of generating an audio output and/or a visual display from the stream of packets received by the user.

7. The method of claim 1 further comprising the stops of:

storing a first stream of packets received by the user at a first time and

at a later time, inserting the first stream of packets into a second stream of packets received by the user.

8. The method of claim 7 wherein the content of the first stream of packets is varied depending on the identity of the users to whom the first stream of packets are delivered.

9. The method of claim 7 further comprising the step of converting the combined first and second streams of packets into an audio output and/or visual display.

10. The method of claim 7 wherein the content of the first stream of packets is varied depending on the identity of the user.

11. The method of claim 10 wherein the first stream of packets contains advertising information.

12. The method of claim 1 further comprising the steps of:

storing a first stream of packets at an intermediate point in the distribution architecture at a first time and

at a later time, inserting the first stream of packets into a second stream of packets.

13. The method of claim 12 wherein the content of the first stream of packets is varied depending on the identity of one or more users.

14. The method of claim 13 wherein the first stream of packets contains advertising information.

15. The method of claim 1 wherein at least one stream of packets comprises copyrighted selections and the records that are accumulated indicate which users received specific copyrighted selections.

16. The method of claim 1 wherein at least one stream of packets comprises audio and/or visual selections and the records that are accumulated indicate which users did or did not listen to and/or view the entire selection.

17. The method of claim 1 further comprising the steps of:

compressing the stream of packets in their passage from source to user, and

decompressing the stream of packets near the user.

18. The method of claim 17 wherein the compressing step uses a compression algorithm that is selected in accordance with the content of the information being communicated in the stream of packets.

19. The method of claim 18 wherein the compressing step inserts into each packet an identification of the compression algorithm used and the decompressing step monitors each packet to read such identification and to vary its decompression algorithm in response thereto.

20. The method of claim 17 wherein the compressing step uses a compression algorithm and the decompression step uses a decompression algorithm that varies with the user to whom the stream of packets are delivered.

21. The method of claim 17 wherein the compressing step uses a compression algorithm that varies with the characteristics of the communications network.

22. The method of claim 17 wherein the decompressing step uses a decompression algorithm that varies with the characteristics of the communications network.

23. The method of claim 1, further comprising the step of varying the information content of at least one stream of packets with the identity of the users to whom the at least one stream of packets are delivered.

24. The method of claim 1, wherein the records that are accumulated include user information and system-related information.

25. A method for transmitting at least one stream of audio and/or visual information over a communications network to one or more users comprising the steps of:

controlling the routing of the stream of information through the network in response to selection signals received from the users, and

monitoring the reception of the stream of information by the users and accumulating records relating to the reception of the stream of information by the users, wherein at least one stream of information comprises an audio and/or visual selection and the records that are accumulated indicate the time that a user starts receiving the audio and/or visual selection.

26. The method of claim 25 further comprising the step of varying the information content of at least one stream of information with the identity of the user to whom the at least one stream of information is delivered.

27. The method of claim 26 wherein the varied information content is inserted into the stream of audio and/or visual information.

28. The method of claim 25 further comprising the steps of:

storing a first stream of information received by the user at a first time and

at a later time, inserting the first stream of information into a second stream of information received by the user, wherein the content of the first stream of information is varied depending on the identity of the user.

29. The method of claim 28 wherein the first stream of information contains advertising information.

30. The method of claim 25 further comprising the steps of:

storing a first stream of information at an intermediate point in the distribution architecture at a first time and

at a later time, inserting the first stream of information into a second stream of information, wherein the content of the first stream of information is varied depending on the identity of one or more users.

31. The method of claim 30 wherein the first stream of information contains advertising information.

32. The method of claim 25 further comprising the steps of:

storing a first stream of information received by the user at a first time and

at a later time, inserting the first stream of information into a second stream of information received by the user, wherein the content of the first stream of information is varied depending on the identity of the users to whom the first stream of information is delivered.

33. The method of claim 25, further comprising the step of varying the information content of at least one stream of information with the identity of the users to whom the at least one stream of information is delivered.

34. The method of claim 25 further comprising the steps of:

compressing the stream of information in its passage from source to user, and

decompressing the stream of information near the user.

35. The method of claim 34 wherein the compressing step uses a compression algorithm that is selected in accordance

with the content of the information being communicated in the stream of information.

36. The method of claim **34** wherein the compressing step uses a compression algorithm and the decompression step uses a decompression algorithm that varies with the user to whom the stream of packets are delivered.

37. The method of claim **34** wherein the compressing step uses a compression algorithm that varies with the characteristics of the communications network.

38. The method of claim **34** wherein the decompressing step uses a decompression algorithm that varies with the characteristics of the communications network.

39. The method of claim **25** wherein multiple streams of audio and/or visual information are transmitted over the communications network and the user can select which stream to receive.

40. The method of claim **25**, wherein the records that are accumulated include user information and system-related information.

41. The method of claim **26** wherein the records that are accumulated indicate how many users received specific advertising information.

42. The method of claim **26** wherein at least one stream of information comprises copyrighted selections and the records that are accumulated indicate which users received specific selections.

43. The method or claim **26** wherein at least one stream of information comprises audio and/or visual selections and the records that are accumulated indicate which users did or did not listen to and/or view the entire selection.

44. A communication system comprising:

means for converting at least one stream of audio and/or visual information into a stream of addressed digital packets complying with the specifications of a network communication protocol,

means for routing such stream via a communication network to selected users,

means for controlling the routing of the stream of packets in response to selection signals received from the users, and

means for monitoring the reception of packets by the user and for accumulating records that indicate which streams of packets were received by which users, wherein at least one stream of packets comprises an audio and/or visual selection, and the means for monitoring further includes means for accumulating records that indicate the time that a user starts receiving the audio and/or visual selection.

45. The method of claim **44** further comprising means for varying the information content of at least one stream of packets with the identity of the user to whom the at least one stream of packets are delivered.

46. The method of claim **45** wherein the varied information content is inserted into the stream of audio and/or visual information before such stream is converted into a stream of packets.

47. The method of claim **45**, wherein the varied information contains advertising information.

48. The communication system of claim **44** further comprising means for generating from the stream of packets received at the user an audio output and/or a visual display.

49. The communication system of claim **44** further comprising means for storing packets received at the user during a first time period and means for inserting such packets into other packets received at the user at a later time period.

50. The communication system of claim **49** wherein the content of the stream of packets received during the first time period is varied depending on the identity of the user.

51. The communication system of claim **50** wherein the stream of packets received during the first time period contains advertising information.

52. The communication system of claim **44** further comprising means for storing packets at an intermediate point in the distribution architecture at a first time and means for inserting such packets into other packets to be received by one or more users at a later time period.

53. The communication system of claim **52** wherein the content of the stream of packets received during the first time period is varied depending on the identity of the one or more users.

54. The communication system of claim **53** wherein the stream of packets received during the first time period contains advertising information.

55. The communication system of claim **52** wherein the content of the stream of packets received during the first time period is varied depending on the identity of the users to whom the stream of packets are delivered.

56. The communication system of claim **44** further comprising:

means for compressing the stream of packets in their passage from source to user, and

downstream of the compressing means, means for decompressing the stream of packets.

57. The communication system of claim **56** wherein the compressing means is located near the converting means and the decompressing means is located at the user.

58. The communication system of claim **56** wherein the compressing means uses a compression algorithm that is selected in accordance with the content of the information being communicated in the stream of packets.

59. The communication system of claim **56** wherein the compressing means inserts into each packet an identification of the compression algorithm used and the decompressing means monitors each packet to read such identification and to vary its decompression algorithm in response thereto.

60. The method of claim **56** wherein the compressing means uses a compression algorithm and the decompression means uses a decompression algorithm that varies with the user to whom the stream of packets are delivered.

61. The method of claim **56** wherein the compressing means uses a compression algorithm that varies with the characteristics of the communications network.

62. The method of claim **56** wherein the decompressing means uses a decompression algorithm that varies with the characteristics of the communications network.

63. The method of claim **44** further comprising means for varying the information content of at least one stream of packets with the identity of the users to whom the at least one stream of packets are delivered.

64. The method of claim **44**, wherein the records that are accumulated include user information and system-related information.

65. A method for transmitting message packets over a communications network comprising the steps of:

converting at least one stream of audio and/or visual information into at least stream of addressed digital packets complying with the specifications of a network communication protocol,

for each stream, routing such stream to one or more users,

controlling the routing of the stream of packets in response to selection signals received from the users, and

monitoring the reception of packets by the users and accumulating records that indicate which streams of

packets were received by which users, wherein at least one stream of packets comprises audio and/or visual selections and the records that are accumulated indicate how many users did or did not listen to and/or view the entire selection.

66. A method for transmitting at least one stream of audio and/or visual information over a communications network to a plurality of users comprising the steps of:

controlling the routing of the stream of information through the network in response to selection signals received from the users, and

monitoring the reception of the stream of information by the users and accumulating records relating to the reception of the stream of information by the users, wherein at least one stream of information comprises audio and/or visual selections and the records that are accumulated indicate how many users did or did not listen to and/or view the entire selection.

67. A method for transmitting message packets over a communications network comprising the steps of:

converting at least one stream of audio and/or visual information into at least stream of addressed digital packets complying with the specifications of a network communication protocol,

for each stream, routing such stream to one or more users,

controlling the routing of the stream of packets in response to selection signals received from the users, and

monitoring the reception of packets by the users and accumulating records that indicate which streams of packets were received by which users, wherein at least one stream of packets comprises audio and/or visual selections and the records that are accumulated indicate which users did or did not listen to and/or view the entire selection.

68. A method for transmitting at least one stream of audio and/or visual information over a communications network to a plurality of users comprising the steps of:

controlling the routing of the stream of information through the network in response to selection signals received from the users, and

monitoring the reception of the stream of information by the users and accumulating records relating to the reception of the stream of information by the users, wherein at least one stream of information comprises audio and/or visual selections and the records that are accumulated indicate which users did or did not listen to and/or view the entire selection.

* * * * *

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US006434622B1

(12) **United States Patent**
Monteiro et al.

(10) **Patent No.: US 6,434,622 B1**
(45) **Date of Patent: Aug. 13, 2002**

(54) **MULTICASTING METHOD AND APPARATUS**

(75) Inventors: **Antonio M Monteiro; James F Butterworth**, both of New York, NY (US)

(73) Assignee: **Netcast Innovations Ltd.**, Boulder, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/617,647**

(22) Filed: **Jul. 17, 2000**

Related U.S. Application Data

(63) Continuation of application No. 09/435,732, filed on Nov. 8, 1999, now Pat. No. 6,119,163, which is a continuation of application No. 09/110,369, filed on Jul. 6, 1998, now Pat. No. 5,983,005, which is a continuation of application No. 08/644,072, filed on May 9, 1996, now Pat. No. 5,778,187.

(51) **Int. Cl.**[7] **G06F 17/00**

(52) **U.S. Cl.** **709/231**; 709/200.66

(58) **Field of Search** 395/200.61, 200.66, 395/200.72

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D.P. Brutzman et al., "MBONE Provides Audio and Video Across the Internet," IEEE Computer, vol. 27, No. 4, pp. 30–36 (Apr. 1994).

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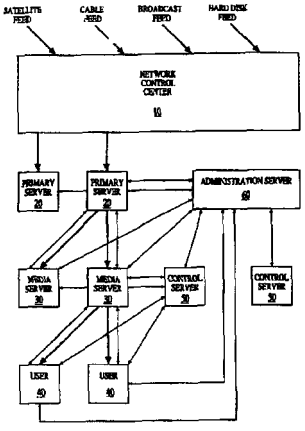
Primary Examiner—Thomas R. Peeso
(74) *Attorney, Agent, or Firm*—Pennie & Edmonds LLP

(57) **ABSTRACT**

A scalable architecture is disclosed for delivery of real-time information over a communications network. Embedded into the architecture is a control mechanism that provides for the management and administration of users who are to receive the real-time information. In the preferred embodiment, the information being delivered is high-quality audio. However, it could also be video, graphics, text or any other type of information that can be transmitted over a digital network. Preferably, there are multiple channels of information available simultaneously to be delivered to users, each channel consisting of an independent stream of information. A user chooses to tune in or tune out a particular channel, but does not choose the time at which the channel distributes its information. Advantageously, interactive (two-way) information can be incorporated into the system, multiple streams of information can be integrated for delivery to a user, and certain portions of the information being delivered can be tailored to the individual user.

56 Claims, 23 Drawing Sheets



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Progressive Networks' Real Audio Player has exclusive with Microsoft's Internet Explorer—Aug. 17, 1995.
Progressive Networks Announces "Live RealAudio" System—Aug. 30, 1995.
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Progressive Netorks to broadcast the Live and In Concert—Jan. 4, 1996.
Microsoft and Progressive Networks demonstrate first OLE–enabled Internet browser to incorporate RealAudio—Dec. 7, 1995.
Progressive Networks Announces RealAudio Server Products for Macintosh—Jan. 10, 1996.
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Progressive Networks Announces Open RealAudio Architecture—Jan. 31, 1996.
RealAudio™ Server Software to be Bundled with newest Line of Apple Internet Servers—Feb. 27, 1996.
Bruce Jacobsen named President and Chief Operating Officer of Progressive Networks—Feb. 21, 1996.
GTA Announces RealAudio Support for the GFX Internet Firewall System—Mar. 1, 1996.
Morning Star's SecureConnect Technology Provides Internet Users of Real Audio With Sound Security—Mar. 4, 1996.
Progressive Networks and Microsoft Announce Streaming Media Agreement—Mar. 12, 1996.
Progressive Networks Announces RealAudio Firewall Proxy Kit—Apr. 2, 1996.
Progressive Networks Launches RealAudio 2.0 Intranet Offerings with Corporate Licensing Program and Intranet Server Pricing—Apr. 2, 1996.
Progressive Networks Ships Final Version of RealAudio System 2.0 with Open Architecture Enhancements and Ability to Deliver Synchronized Multimedia Capabilities—Apr. 2, 1996.
Progressive Networks Launches Timecast: The RealAudio Guide—Apr. 29, 1996.
RealAudio Wins Internet World magazine Outstanding Software Product of the Year Aware—Apr. 30, 1996.

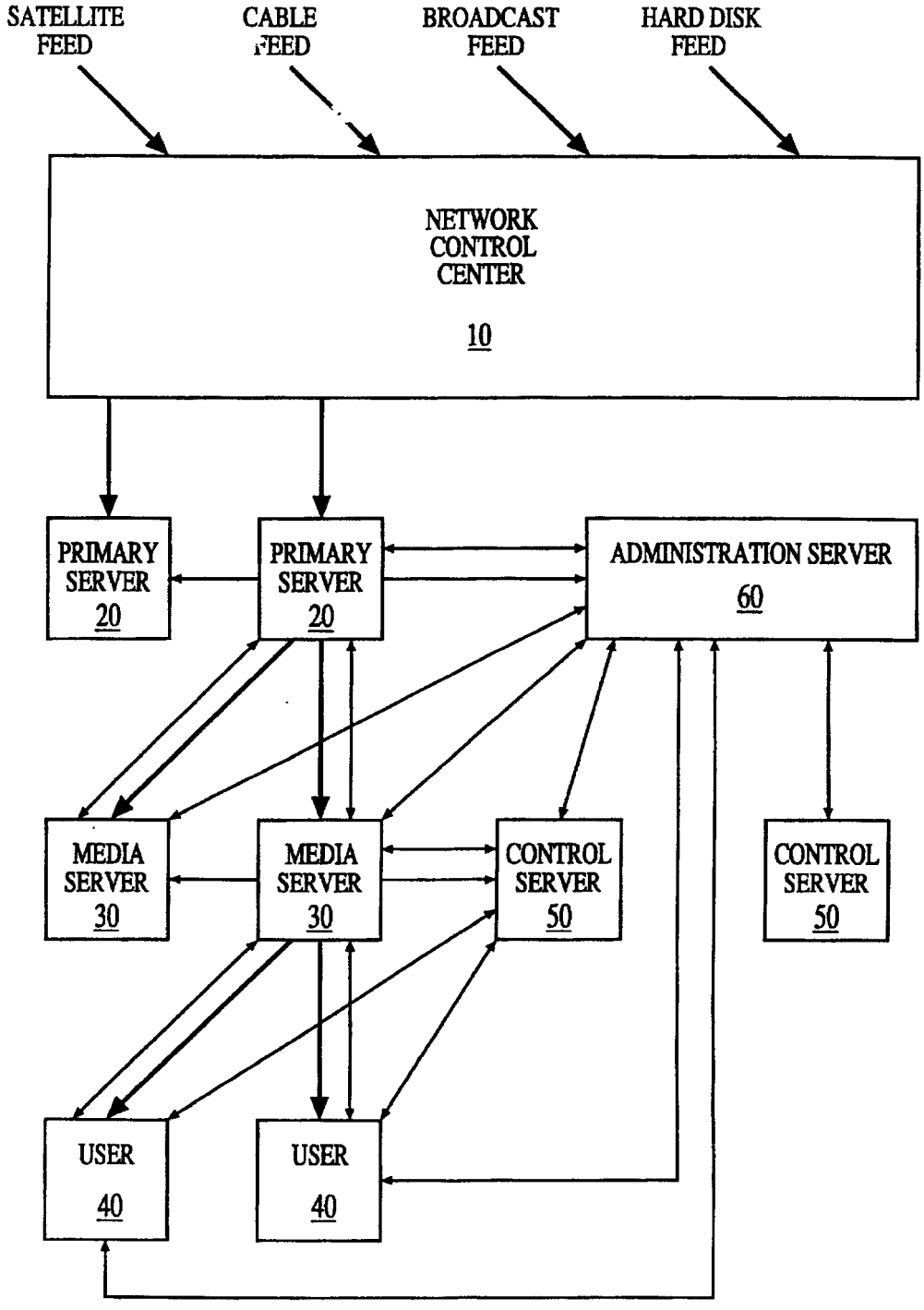

SATELLITE FEED
CABLE FEED
BROADCAST FEED
HARD DISK FEED
NETWORK CONTROL CENTER
10
PRIMARY SERVER 20
PRIMARY SERVER 20
ADMINISTRATION SERVER 60
MEDIA SERVER 30
MEDIA SERVER 30
CONTROL SERVER 50
CONTROL SERVER 50
USER 40
USER 40

FIG. 1

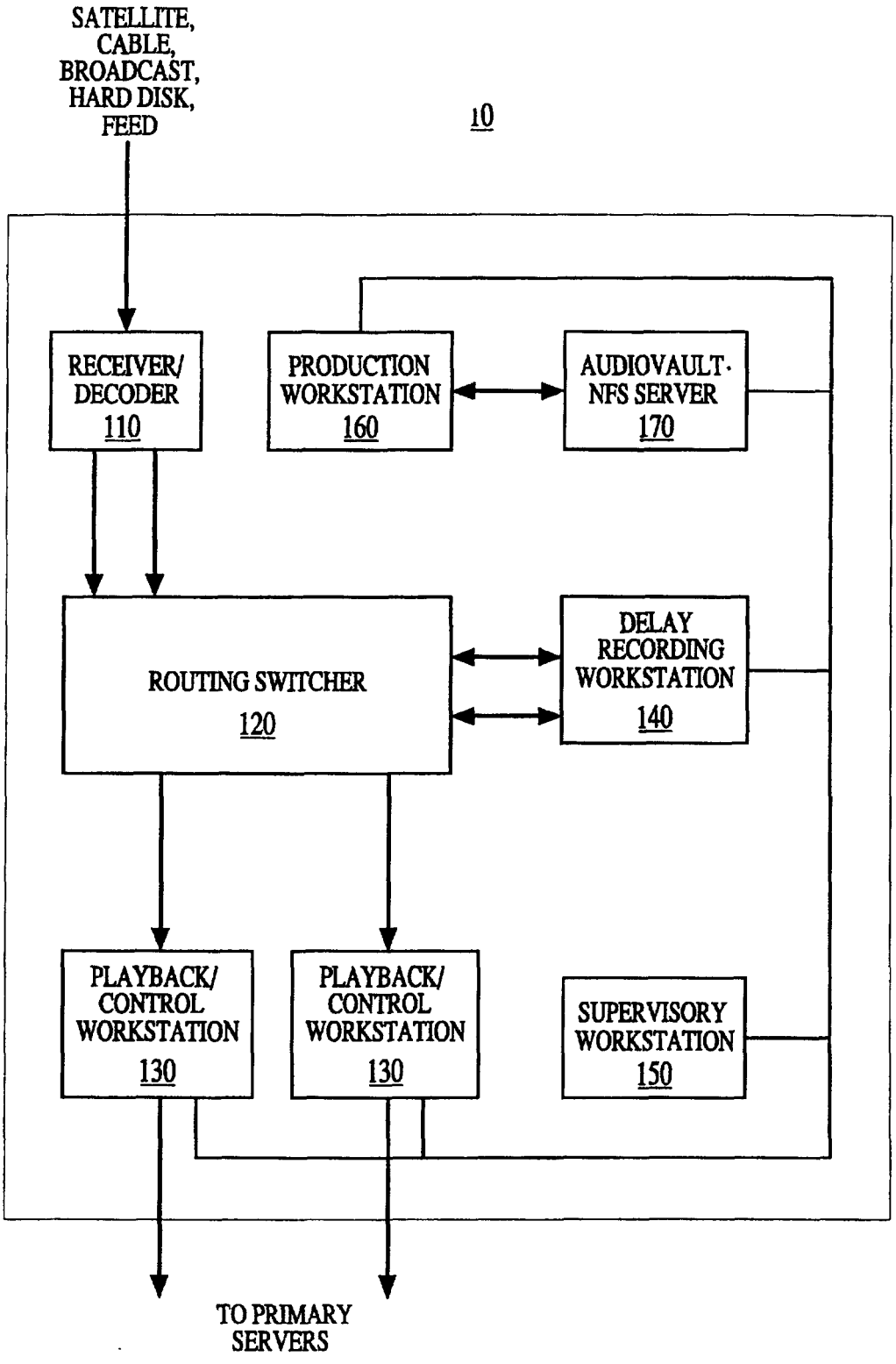

SATELLITE, CABLE, BROADCAST, HARD DISK, FEED
10
RECEIVER/ DECODER 110
PRODUCTION WORKSTATION 160
AUDIOVAULT· NFS SERVER 170
ROUTING SWITCHER 120
DELAY RECORDING WORKSTATION 140
PLAYBACK/ CONTROL WORKSTATION 130
PLAYBACK/ CONTROL WORKSTATION 130
SUPERVISORY WORKSTATION 150
TO PRIMARY SERVERS

FIG. 2

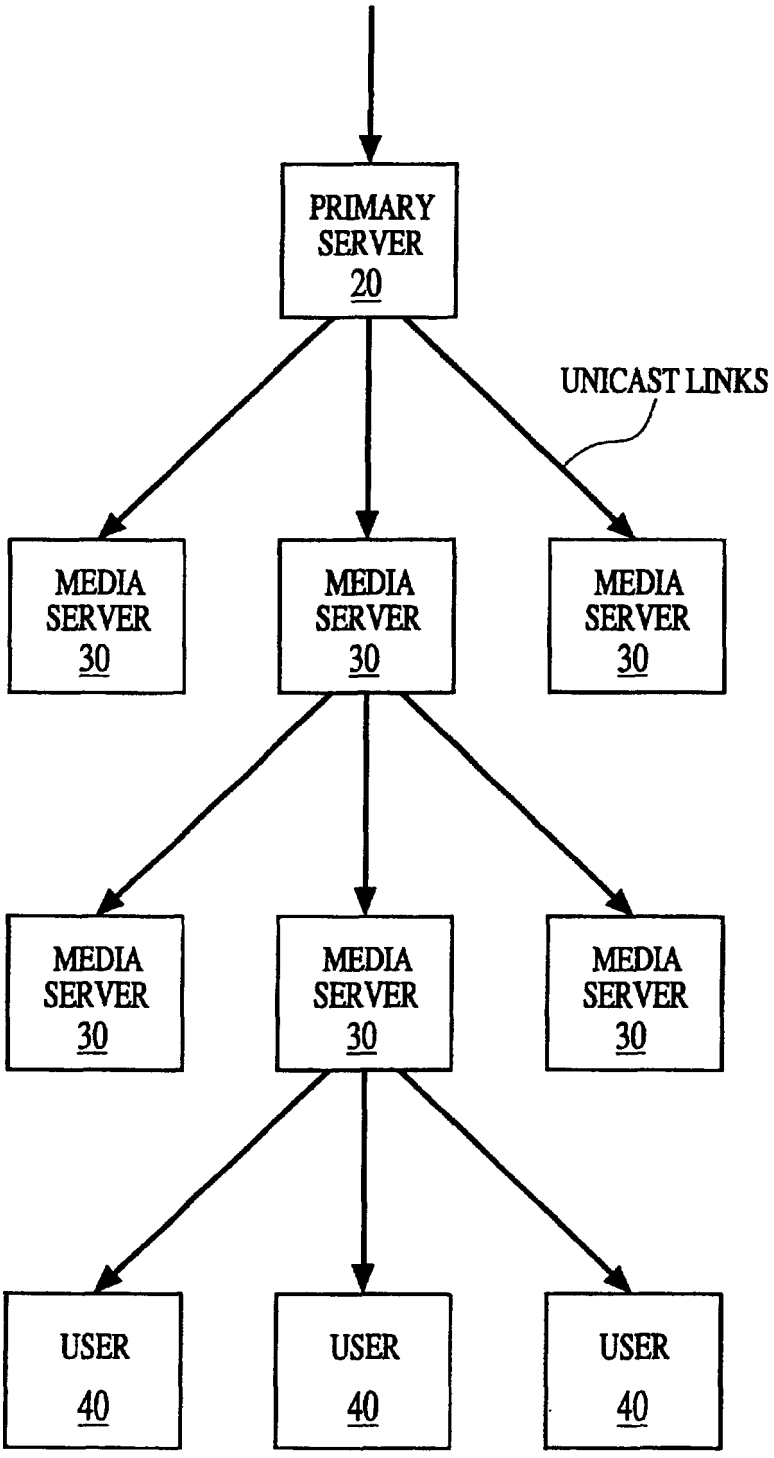

PRIMARY SERVER 20
UNICAST LINKS
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
MEDIA SERVER 30
USER 40
USER 40
USER 40

FIG. 3

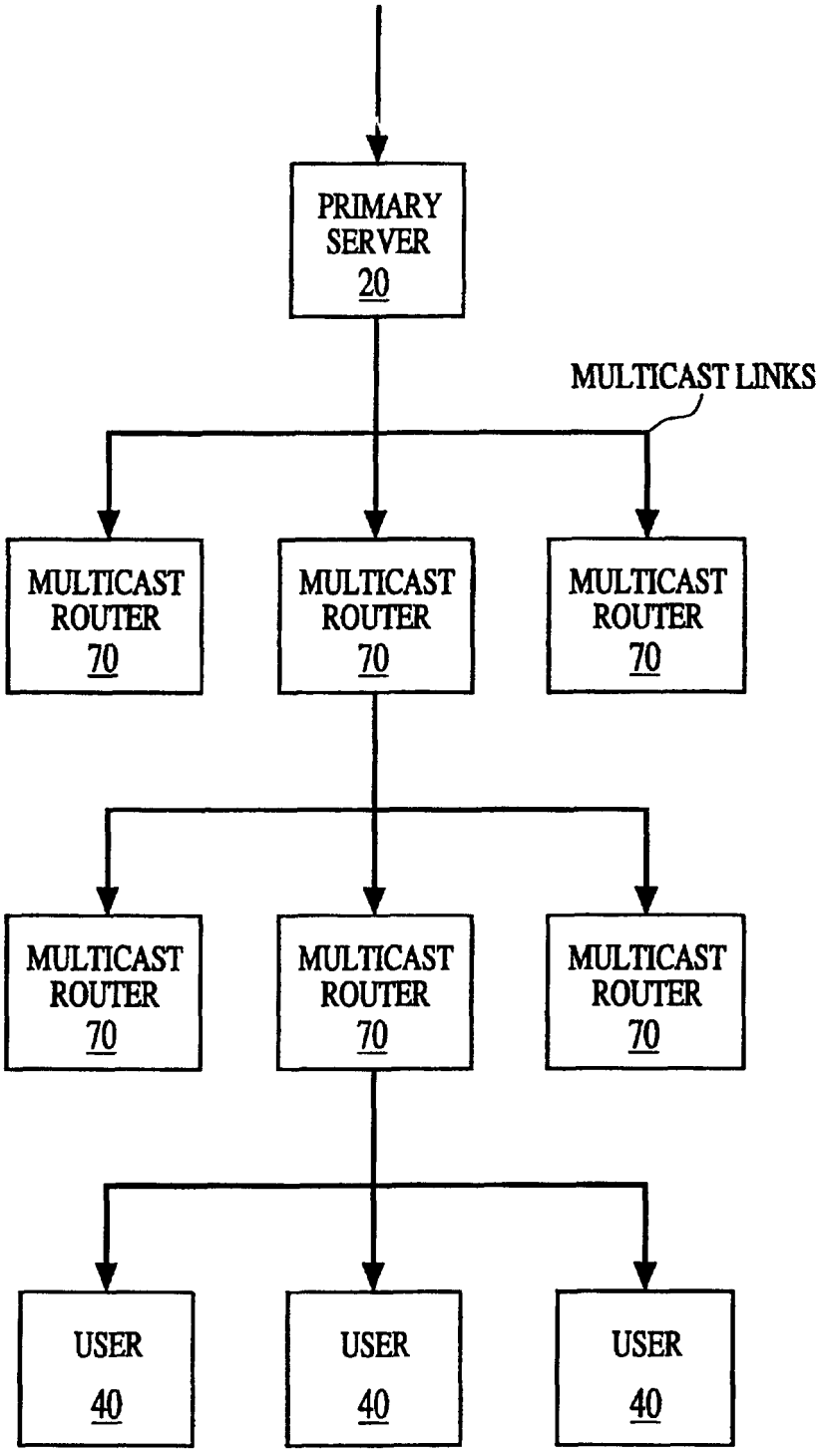

PRIMARY SERVER 20
MULTICAST LINKS
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
MULTICAST ROUTER 70
USER 40
USER 40
USER 40

FIG. 4

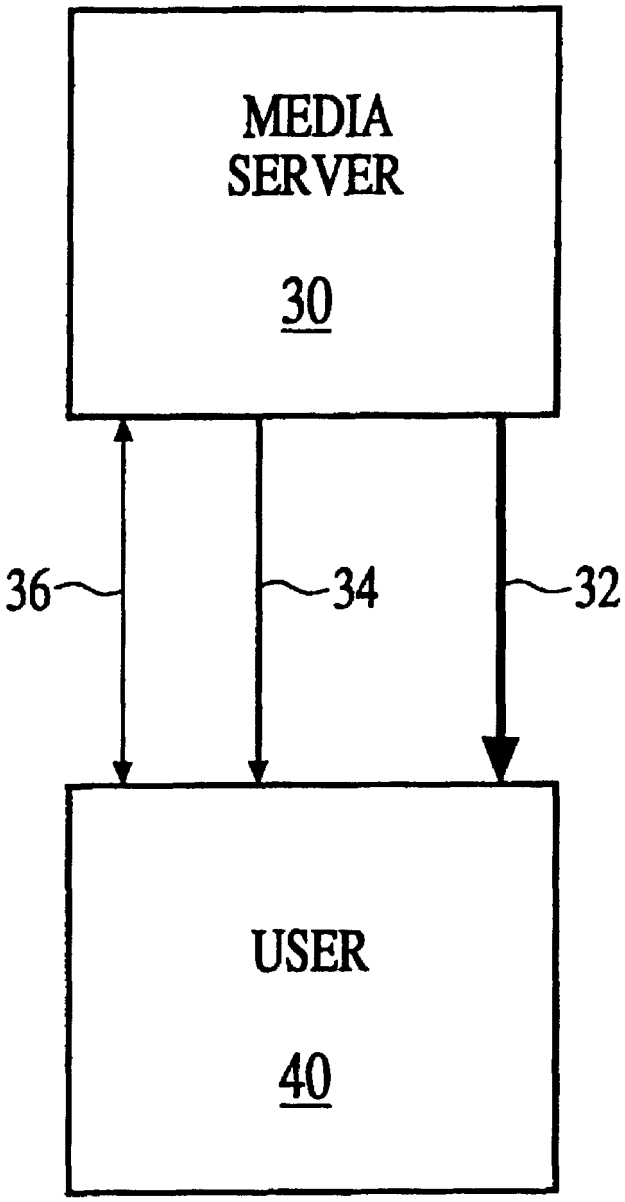


FIG. 5

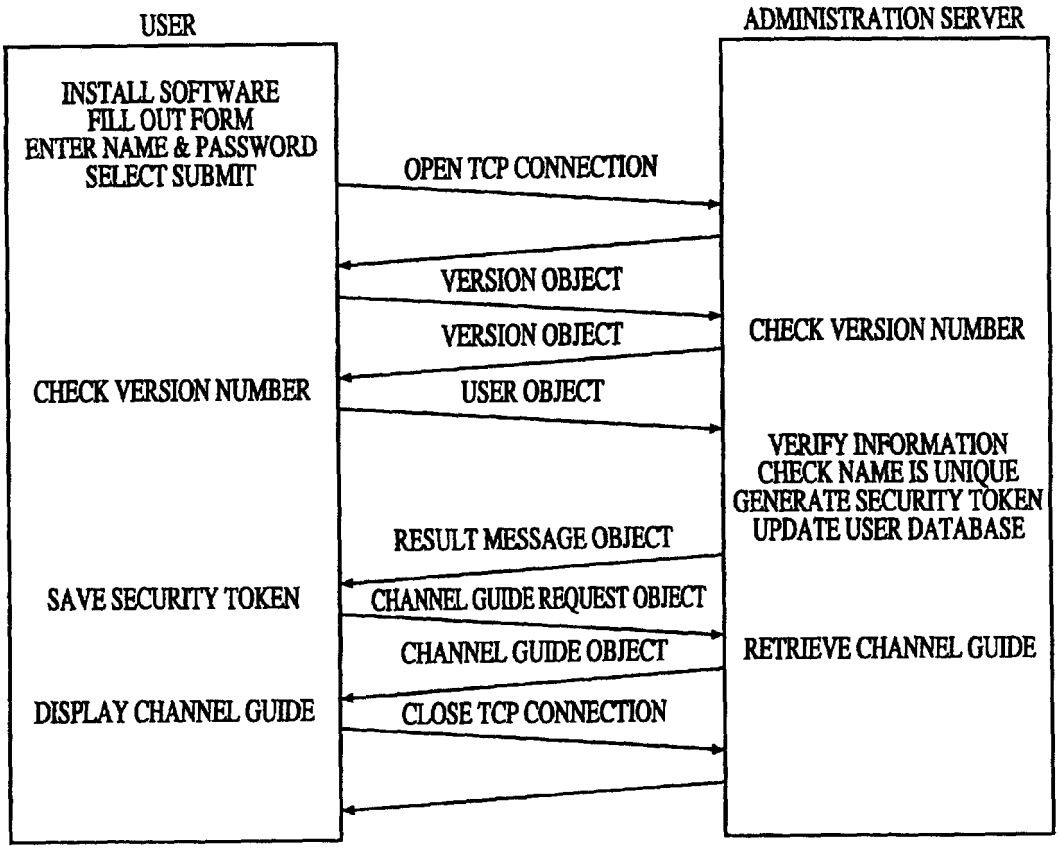

USER
ADMINISTRATION SERVER
INSTALL SOFTWARE
FILL OUT FORM
ENTER NAME & PASSWORD
SELECT SUBMIT
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
USER OBJECT
VERIFY INFORMATION
CHECK NAME IS UNIQUE
GENERATE SECURITY TOKEN
UPDATE USER DATABASE
RESULT MESSAGE OBJECT
SAVE SECURITY TOKEN
CHANNEL GUIDE REQUEST OBJECT
CHANNEL GUIDE OBJECT
RETRIEVE CHANNEL GUIDE
DISPLAY CHANNEL GUIDE
CLOSE TCP CONNECTION

FIG. 6

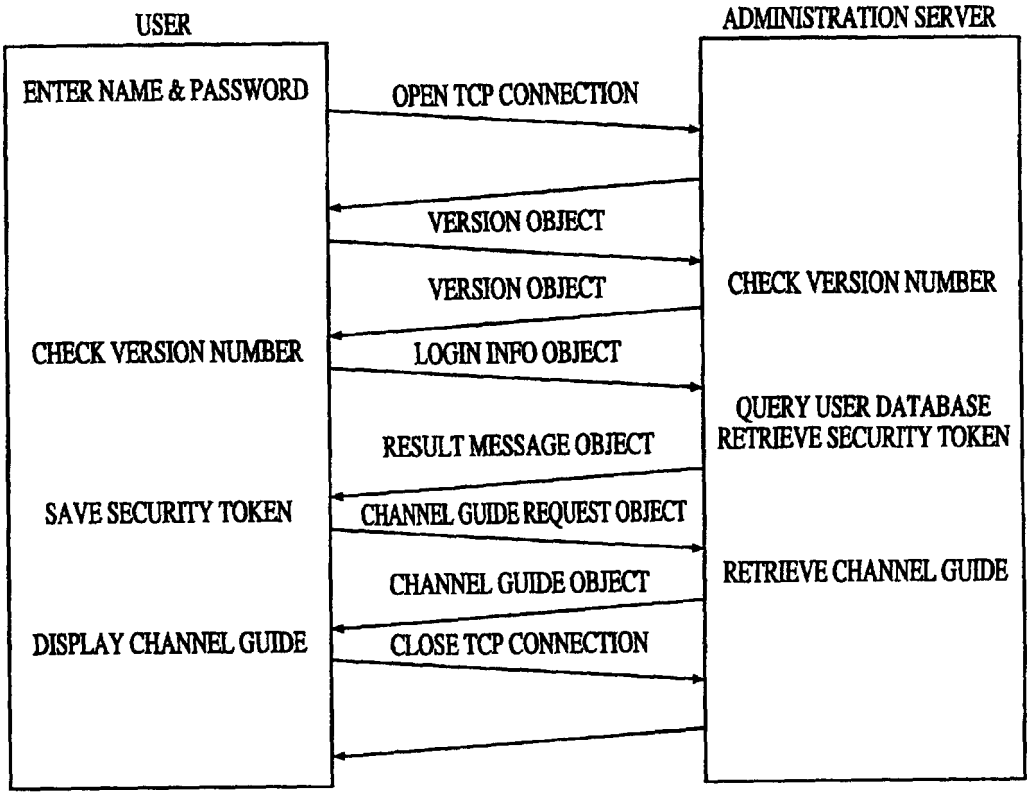

USER
ADMINISTRATION SERVER
ENTER NAME & PASSWORD
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
LOGIN INFO OBJECT
QUERY USER DATABASE
RETRIEVE SECURITY TOKEN
RESULT MESSAGE OBJECT
SAVE SECURITY TOKEN
CHANNEL GUIDE REQUEST OBJECT
RETRIEVE CHANNEL GUIDE
CHANNEL GUIDE OBJECT
DISPLAY CHANNEL GUIDE
CLOSE TCP CONNECTION

FIG. 7

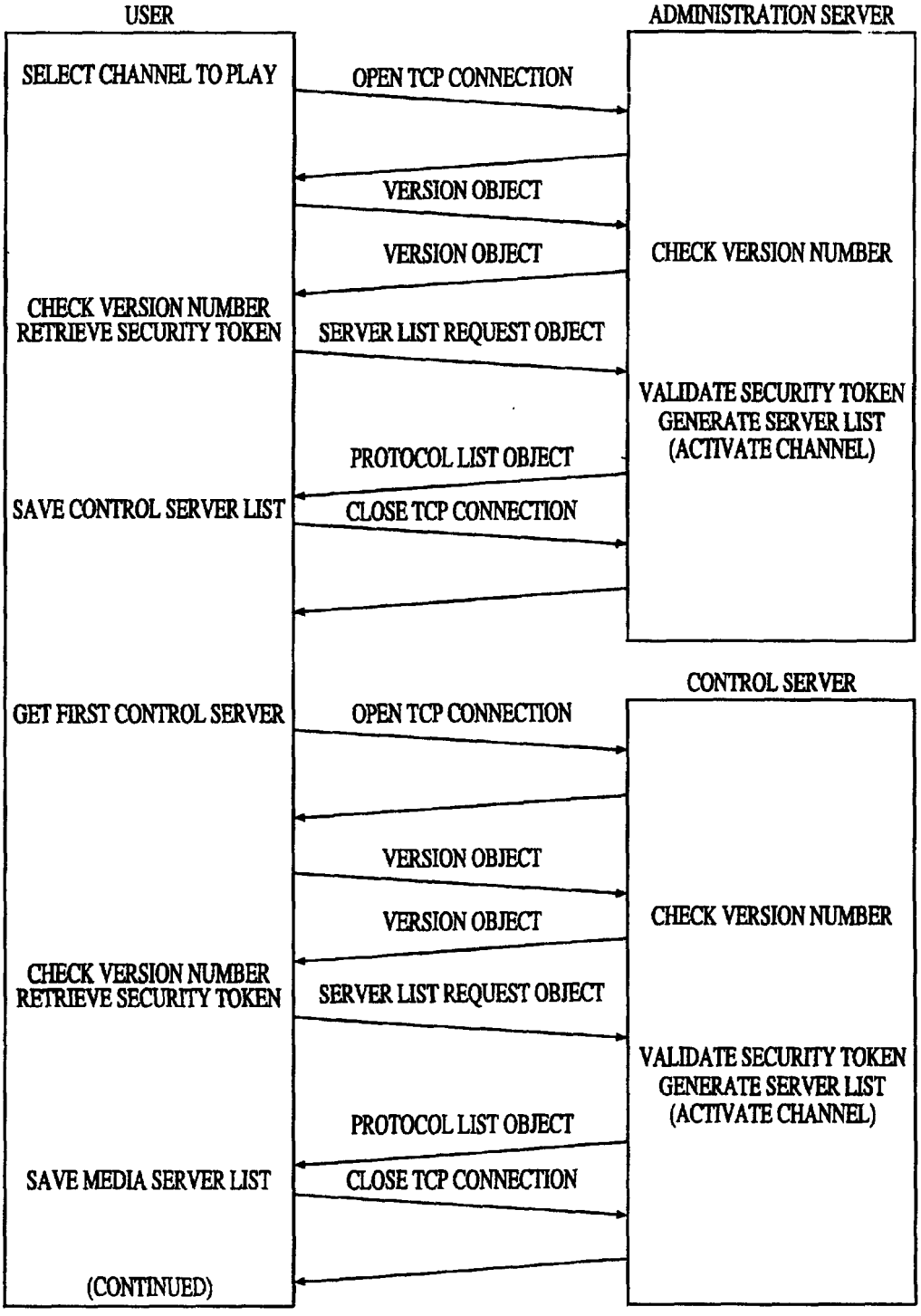

USER
ADMINISTRATION SERVER
SELECT CHANNEL TO PLAY
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
SERVER LIST REQUEST OBJECT
VALIDATE SECURITY TOKEN
GENERATE SERVER LIST
(ACTIVATE CHANNEL)
PROTOCOL LIST OBJECT
SAVE CONTROL SERVER LIST
CLOSE TCP CONNECTION
CONTROL SERVER
GET FIRST CONTROL SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
SERVER LIST REQUEST OBJECT
VALIDATE SECURITY TOKEN
GENERATE SERVER LIST
(ACTIVATE CHANNEL)
PROTOCOL LIST OBJECT
SAVE MEDIA SERVER LIST
CLOSE TCP CONNECTION
(CONTINUED)

FIG. 8A

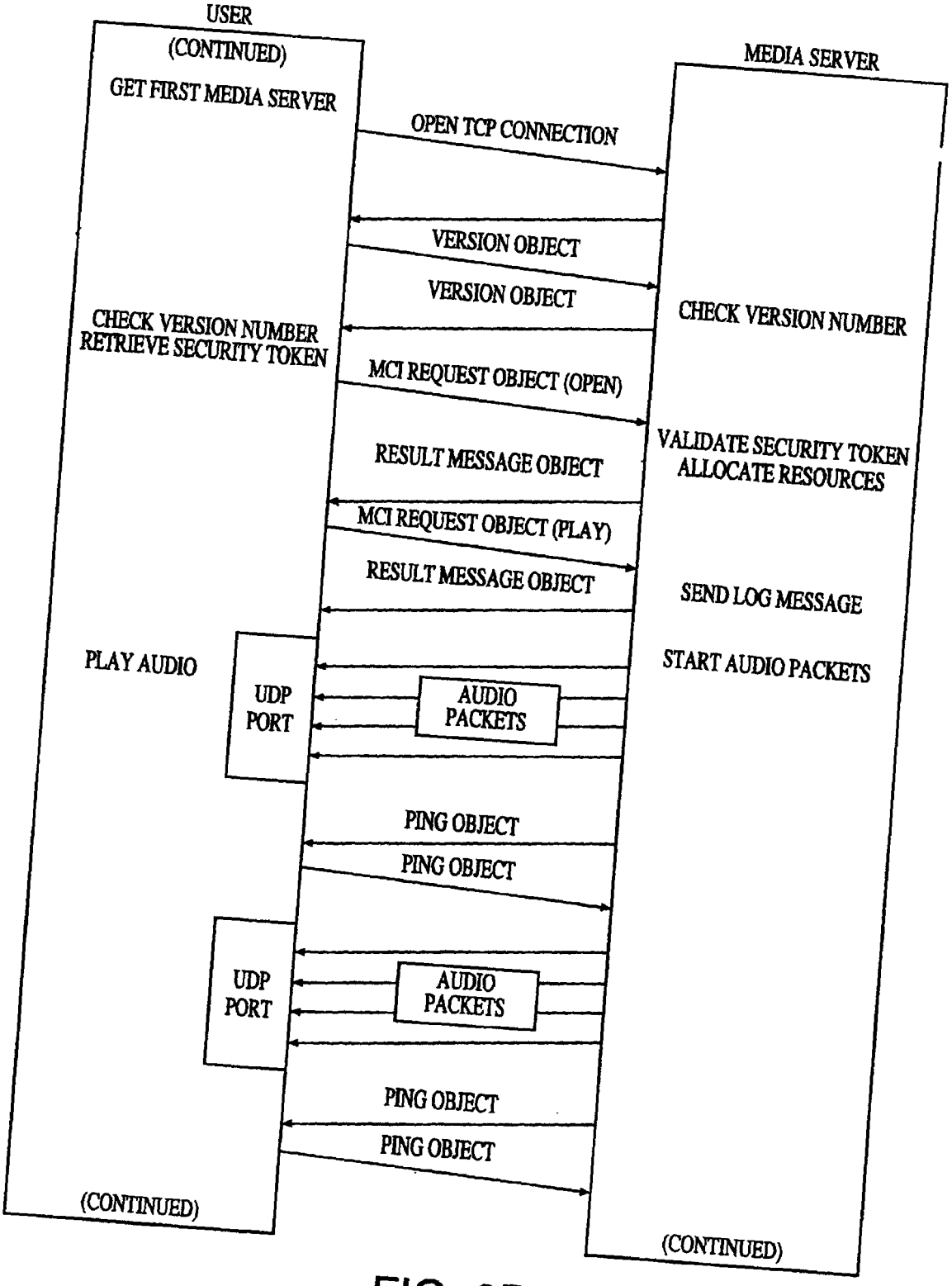

USER
(CONTINUED)
GET FIRST MEDIA SERVER
MEDIA SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
RETRIEVE SECURITY TOKEN
MCI REQUEST OBJECT (OPEN)
VALIDATE SECURITY TOKEN
ALLOCATE RESOURCES
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (PLAY)
RESULT MESSAGE OBJECT
SEND LOG MESSAGE
PLAY AUDIO
START AUDIO PACKETS
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
(CONTINUED)
(CONTINUED)

FIG. 8B

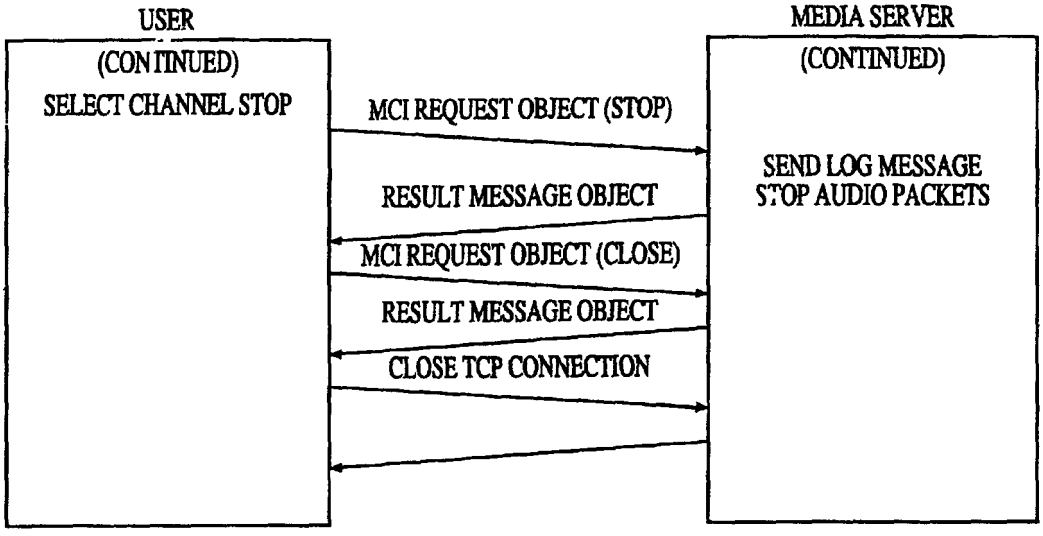

USER
(CONTINUED)
SELECT CHANNEL STOP
MEDIA SERVER
(CONTINUED)
MCI REQUEST OBJECT (STOP)
SEND LOG MESSAGE
STOP AUDIO PACKETS
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (CLOSE)
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION

FIG. 8C

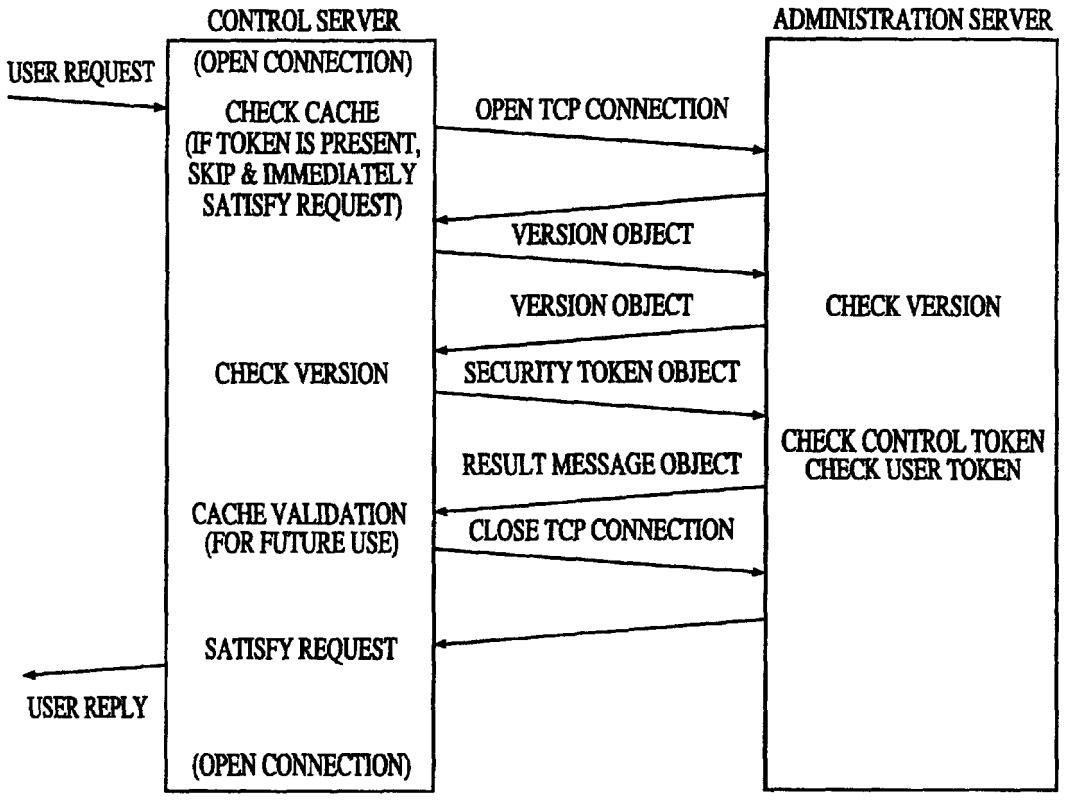

CONTROL SERVER
ADMINISTRATION SERVER
USER REQUEST
(OPEN CONNECTION)
CHECK CACHE
(IF TOKEN IS PRESENT, SKIP & IMMEDIATELY SATISFY REQUEST)
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION
CHECK VERSION
SECURITY TOKEN OBJECT
CHECK CONTROL TOKEN
CHECK USER TOKEN
RESULT MESSAGE OBJECT
CACHE VALIDATION
(FOR FUTURE USE)
CLOSE TCP CONNECTION
SATISFY REQUEST
USER REPLY
(OPEN CONNECTION)

FIG. 9A

(SHOWN ABOVE)

REQUEST FROM	REQUEST TO	VALIDATION WITH
USER	CONTROL SERVER	ADMINISTRATION SERVER
USER	MEDIA SERVER	CONTROL SERVER
MEDIA SERVER	MEDIA SERVER	CONTROL SERVER
MEDIA SERVER	PRIMARY SERVER	ADMINISTRATION SERVER
MEDIA SERVER	CONTROL SERVER	ADMINISTRATION SERVER
CONTROL SERVER	MEDIA SERVER	ADMINISTRATION SERVER

FIG. 9B

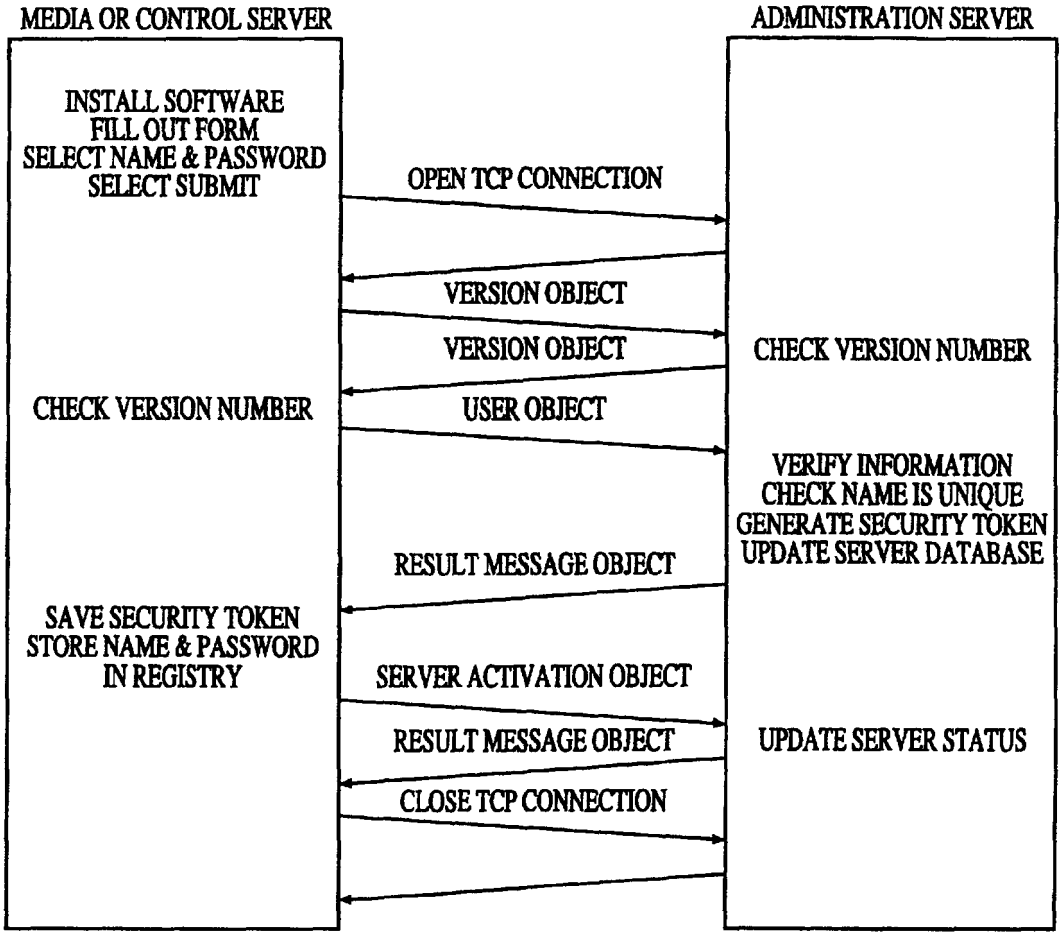

MEDIA OR CONTROL SERVER
ADMINISTRATION SERVER
INSTALL SOFTWARE
FILL OUT FORM
SELECT NAME & PASSWORD
SELECT SUBMIT
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
USER OBJECT
VERIFY INFORMATION
CHECK NAME IS UNIQUE
GENERATE SECURITY TOKEN
UPDATE SERVER DATABASE
RESULT MESSAGE OBJECT
SAVE SECURITY TOKEN
STORE NAME & PASSWORD
IN REGISTRY
SERVER ACTIVATION OBJECT
RESULT MESSAGE OBJECT
UPDATE SERVER STATUS
CLOSE TCP CONNECTION

FIG. 10

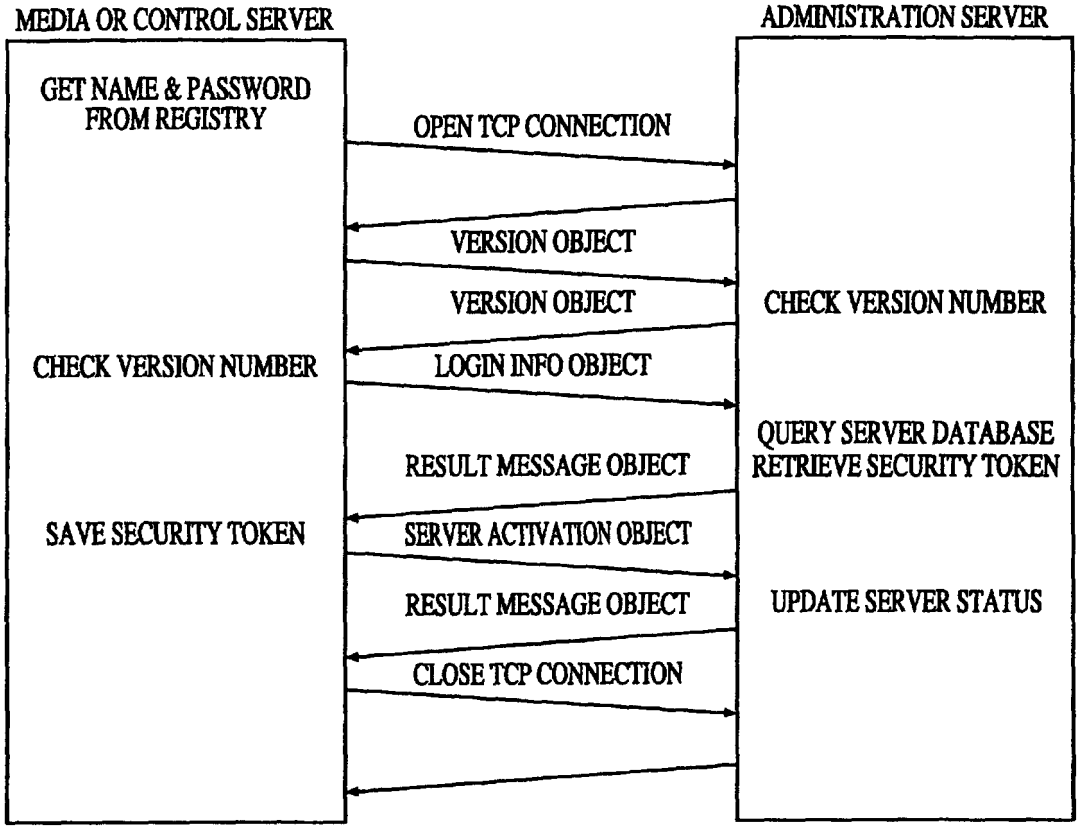

MEDIA OR CONTROL SERVER
ADMINISTRATION SERVER
GET NAME & PASSWORD FROM REGISTRY
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
LOGIN INFO OBJECT
QUERY SERVER DATABASE RETRIEVE SECURITY TOKEN
RESULT MESSAGE OBJECT
SAVE SECURITY TOKEN
SERVER ACTIVATION OBJECT
RESULT MESSAGE OBJECT
UPDATE SERVER STATUS
CLOSE TCP CONNECTION

FIG. 11

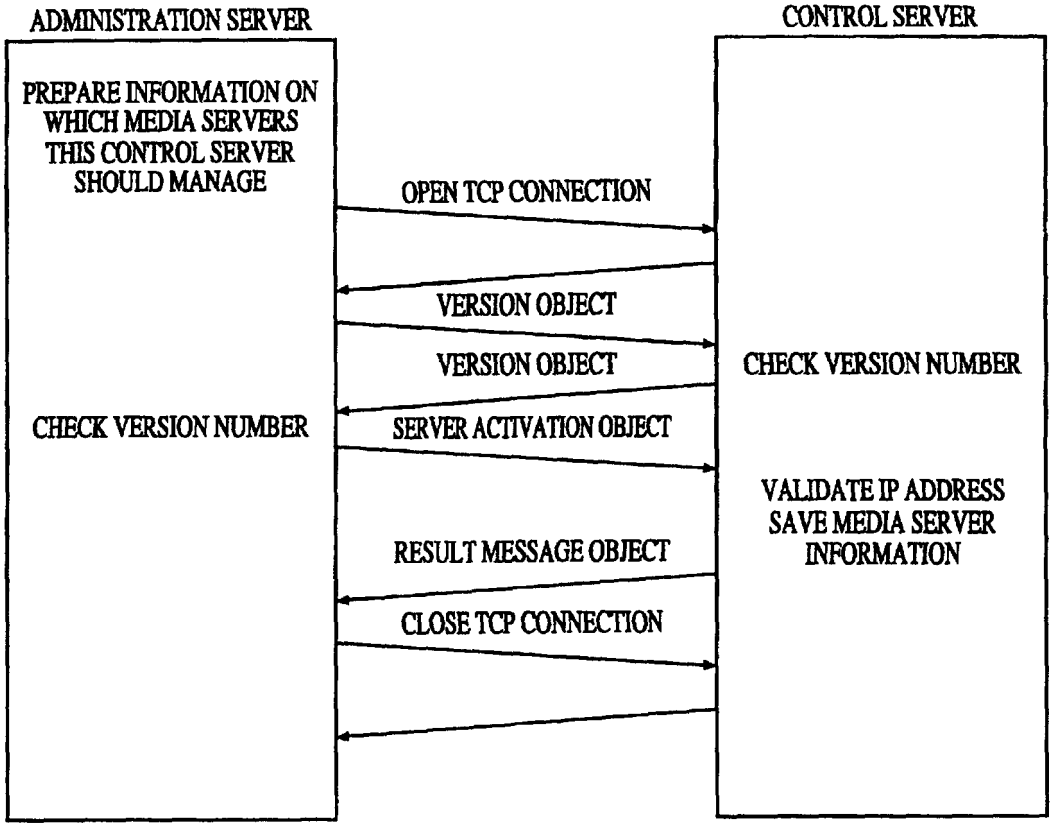

ADMINISTRATION SERVER
CONTROL SERVER
PREPARE INFORMATION ON WHICH MEDIA SERVERS THIS CONTROL SERVER SHOULD MANAGE
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
SERVER ACTIVATION OBJECT
VALIDATE IP ADDRESS SAVE MEDIA SERVER INFORMATION
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION

FIG. 12

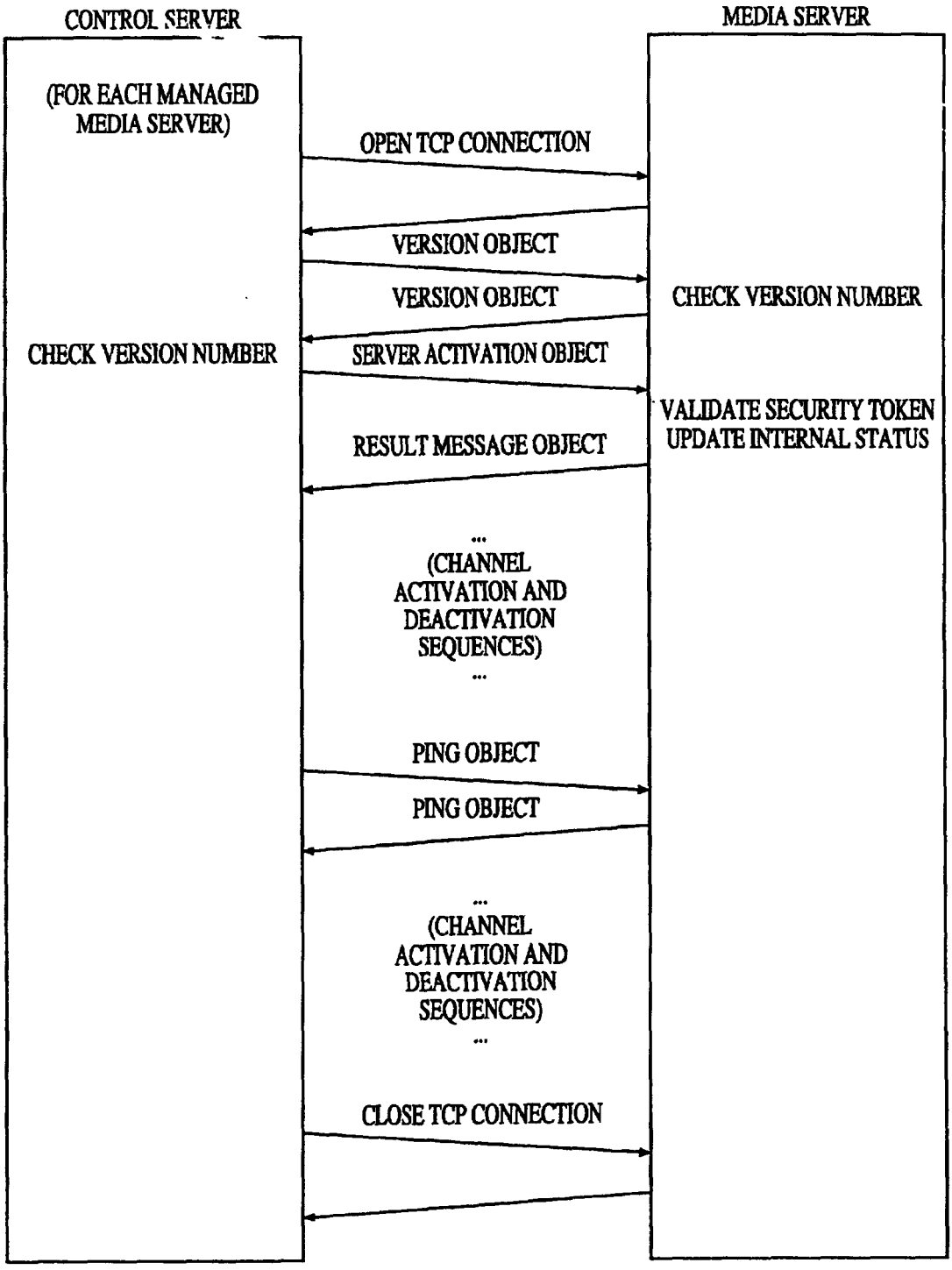

CONTROL SERVER
MEDIA SERVER
(FOR EACH MANAGED MEDIA SERVER)
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
SERVER ACTIVATION OBJECT
VALIDATE SECURITY TOKEN
UPDATE INTERNAL STATUS
RESULT MESSAGE OBJECT
...
(CHANNEL ACTIVATION AND DEACTIVATION SEQUENCES)
...
PING OBJECT
PING OBJECT
...
(CHANNEL ACTIVATION AND DEACTIVATION SEQUENCES)
...
CLOSE TCP CONNECTION

FIG. 13

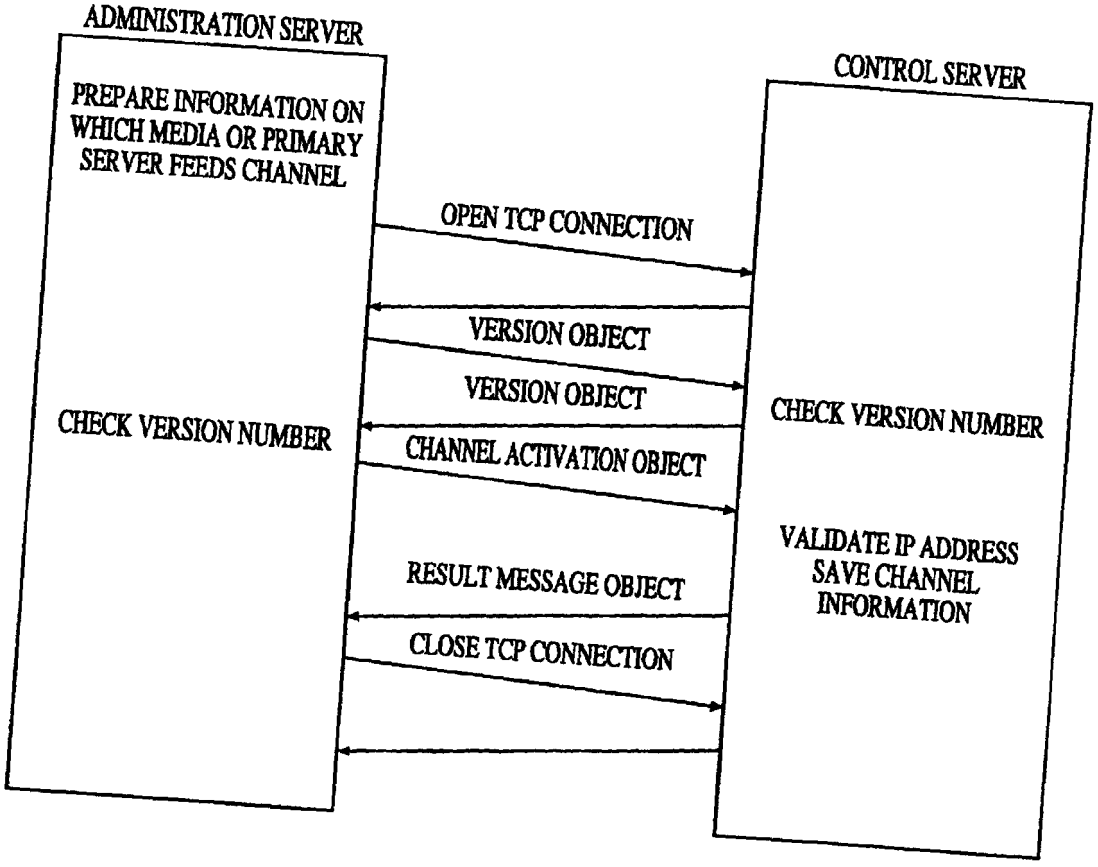

ADMINISTRATION SERVER
CONTROL SERVER
PREPARE INFORMATION ON WHICH MEDIA OR PRIMARY SERVER FEEDS CHANNEL
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
CHANNEL ACTIVATION OBJECT
VALIDATE IP ADDRESS SAVE CHANNEL INFORMATION
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION

FIG. 14

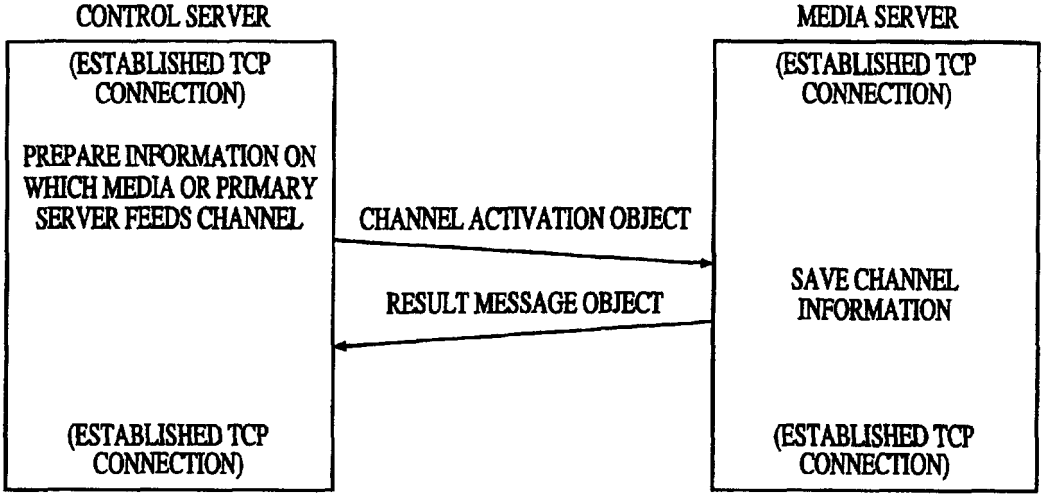

CONTROL SERVER
(ESTABLISHED TCP CONNECTION)
PREPARE INFORMATION ON WHICH MEDIA OR PRIMARY SERVER FEEDS CHANNEL
(ESTABLISHED TCP CONNECTION)
MEDIA SERVER
(ESTABLISHED TCP CONNECTION)
CHANNEL ACTIVATION OBJECT
RESULT MESSAGE OBJECT
SAVE CHANNEL INFORMATION
(ESTABLISHED TCP CONNECTION)

FIG. 15

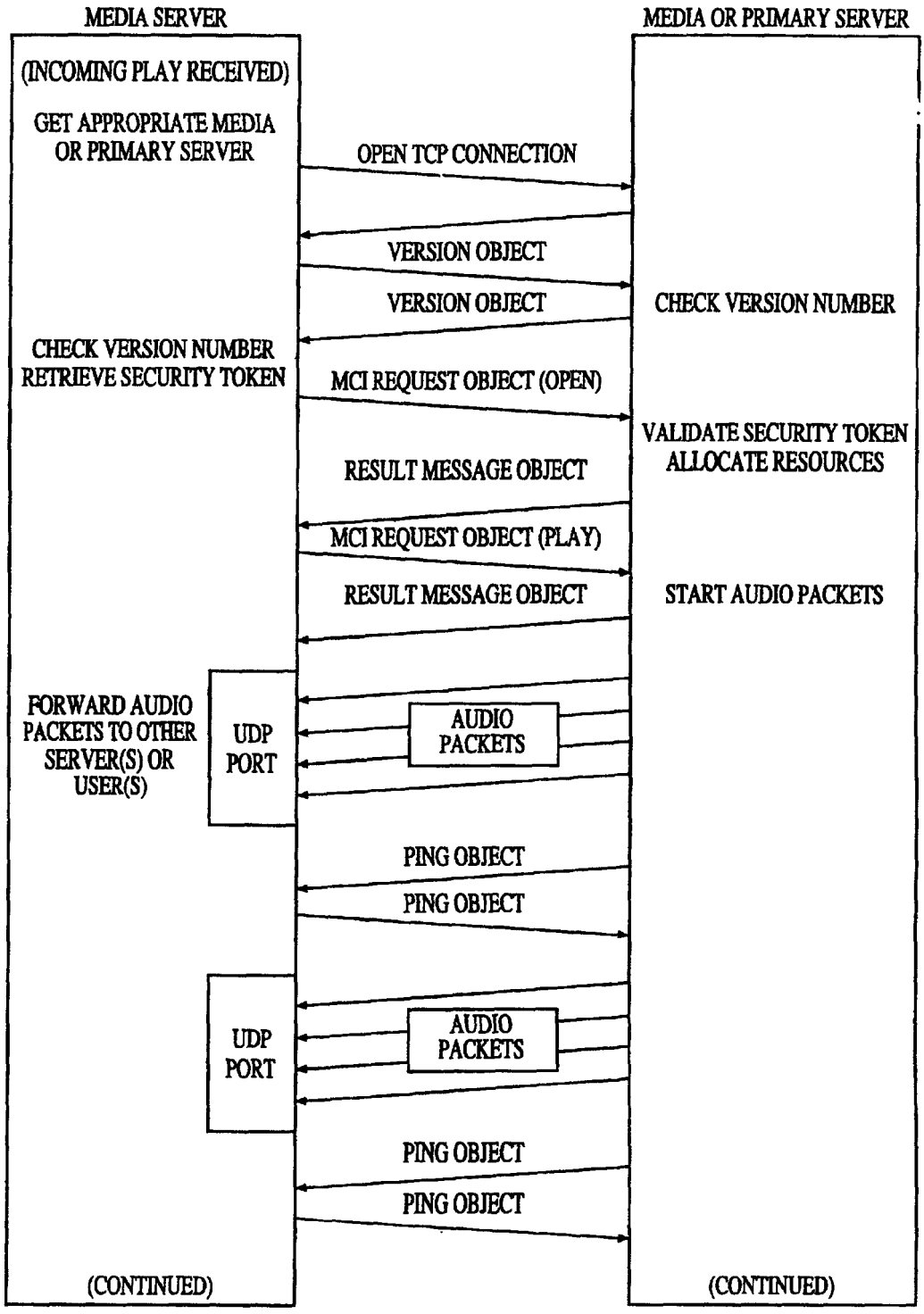

MEDIA SERVER
MEDIA OR PRIMARY SERVER
(INCOMING PLAY RECEIVED)
GET APPROPRIATE MEDIA OR PRIMARY SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER RETRIEVE SECURITY TOKEN
MCI REQUEST OBJECT (OPEN)
VALIDATE SECURITY TOKEN ALLOCATE RESOURCES
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (PLAY)
RESULT MESSAGE OBJECT
START AUDIO PACKETS
FORWARD AUDIO PACKETS TO OTHER SERVER(S) OR USER(S)
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
UDP PORT
AUDIO PACKETS
PING OBJECT
PING OBJECT
(CONTINUED)
(CONTINUED)

FIG. 16A

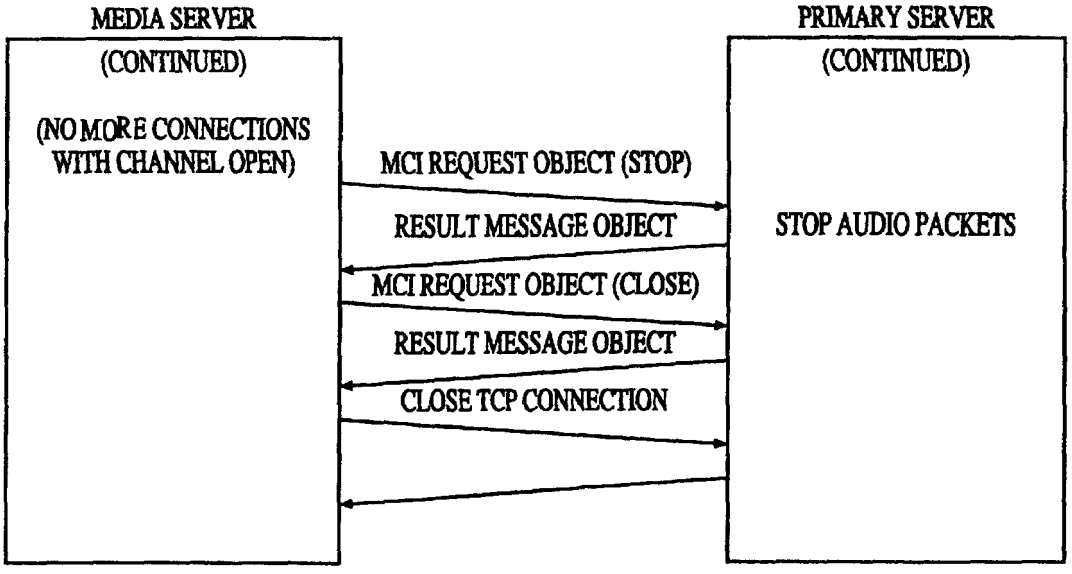

MEDIA SERVER
(CONTINUED)
(NO MORE CONNECTIONS WITH CHANNEL OPEN)
PRIMARY SERVER
(CONTINUED)
STOP AUDIO PACKETS
MCI REQUEST OBJECT (STOP)
RESULT MESSAGE OBJECT
MCI REQUEST OBJECT (CLOSE)
RESULT MESSAGE OBJECT
CLOSE TCP CONNECTION

FIG. 16B

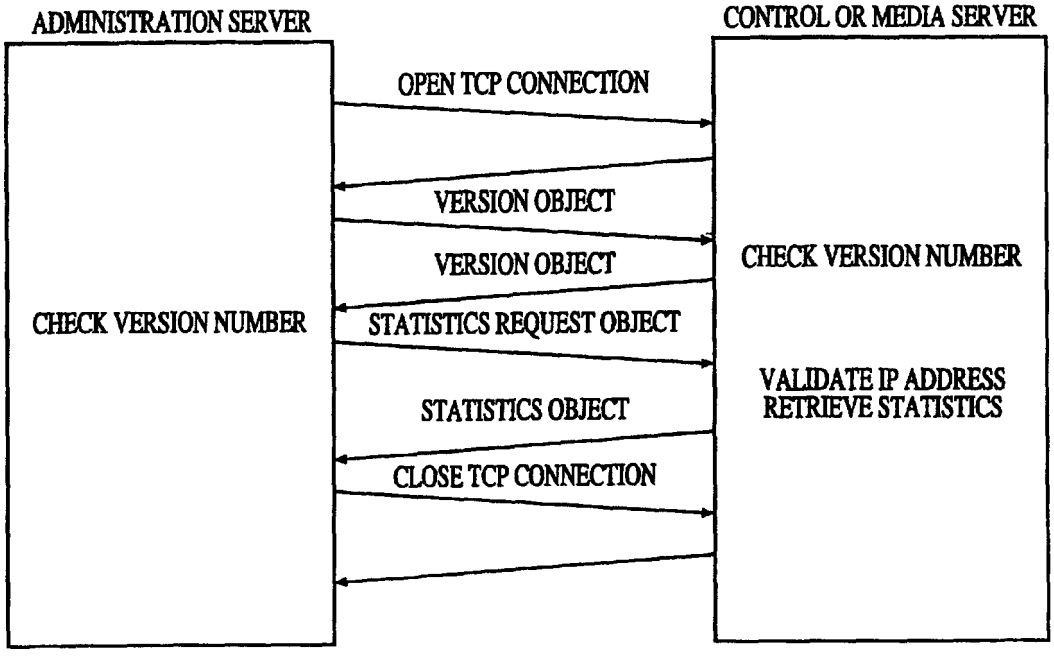

ADMINISTRATION SERVER
CONTROL OR MEDIA SERVER
OPEN TCP CONNECTION
VERSION OBJECT
VERSION OBJECT
CHECK VERSION NUMBER
CHECK VERSION NUMBER
STATISTICS REQUEST OBJECT
VALIDATE IP ADDRESS
RETRIEVE STATISTICS
STATISTICS OBJECT
CLOSE TCP CONNECTION

FIG. 17

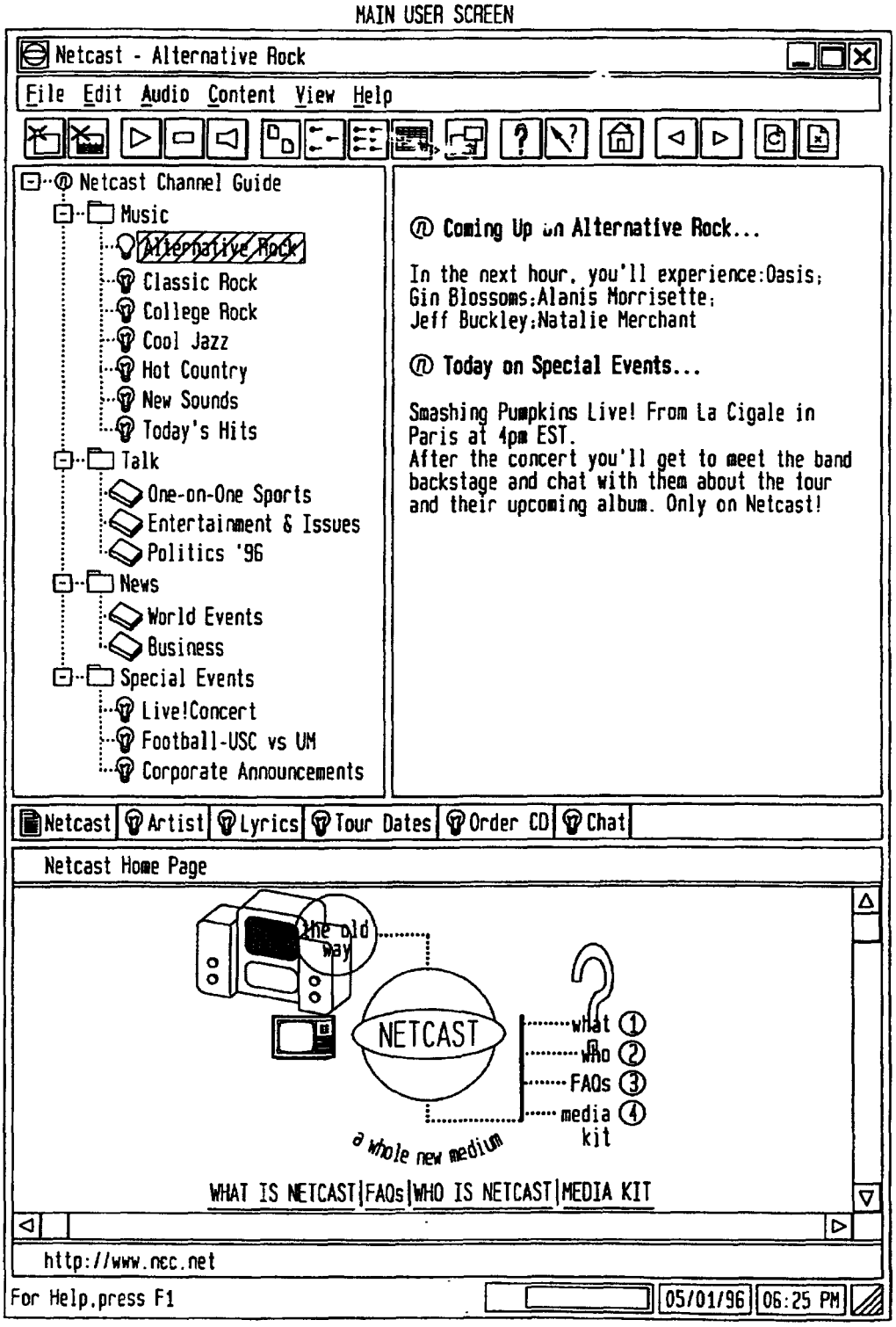
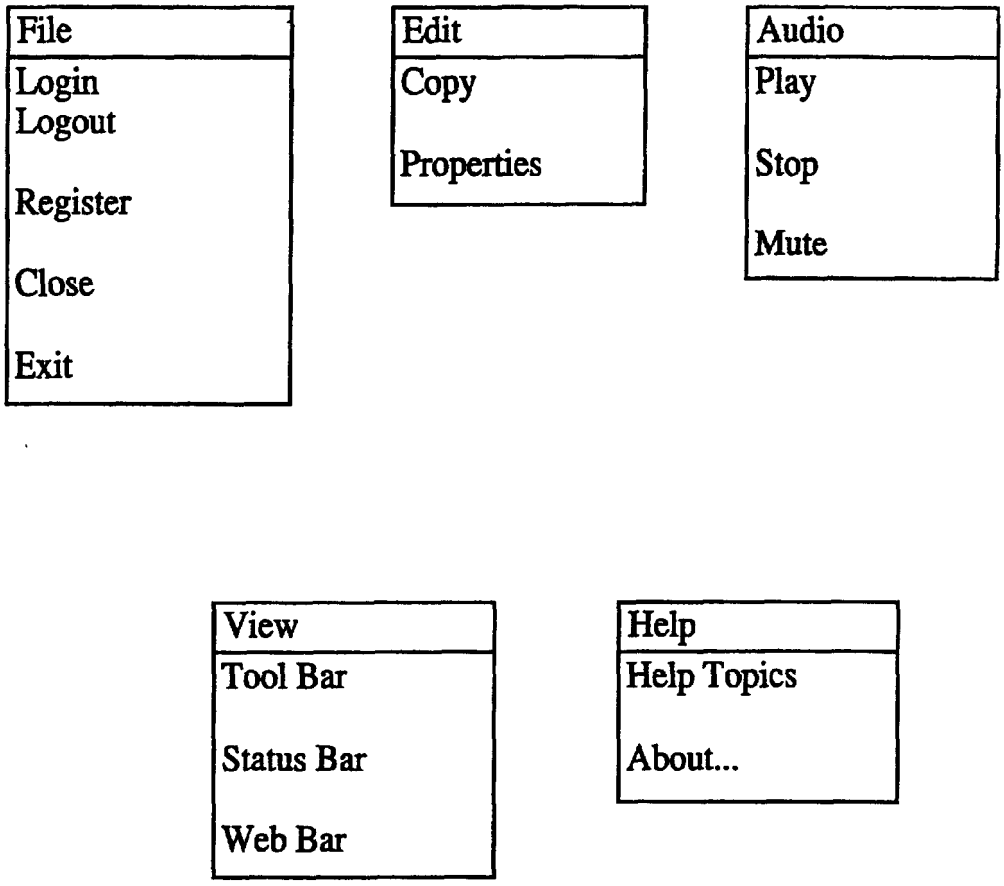

MAIN USER SCREEN
Netcast - Alternative Rock
File Edit Audio Content View Help
Netcast Channel Guide
Music
Alternative Rock
Classic Rock
College Rock
Cool Jazz
Hot Country
New Sounds
Today's Hits
Talk
One-on-One Sports
Entertainment & Issues
Politics '96
News
World Events
Business
Special Events
Live!Concert
Football-USC vs UM
Corporate Announcements
Coming Up on Alternative Rock...
In the next hour, you'll experience:Oasis;
Gin Blossoms;Alanis Morrisette;
Jeff Buckley;Natalie Merchant
Today on Special Events...
Smashing Pumpkins Live! From La Cigale in
Paris at 4pm EST.
After the concert you'll get to meet the band
backstage and chat with them about the tour
and their upcoming album. Only on Netcast!
Netcast
Artist
Lyrics
Tour Dates
Order CD
Chat
Netcast Home Page
the old way
NETCAST
what ①
who ②
FAQs ③
media kit ④
a whole new medium
WHAT IS NETCAST | FAQs | WHO IS NETCAST | MEDIA KIT
http://www.ncc.net
For Help, press F1
05/01/96
06:25 PM

FIG. 18



Key Pull-Down Menus on Main User Screen

FIG. 19

MULTICASTING METHOD AND APPARATUS

This is a continuation, of application Ser. No. 09/435,732, filed Nov. 8, 1999, now U.S. Pat. No. 6,119,163 which is a continuation of application Ser. No.09/110,369, filed Jul. 6, 1998 (now U.S. Pat. No. 5,983,005), which is a continuation of application Ser. No. 08/644,072, filed May 9, 1996 (now U.S. Pat. No. 5,778,187), and such applications are hereby incorporated by reference.

FIELD OF THE INVENTION

This relates to a method and apparatus for providing audio and/or visual communication services, in real-time to a multiplicity of identifiable users on a communications network, such as the Internet. In a preferred embodiment, the invention monitors which users are receiving signals on which one of a plurality of channels and modifies the content of at least some signals in response thereto. A particular application is to provide services akin to multi-channel radio or television with commercial programming content adjusted in accordance with the identity of the individual user.

BACKGROUND OF THE INVENTION

Systems such as the Internet typically are point-to-point (or unicast) systems in which a message is converted into a series of addressed packets which are routed from a source node through a plurality of routers to a destination node. In most communication protocols the packet includes a header which contains the addresses of the source and the destination nodes as well as a sequence number which specifies the packet's order in the message.

In general, these systems do not have the capability of broadcasting a message from a source node to all the other nodes in the network because such a capability is rarely of much use and could easily overload the network. However, there are situations where it is desirable for one node to communicate with some subset of all the nodes. For example, multi-party conferencing capability analogous to that found in the public telephone system and broadcasting to a limited number of nodes are of considerable interest to users of packet-switched networks. To satisfy such demands, packets destined for several recipients have been encapsulated in a unicast packet and forwarded from a source to a point in a network where the packets have been replicated and forwarded on to all desired recipients. This technique is known as IP Multicasting and the network over which such packets are routed is referred to as the Multicast Backbone or MBONE. More recently, routers have become available which can route the multicast addresses (class D addresses) provided for in communication protocols such as TCP/IP and UDP/IP. A multicast address is essentially an address for a group of host computers who have indicated their desire to participate in that group. Thus, a multicast packet can be routed from a source node through a plurality of multicast routers (or mrouters) to one or more devices receiving the multicast packets. From there the packet is distributed to all the host computers that are members of the multicast group.

These techniques have been used to provide on the Internet audio and video conferencing as well as radio-like broadcasting to groups of interested parties. See, for example, K. Savetz et al. *MBONE Multicasting Tomorrow's Internet* (*IDG Books WorldWide Inc.,* 1996).

Further details concerning technical aspects of multicasting may be found in the Internet documents Request for Comments (RFC) 1112 and 1458 which are reproduced at Appendices A and B of the Savetz book and in D. P. Brutaman et al., "MBONE provides Audio and Video Across the Internet," *IEEE Computer,* Vol. 27, No. 4, pp. 30–36 (April 1994), all of which are incorporated herein by reference.

Citation of the foregoing documents is not to be construed as an admission that any of such documents is a prior art publication relative to the present invention.

SUMMARY OF THE INVENTION

The present invention is a scalable architecture for delivery of real-time information over a communications network. Embedded into the architecture is a control mechanism that provides for the management and administration of users who are to receive the real-time information.

In the preferred embodiment, the information being delivered is high-quality audio. However, it could also be video, graphics, text or any other type of information that can be transmitted over a digital network. This information is delivered in real-time to any number of widely distributed users. It is real-time in that for a given channel of information, approximately the same information is being sent at approximately the same time to everyone who is enabled to receive the information.

Preferably, there are multiple channels of information available simultaneously to be delivered to users, each channel consisting of an independent stream of information. A user chooses to tune in or tune out a particular channel, but does not choose the time at which the channel distributes its information. Advantageously, interactive (two-way) information can be incorporated into the system, multiple streams of information can be integrated for delivery to a user, and certain portions of the information being delivered can be tailored to the individual user.

BRIEF DESCRIPTION OF THE DRAWING

These and other objects, features and advantages of our invention will be more readily apparent from the following Detailed Description of a Preferred Embodiment of our invention in which

FIG. **1** is a schematic diagram depicting an overview of the system of the present invention;

FIG. **2** is a schematic diagram depicting the network control center for the system of FIG. **1**;

FIG. **3** is a schematic diagram depicting a unicast distribution structure;

FIG. **4** is a schematic diagram depicting a multicast distribution structure;

FIG. **5** is a schematic diagram depicting the connection between the media server and the user in the system of FIG. **1**;

FIGS. **6–17** are timing diagrams which depict various aspects of the operation of the system of FIG. **1**; and

FIGS. **18** and **19** depict the user interface for control of the system of FIG. **1**.

Where the same reference numerals appear in multiple drawings, the numerals refer to the same or corresponding structure in such drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1**, the system of the present invention comprises a Network Control Center **10**, a plurality of

Primary Servers **20**, Media Servers **30**, Users **40** and Control Servers **50** and an Administration Server **60**. The servers are interconnected by a communications network, which in the preferred embodiment is the global connected internetwork known as the Internet. The Network Control Center **10** is the source of the information being distributed. It receives audio feeds from satellite, over the air broadcast or in other ways and processes this information for delivery over the network on multiple channels of information. This processing consists of optionally recording the information for future broadcast and dynamically inserting paid commercial advertisements.

For each channel of information, there is a Primary Server **20** that receives the stream of information from the Network Control Center **10** and compresses the information stream to allow for more efficient transmission. The Primary Servers **20** are directly connected to the network.

The Primary Servers forward information via the network to a number of Media Servers **30**. There may be a large number of Media Servers and in fact there may be many levels of Media Servers. For example, a Media Server which receives a stream of information from a Primary Server may forward that stream via the network to another Media Server **35** which then forwards it to a User **40**. This multilevel hierarchical structure is described in more detail below.

The topology of the Internet dictates the ideal placement of Media Servers, the fan-out of each Media Server and the number of levels of Media Servers between the Primary Server and Users. For example, the Media Servers which feed from a Primary Server might be placed at a major points of presence (POPs) of each of the large Internet service providers. These Media Servers might also be placed near clouds which serve as high bandwidth exchange points between the major carriers. Similarly, Media Servers which feed to Users might be placed on or close to networks which have a large number of subscribers to minimize the distance and number of data streams being transmitted.

Control Servers **50** are responsible for keeping track of which Users are listening to which channels and for directing the Media Servers to start and stop streams of information to those Users. The Control Servers are also responsible for handling other interactions among the various components of the system as will be described in more detail below. Each Control Server is responsible for managing a cluster of Media Servers; and each Media Server is managed by a single Control Server at any given time. As a result, the Control Servers are distributed throughout the Internet, preferably located close to the Media Servers.

The Administration Server **60** is responsible for registering new Users, authenticating Users who want to log onto the system, and maintaining audit logs for how many Users are listening to which channels and at which times. Maintaining audit logs and gathering statistics are features critical to monitoring the delivery of paid commercial messages as well as for other purposes. For example, for purposes of assessing copyright royalties, the audit logs can record the number of listeners for each musical or video selection that is distributed by the system. Another application is to determine the percentage of listeners who are interested in listening to a particular musical selection by determining how many listen to the entire selection and how many turn it off.

The system of the present invention can be considered a distribution architecture integrated with a control architecture. The distribution architecture handles scalable real-time delivery of information to any number of Users on a packet switched network, such as the Internet. The control architecture represents a second scalable system integrated with the distribution architecture for managing and administering the delivery of that information.

The remainder of this description is divided into three sections. In the next section the distribution architecture will be described in more detail. Following that, the control architecture will be described. In the third section the User interface will be illustrated.

I. Distribution Architecture

The distribution architecture provides for the delivery of real-time information to any number of Users distributed throughout a network. As will be described in detail below, the distribution architecture is scalable to allow for efficient delivery of multiple simultaneous information channels in real-time to a large number of Users.

In the preferred embodiment, the information which is being distributed consists of high-quality audio in addition to other information. It should be appreciated that the basic architecture and other general principles set forth herein would also apply to the delivery of video, graphics, text or any other type of information that can be delivered over a digital network. In addition, it should be appreciated that an information stream can consist of audio with supplemental information such as text and graphic images and commands to control software running on the User's computer.

The source of information in the preferred embodiment is the Network Control Center **10**, depicted in the schematic diagram of FIG. **2**. Control Centers of this type of design are available from Broadcast Electronics, Inc. and are similar to what would be found in a conventional radio station serving multiple frequencies.

Referring to FIG. **2**, the incoming signal can be received in a variety of ways such as from a satellite, over-the-air broadcast, cable or hard disk. It is then processed by Receiver/Decoder **110**, which decodes the signal and provides an incoming audio stream. Routing Switcher **120** is responsible for routing the incoming audio feed from the Receiver to either Delay Recording Workstation **140** or to one of the Playback/Control Workstations **130**. Real-time insertion of paid commercial advertising takes place at the Playback/Control Workstations and the resulting integrated audio stream is delivered to the Primary Servers. The Delay Recording Workstation is responsible for recording an incoming broadcast so that it can be played back at a later time.

Supervisory Workstation **150** is responsible for managing and controlling the Playback/Control Workstations, Delay Recording Workstations and other computers as may be connected to the local area network within the Network Control Center. Production Workstation **160** and AudioVAULT-NFS Server **170** are used to manipulate audio samples, such as commercial messages for use by the Playback/Control Workstations. The audio being delivered can consist of syndicated TV or radio programs, such as would be received over satellite or cable and delivered as described above. These can be delivered live and/or played back at a later time. It is also possible for the delivery of information, such as music, to take place from information that is all stored locally such as on a hard disk. A new play list and its associated music data can then be downloaded periodically to update the channel. Additionally, it is possible to deliver commercial-free programming, for example public service announcements or label-specific music.

In the preferred embodiment the Primary Servers are responsible for compressing the audio stream using an

advanced perceptual technique developed and licensed by AT&T Corp. and Lucent Technologies, Inc. This highly sophisticated algorithm is used to maximize the benefit of the bandwidth available. Advantageously, two bitrates are available, a first rate of approximately 20 Kbps and a second rate of approximately 56 Kbps. Using the perceptual technique, the quality of the first rate is similar to FM monaural (with a sampling rate of approximately 22,000 16-bit samples per second) and the second rate is close to CD quality stereo (with a sampling rate of approximately 32,000 16-bit samples in stereo each second). The signals at the two different bitrates comprise two different audio channels and thus require two different compression processes.

The computational requirements of compressing an audio stream in real time using techniques such as the advanced perceptual technique are approximately 100% of a Pentium-Pro 200 Mhz computer and the computational requirements of decompressing an audio stream in real time are approximately 30% of a Pentium 75 Mhz computer. Future improvements and/or changes to the algorithm could significantly change these requirements. For the present, a dedicated computer is required within the Primary Server to compress the audio stream. The decompression process takes place on end Users' computers and preferably would use only a portion of the computers' computational requirements, allowing the computers to be used for other tasks while they are processing the audio stream.

It is important to appreciate that the compression and decompression techniques employed by the present invention are not critical to the overall operation of the system and the advantages obtained therefrom could be obtained with other compression methodologies. Advantageously, the identity of the compression technique used can be encoded into the audio stream in the packet header. This makes it possible to identify to the receiver the nature of the decompression algorithm to use; and thereby make it possible for the computer within the Primary Server to select an optimum compression algorithm depending on the nature of the audio stream to be compressed.

The remainder of the distribution architecture comprises the multilevel hierarchy of data transmission originating at the Primary Server **20** and terminating at the Users **40** as shown in FIG. **3**. In the preferred embodiment, the network is the global connected Internet. It can also include private networks which are connected to the Internet and it could be implemented on any packet switched network, cable-modem-based or satellite-based cable system. It is possible that certain links within the overall system, for example, the link between the Primary Server and the first level of Media Servers, are private data links which carry only data associated with this system. This could also be true of other data transmission paths in the distribution architecture. The User receiving the information preferably can be anyone who has access to the Internet with sufficient bandwidth to receive the resulting audio data.

It should be appreciated that the distribution architecture of the present invention provides for scalability. Using such a structure, any number of Users, and as widely distributed as necessary, can be accommodated. In the preferred embodiment, the fan-out at each level of Media Server (given the state of technology today) is on the order of ten, but the same structure could be applied with other fan-outs. The location and fan-out of the Media Servers is chosen to minimize overall network bandwidth consumed.

The flow of information from Primary Server **20** through network to User **40** is based on the delivery of a continuous sequence of individual pieces of information, or packets. Thus the distribution architecture implements a form of multicast packet delivery to a group. The group in this case is the set of all Users who are listening to a given channel at a given time. Group membership is dynamic, Users can start and stop listening to a channel at any time.

Multicasting can be implemented in a variety of ways, any or all of which can be used in the present invention. In the preferred embodiment, the Media Servers receive unicast packet streams and they then duplicate these streams into more unicast streams to other Media Servers which are in the membership group for that stream. The lowest level Media Servers use hardware broadcast, multicast and/or unicast to reach all Users served by that Media Server.

If the Media Server is directly connected to the same physical network as the User, hardware broadcast or multicast can be used to transmit the packet stream to all Users listening at that time on that network. In this case the Media Servers can translate the incoming packets into broadcast or multicast packets for transmission on the local network. Only a single packet is transmitted at-a-time on the local network and any computer directly connected to the local network can receive that packet. Hardware multicast is built into most networks and it is lower in overall overhead than hardware broadcast since computers not interested in a transmission do not have to process the packets. In the case that a Media Server is serving a User who is not on the same physical network, a unicast transmission is used to reach that User, which requires a separate packet transmission for each User so connected. In the preferred embodiment, the assignment of Users to Media Servers is done using control transactions among the User **40**, Control Servers **50**, and Administration Server **60**. This system will be described more fully in the following section.

Multicasting can also be implemented within the Internet at the IP level using IP class D addresses and the IGMP group control protocol. FIG. **4** illustrates how the multilevel hierarchical distribution architecture would operate using IP multicast delivery. Under this system, a packet is transmitted with a multicast address for a destination and each router maintains group membership lists for each interface that it is connected to and will forward packets across the Internet to other routers such that all Users within the global group eventually receive a copy of the packet. Unless and until all routers within the Internet understand multicasting in this way, it is necessary to supplement it with IP tunneling in which multicast packets are encapsulated in unicast packets and routed by unicast routers to a multicast routers. The present invention can and will be able to take advantage of IP multicasting as it becomes widely available. Each channel of information would be given its own class D address and the Media Server would then simply transmit packets using the appropriate IP destination address. In this case no Media Servers would be used as this function would be accomplished by the routers in use to store and forward other IP packets.

Thus it can be appreciated that the implementation of the multicast delivery structure can be implemented using a combination of IP unicast, IP multicast and hardware multicast or any other system which provides for distributed delivery of information to a specific group of destinations. It is expected that special relationships with Internet providers will be established so that delivery of the audio steams can take place with a guaranteed bandwidth and in the most efficient way possible.

In the preferred embodiment, packets of information for distribution use the UDP protocol under IP rather than the

TCP protocol. TCP provides for reliable stream delivery but at the cost of retransmission and delays. For real-time information, it is usually more appropriate to use UDP since the information is time critical and low latency is more important that reliability. Since TCP is a point-to-point protocol, it is incompatible with IP multicasting. However, TCP could be used on the IP unicast links between Media Servers which are expected to have very low packet loss. In order to handle out of order, lost, duplicate and corrupted packets, the UDP packets are serialized.

In the preferred embodiment the size of the audio packets being transmitted is variable and can change on a packet by packet basis. It is expected that when using compression schemes that have a fixed bit rate, such as ADPCM, all packets for that stream would be the same size. Alternatively when using a variable bit rate compression algorithm, it is expected that packet size would vary so as to establish approximately the same amount of time for each sample. For example, if each packet corresponds to a 20 millisecond segment of speech, this could correspond to 100 bytes during one time period and 200 bytes during another. Additionally, the Media Server may choose to dynamically vary the packet size to accommodate changes in network conditions.

Since the resulting playback of audio information is sensitive to packet loss and network congestion, software running on the various computers which make up this system monitor the ongoing situation and adapt to it in the best possible way. This may involve using different Media Servers and/or lowering the data rate to the User. For example, similar to analog dynamic signal quality negotiation present in many analog radio receivers, the User software may request a lower bitrate until the situation is improved. Also, note that the audio information being delivered to the User is preferably interleaved so that a contiguous segment of the audiostream is distributed for transmission over several packets. As a result, the loss of one packet is spread out over multiple audio samples and causes minimal degradation in audio. Advantageously, a small degree of redundancy may be incorporated within the audio stream to further guard against packet loss.

Preferably, there are two bitrate options available to the User for audio delivery. These are approximately 20 Kbps for standard audio and approximately 56 Kbps for high quality audio. Thus, a 28.8 Kbps modem connection over an analog phone line is sufficient to listen to standard audio broadcasts. To listen to high quality audio, an ISDN connection to the Internet is required, or some other connection with greater than 56 Kbps bandwidth. It should be appreciated that higher bandwidths are currently becoming available to end Users. In particular the use of cable modems and residential fiber networks are enhancing the bandwidths available to Users and thus making broadcasts of higher bitrates more practical.

In addition to the content of the audio channel being delivered, it is also possible to deliver out of band of side-bar information such as graphics, images and text. This side-bar information is synchronized with the audio channel. This may only involve small increases in bandwidth requirements, such as 1–2 Kbps. For example a music program could deliver images of an album cover, the text of song lyrics, or URLs for use by a Web browser. The User can preferably choose to have the side-bar information show up automatically or be hidden. It is also possible to incorporate two-way interaction into the system, such that for example Users can participate in a global chat session during the audio broadcast. These and other details are explained in more detail below under the description of the User interface.

The delivery of paid commercial advertising information is an important aspect of the present invention. Advertising may be incorporated into the audio stream within the Network Control Center as described above. It may also be incorporated into the audio stream at the User level, or at some intermediate point in the distribution architecture.

In addition, the side-bar information discussed above can also include advertising content. FIG. **5** illustrates the provision to the User of two separate streams **32, 34** of packets, one of which may be used for advertising. In this case the insertion of the stream of commercial advertising into the non-commercial stream occurs on the User's computer. FIG. **5** also illustrates packet stream **36** which identifies the User to the system. This enables the system to monitor which Users are listening to which channels and also allows the system to vary, for example, the advertising content delivered to a User.

One advantage of this alternative is to allow targeted commercial delivery based on the individual User. That is, an individual User would receive the main audio feed plus a particular advertising stream unique to his demographic group. Note that the advertising stream typically is lower in overall bitrate and generally does not require real-time delivery, thus lowering the overall load on the network. For example, the advertising stream could be delivered to the User in advance of the regular programming, stored in a buffer in the User's computer and inserted into the stream of regular programming upon receipt of a cueing signal embedded in the stream of regular programming. Thus, a substantial number of targeted groups, perhaps 10 or 100 or even more could be accommodated without an impractical increase in network load.

II. Control Architecture

The control architecture described in this section is responsible for managing and administering the Users who are receiving the information being delivered by the distribution architecture described in the previous section. The control architecture handles new User registration, User login, the starting and stopping of audio streams and the monitoring of ongoing transmissions. The control architecture is scalable just as is the distribution architecture so that any number of Users can be managed.

This section describes the control protocol, which consists of the format and sequence of control messages that are exchanged among Users, Control Servers, Media Servers, Primary Servers and the Administration Server. These messages are in the form of objects, which have specific data formats. Objects are exchanged preferably using the TCP protocol although other options are possible. Below we describe the sequence of objects passed among the various computers and detail the internal structure of each object.

The major objects used in the present embodiment of the invention are set forth in Table 1. For each object, Table 1 provides a brief description of its function, identification of the names of the fields in the object, their types and a brief description of their function.

TABLE 1

Field Name	Field Type	Remarks
Channel Activation Object Contains information used for channel activation/deactivation. It is sent to Media and Primary Servers to tell them to carry or stop carrying a specific channel. Media Servers get the channel from another server in the system hierarchy and Primary Servers get and encode the feed from the actual input source.		
Token	Security Token Object	
Moniker	Moniker Object	unique channel identifier

TABLE 1-continued

Field Name	Field Type	Remarks
Activate	Int	action flag (activate/ deactivate)
CompressType	Int	type of compression to use
Host	Host Object	host carrying the channel

Channel Guide Object
Contains analytical and descriptive information for an item requested that is uniquely identified by a moniker. It is usually the reply to a Channel Guide Request object.

Token	Security Token Object	
Type	Int	type of content
Result		the content data itself

Channel Guide Request Object
Conveys a request for analytical and descriptive information about an item uniquely identified by the contained moniker. The reply is in the form of a Channel Guide object

Token	Security Token Object	inherited from base class
Type	Int	type of content
Moniker	Moniker Object	unique identifier

Host Object
Encapsulates the attributes of a networked computer related to the operation or services it offers or requests.

Token	Security Token Object	
HostName	String	computer name and domain
PortNumber	Int	port number for service
DisplayName	String	descriptive computer name

Login Information Object
Encapsulates the name and password by which a User is known to the system.

Token	Security Token Object	
Login	String	User's system login name
Password	String	User's system password (possibly encrypted)

Media Control Interface (MCI) Request Object
Encapsulates a multimedia control command, such as play and stop, and any extra information that may be necessary to perform the requested service.

Token	Security Token Object	
Command	Int	multimedia command
String	String	command-specific extra info

Moniker Object
A moniker encapsulates the name of an object or process with the intelligence necessary to work with that name. In other words, it provides naming and binding services. The Moniker Object is used in the system for unique identification of various components, parts or features, such as a channel, a directory, or a computer list.

Token	Security Token Object	
ID	String	unique string identifier
DisplayName	String	User-readable name

Ping Object
Ping is the name given to the "Are-you-Alive?" operation useful in determining if a specific computer is up and running. This object is used in the system when a server has to be queried for its operation status. It can also provide timing information for statistical purposes and quality of service evaluations.

Token	Security Token Object	
Date	Date	system date
Time	Time	system time

TABLE 1-continued

Field Name	Field Type	Remarks
Protocol List Object Encapsulates a general purpose collection object		
Token	Security Token Object	
Type	Int	type of object list

Result Message Object
Acts as the acknowledgment for a requested service successfully carried that out or reports errors that occur in the system during a client/server transaction.

Token	Security Token Object	
Code	Int	result code
Message	String	message corresponding to code

Security Token Object
Contains the authorization key for a transaction The key must be validated before any service is performed.

ID	String	authorization key/ transaction ID.

Server Activation Object
Contains information used in the server activation/deactivation process. Used for announcement as well as command purposes (e.g., a server can notify the administration database that is now activated or a server can be instructed to manage someone else).

Token	Security Token Object	
Active	Int	action flag (activate/ deactivate)
Manage	Int	control flag (manage/ associate)
Type	Int	server type
Host	Host Object	host to be controlled

Server List Request Object
Encapsulates a request for a list of available server resources for an identified service (e.g., a request for a list of Control Servers for a specified channel).

Token	Security Token Object	
Type	Int	type of service
Moniker	Moniker Object	content/channel unique identifier
Host	Host Object	local host information

Statistics Object
Contains system-related information that can be used by load-balancing algorithms and for statistical purposes.

Token	Security Token Object	
Load	Int	load on the system
Threads	Int	number of threads running
Users	Int	number of Users being serviced
Uptime	Int	amount of time running
NumberManaged	Int	number of managed servers
NumberAssociated	Int	number of associated servers

Statistics Request Object
Encapsulates a request for system-related information that can be used by load-balancing algorithms and statistical purposes.

Token	Security Token Object	
Load	Int	request flag (on/off)
Threads	Int	request flag (on/off)
Users	Int	request flag (on/off)
Uptime	Int	request flag (on/off)

TABLE 1-continued

Field Name	Field Type	Remarks
NumberManaged	Int	request flag (on/off)
NumberAssociated	Int	request flag (on/off)
User Object Users and Servers use this object to register themselves with the administration database. They provide the information for subsequent logins (name, password) and other system-related info. The end-Users provide personal, demographic, and system-related information.		
Token	Security Token Object	
Login	Login Information Object	login information (name, password)
FirstName	String	User's first name
LastName	String	User's last name
Title	String	User's job title
Company	String	User's employer
Address1	String	User's home street address
Address2	String	User's address extra
City	String	city, village
State	String	state, province or foreign country
ZipCode	String	zip or postal code
Age	String	User's age
Gender	String	User's gender
PhoneNumber	String	telephone number
FaxNumber	String	fax number
Email	String	email address
Demographics	Dictionary	market targeting extra User info
SystemInfo	Dictionary	system-related information
Version Object All components of the system use this object to report their versioning information to the party they transact with in order to use a protocol they both understand. They are also given the chance to update themselves if a newer version exists.		
Token	Security Token Object	
Major	Int	major protocol version number
Minor	Int	minor protocol version number
Type	Int	sender type
Client	Version	client version information

Unlike traditional protocols based on state computers, the control protocol of the present invention is a light-weight, stateless protocol comprising simple sequences objects. It is light-weight in that in most sequences only two objects are involved in the transaction and after a sequence is completed the connection can be reused. It is also stateless in that the server maintains no information about the client. Every transaction is handled independently of the previous ones. States exist in the lower levels, for example within the TCP layer, to express logical states of a network connection but they are not actually part of the control protocol.

In the preferred embodiment, the software-running on the Control Servers, Media Servers and Primary Servers is programmed for Windows NT and UNIX environment using the OLE environment. In addition, COM interfaces are used between components. The Rogue Wave system is used to transfer objects between the applications running on the various computers. The software running on the User computer is preferably programmed for a Windows 32-bit environment, so it will run on a Windows 95 or Windows NT computer. Alternatively, Macintosh and UNIX environments can be accommodated by other User software.

The basic process of a control transaction consists of a version sequence followed by one or more protocol sequences. The version sequence starts after the computer initiating the transaction, the client, has established a connection with the computer completing the transaction, the server. The client sends a Version Object (defined in Table 1) and in response the server then sends back its own Version Object. This version sequence is used so that both client and server are aware of the version numbers of the software they are using. If a version number is older than expected, either client or server can choose to conform to the previous version or abort the transaction, depending on its needs and capabilities. If a version number is newer than expected, in most cases the current transaction can be completed since the software systems are designed to be fully backward compatible with previous versions. Additionally, in the case that the server of the transaction is the Administration Server, the client receives information about what the latest version number is and thus the client can be informed that a software update is needed. The process of handling automatic updating of User software is described more fully below.

After the version sequence, one or more protocol sequences occur in which other objects are exchanged between client and server. When a particular protocol sequence is completed, another independent protocol sequence can be serviced. The protocol sequences that are part of the control architecture of the present invention are summarized in Table 2 and described below in conjunction with FIGS. **6–17**.

TABLE 2

Summary of Protocol Sequences

Control Sequence	Client	Server	Main Objects Exchanged
User Registration and Login (see FIG. 6)	User	Administration	Version Object User Object Channel Guide Object
User Login (see FIG. 7)	User	Administration	Version Object Login Information Object Channel Guide Object
Channel Play (see FIGS. 8a, 8B, 8C)	User	Administration	Version Object Server List Object
		Control	Version Object Server List Object
		Media	Version Object MCI Objects-OPEN/PLAY/STOP/CLOSE Ping Objects (TCP Connection stays open)
Token Validation (see FIGS. 9A, 9B)	Control or Media or Primary	Administration or Control	Version Object Security Token Object
Server Registration and Login (see FIG. 10)	Media or Control	Administration	Version Object User Object Server Activation Object
Server Login (see FIG. 11)	Media or Control	Administration	Version Object Login Object Server Activation Object
Control Server Activation (see FIG. 12)	Administration	Control	Version Object Server Activation Object

TABLE 2-continued

Summary of Protocol Sequences

Control Sequence	Client	Server	Main Objects Exchanged
Media Server Activation (see FIG. 13)	Control	Media Server Activation Object	Version Object (TCP connection stays open)
Control Channel Activation (see FIG. 14)	Administration	Control	Version Object Channel Activation Object (open TCP connection)
Media Channel Activation (see FIG. 15)	Control	Media	Channel Activation Objects
Distribution Activation (see FIG. 16)	Media	Media or Primary	Version Object MCI Objects-OPEN/PLAY/STOP/CLOSE Ping Objects (TCP connection stays open)
Statistics Request (see FIG. 17)	Administration	Control or Media	Version Object Statistics Object

The User registration and login sequences are the processes by which a new User registers with the system, logs in and retrieves programming information. The channel play sequence takes place when a User asks to listen to a particular channel. The token validation sequence is used to verify that a computer requesting a service is authorized to do so. The Server registration, login and activation sequences are used by Control and Media Servers when they become active. The Control Server and Media Server activation sequences are used to manage the Control and Media Servers. The control channel, media channel and distribution activation sequences are used to cause a channel to be distributed to a Media Server. Finally, the statistics request is used for administrative purposes.

FIG. **6** illustrates the User registration and login sequence in more detail. This sequence takes place after the User has installed the User software on his/her computer. It is expected that the User will download the software from the Internet and then invoke it which in the preferred embodiment will use the Windows Wizard interface. This will guide the User through the installation process including filling out the registration form, which we will describe more fully in the next section. After the User has selected a name and password and selected the option to register, the User computer opens a TCP connection to the Administration Server. Advantageously, the full domain name of the Administration Server is embedded into the User software, although it could be discovered in other ways. The User and Administration Server then exchange version objects with the Administration Server as described above. If the version numbers meet expectations, the User sends a User Object to the Administration Server. The format of the User Object is shown in Table 1. Once the Administration Server receives the User Object, it verifies that the information is filled in properly and that the selected User name is unique. If the User Object is invalid for any reason, the Administration Server returns a Result Message Object with a code indicating the reason. The format of the Result Message Object is shown in Table 1. If the User information is valid, the Administration Server updates the global database of User names and passwords and then generates a security token for that User. This security token is then returned to the User in a Result Message Object.

Upon receiving the Result Message Object, the User saves the security token for future use. This token is an identifier that allows the User to request services from the Administration Server and other computers within the overall system. The security token is not saved permanently or registered on the User computer. Normally, the User software then immediately sends a Channel Guide Request Object to the Administration Server and a Channel Guide Object is returned.

The format of these objects is also shown in Table 1. Note that in principle, this is a separate transaction and could take place in a separate TCP connection to the Administration Server. In particular, once the User has registered and logged in, he/she can request the Channel Guide Object again since it may have been updated since the previous request. At this point the TCP connection to the Administration server is closed.

The process of User registration only needs to take place once for each User. However, anyone can re-register at any time, even after the software has been installed. In particular, it is expected that if multiple persons use a computer, each person will register and obtain his/her own User name and password. If the registration process is not completed successfully, the User software saves the registration information and asks the User if they would like to try again the next time the software is invoked.

Since the security token is not permanently saved by the User software, it is lost when the User software is closed, and the security token must again be retrieved from the Administration Server the next time the User wants to use the system. This process is the purpose of the login sequence illustrated in FIG. **7**. This sequence is used if a User has already registered and needs only to retrieve a valid security token. In this case the sequence consists of the User's sending a Login Information Object to the Administration Server. The Administration Server then queries the User database to validate the login name and password. If the login name and password are correct, then a security token is returned to the User. Normally the receipt of the security token will immediately be followed by a channel information request sequence, just as in the registration sequence described previously.

The control sequence that takes place when a User initiates a channel play operation is illustrated in FIGS. **8**A, **8**B and **8**C. First the User software requests a Control Server List from the Administration Server. Note that the Server List Request Object, illustrated in Table 1 contains a channel identifier. The Administration Server generates a sorted list of Control Servers based on overall system load and the location of the User on the network and returns this list to the User using a Protocol List Object. Once the Control Server List is returned to the User, the Administration Server is no longer needed and the TCP connection is closed.

The User software then searches the list of Control Servers and opens a TCP connection to the first host listed. If that host computer does not respond, then the next Control Server on the list is tested and so forth in succession. Upon obtaining a response from a Control Server, the User software uses a Server List Request Object to request a Media Server List from the Control Server. If the Control Server is too busy to service the User, it returns a Result Message Object so indicating and the User software tries the next Control Server on the list. However, in the likely scenario that the Control Server is able to handle the User's request, a sorted list of Media Servers is generated and returned to the User computer using a Protocol List Object. The TCP connection to the Control Server is then closed by the User software.

At this point the User software initiates a TCP connection to the first Media Server on the list provided by the Control Server. As in the previous case, it attempts to connect to the first host on the list and if unsuccessful tries the next hosts in succession. Once the Version Objects are exchanged, the User software sends an MCI Request Object to the Media Server. An MCI Request Object can be used for four basic commands: OPEN, PLAY, STOP and CLOSE. The User software must first send an OPEN command for the desired channel. If the returned Result Message Object indicates success, the User software then sends a PLAY command.

When the Media Server receives a valid PLAY command, it initiates the delivery of audio information to the User as described in the previous section. Note that this could be in the form of broadcast, multicast or unicast packets to a specific UDP port. The TCP connection through which the MCI Request Objects were sent stays open during the audio play operation. In addition, Ping Objects are sent to the User on a periodic basis to verify that the computer is still working and active. When the User software receives a Ping Object, it simply returns it. The Media Server uses the Ping Objects to measure round trip time and also to determine when a User's computer has terminated abnormally. In that case the audio stream is terminated.

In the case of normal termination of the audio stream, the User makes an explicit selection to stop and this causes a STOP command to be sent to the Media Server in an MCI Request Object. The Media Server then terminates the audio stream to that User. When the User closes the application software or selects another channel to play, the User software will send a CLOSE command to the Media Server in an MCI Request Object and the TCP connection is closed.

The initiation of the audio stream by the Media Server causes a log entry to be generated and sent to the Administration Server. This information is important so that the Administration Server can update its database to indicate which Users are listening to which channels. The security token is used to identify the User initiating the audio stream. Additionally, when the audio stream is terminated to any User, another log message is generated and sent to the Administration Server.

FIG. **9**A illustrates the process by which security tokens are validated. The Administration Server is the only server that can validate a security token. Thus, when a User requests services from a Control Server or from a Media Server, that server must go back to the Administration Server with a token validation sequence. However, Control Servers and Media Servers are allowed to cache validations of security tokens so that they do not have to validate tokens repeatedly once they have validated it the first time. In the case where a Media Server receives a request, the token will be validated with the Control Server that is managing that Media Server. FIG. **9**B identifies the various token validation scenarios.

FIG. **10** illustrates the process by which a new Server is registered. This process is similar to new User registration. It is expected, however, that the server installation will be through a Web interface rather than a Wizard. The Administration Server, upon receiving a User Object from a Media Server or Control Server validates the User name and password and generate a security token just as in the case of User registration. Normally the Server then immediately sends back a Server Activation Object indicating that it is ready to be used as a system resource. Once this process has been completed, the TCP connection to the Administration Server is closed.

If a Media Server or Control Server that has sent a Server Activation Object to the Administration Server becomes inactive, it will send another Server Activation Object indicating this condition. In the case of a Media Server, this object is sent to the managing Control Server. In the case of a Control Server, this object sent to the Administration Server. As in the case of User registration, Media Server and Control Server registration needs only take place once per computer. However, if the computer is restarted, the server must login and again retrieve a security token. This is the server login and activation sequence shown in FIG. **11**.

Once a Control Server has indicated to the Administration Server that it is ready, the Administration Server can activate that Control Server by sending the Control Server a Server Activation Object as illustrated in FIG. **12**. This is a separate transaction and is used to tell the Control Server which Media Servers it is supposed to manage. Recall that a Control Server and a number of Media Servers form a cluster of Media Servers. The single Control Server that manages that cluster must be given a list -of host computers corresponding to the Media Servers in that cluster.

The process by which a Control Server activates the Media Servers that it manages is illustrated in FIG. **13**. The Control Server sends a Server Activation Object to the Media Server indicating that it is responsible for channel management. This TCP connection between the Control Server and the Media Server stays open during the time that both servers are active. The Control Server periodically sends Ping Objects to the Media Server across this open TCP connection to verify that the Media Server is still running.

FIG. **14** illustrates the process by which a given channel is activated by the Administration Server. The Administration Server opens a connection to a Control Server that its wishes to have carry a given channel and provide a Channel Activation Object. This object indicates to the Control Server which Media or Primary Server the Control Server should direct its Media Servers to get the feed from. At this point the Control Server is said to be carrying that channel and it will be a valid host on a list of Control Servers requested by a Channel Play sequence.

FIG. **15** illustrates what happens when a Control Server needs to provide a channel. First it sends a Channel Activation Object to one of the Media Servers that it manages across the open TCP connection described previously. This object indicates to the Media Server that it should start receiving the channel identified and from where it should receive it.

In FIGS. **16**A and **16**B depict how the Media Server requests distribution of an audio channel from another Media Server or from a Primary Server. This sequence is much the same as that in which a User requests the distribution of audio information from a Media Server. Note that a Media Server receives a single incoming stream for each channel that it is carrying and will then redistributes this stream to all Users or other Media Servers that request it.

Finally, FIG. **17** illustrates the statistics request sequence. This sequence is used by the Administration Server to gather information from the Media Servers and Control Servers in order to manage the overall system. It can use this information to detect failures and to balance load as the dynamic conditions change. As indicated above, it can also use this information to monitor which Users are listening to which channel or whether Users stop listening to a channel at any time, such as during the play of a particular song. It can also use this information to control the advertising content that is downloaded to a particular User in advance of receipt of

regular audio programming and/or monitor the delivery of advertising to the Users.

The control architecture described in this section is scalable to handle any number of Users. Note that the User registration process only happens once for each subscriber and the login process only happens once per session. These interactions, which require the Administration Server are expected to constitute a very small percentage of the overall system bandwidth. If the Administration Server were to become a bottleneck, however, it would be possible to duplicate it and to have the database it maintains distributed and automatically updated to guarantee consistency.

The Control Servers are distributed throughout the network and can handle the lower level interactions with the Users and the Media Servers. A single Control Server can handle preferably on the order of ten Media Servers up to several hundred Users. The bitrate among the Users, the Control Servers and the Media Servers is expected to be small in comparison to the audio transmission bitrate. The Ping Objects normally only involve the User and the nearest Media Server. They are also low in overhead since they are small and only get transmitted infrequently.

III. User Interface

The User interface is provided by the client application running on an individual computer and its associated graphical interface. In the preferred embodiment the User interface is available for 32-bit Windows (95 and NT), Macintosh and UNIX platforms. Preferably anyone on the Internet can freely download a copy of the client software and install it in their computer.

FIG. **18** illustrates the main User screen in the preferred embodiment. The screen is composed of three sections: channel guide (upper left frame), program guide (upper right frame), and multimedia frame (lower half of screen). The channel guide lists, as a tree hierarchy, the channels that are available from the system. The User selects a channel from the list of those displayed on the channel guide. The program guide provides information pertaining to the channel selected. This information can be a detailed schedule of the programming that has played or will be playing on the channel selected. Additionally, other relevant information will be displayed in this frame, for example, a notice regarding an upcoming special event on another channel. The multimedia frame provides an integrated web browser that displays information via a series of tabbed sections.

The information contained in the channel guide, program guide, and the tabs of the multimedia frame is dynamically transmitted to the client. For example, if a new channel begins operation, the client application can immediately display it as being available. Furthermore, the tabs displayed can be specifically relevant depending on what song is playing. For example, tabs displaying the album cover, information on the artist, song lyrics, tour dates can be displayed. Additionally, as shown in the example in FIG. **18**, a tab can be available allowing the User to place an order for the CD or allowing the User to participate in a chat session related to the channel.

FIG. **19** illustrates the key pull-down menus available in the main User screen in the preferred embodiment. Table 3 provides a description of each of the functions available through the pull down menus, as shown in FIG. **19**.

As will be apparent to those skilled in the art, numerous modifications may be made within the spirit and cope of the invention.

TABLE 3

Pull-Down Menu Functions

Menu Choice	Menu Sub-Choice	Description
File	Login	Allows the User to login to the system.
	Logout	Allows the User to logout from the system.
	Register	Brings up a dialog so that the User can register with the system for the first time.
	Close	Minimizes the screen.
Edit	Copy	Allows the User to copy the selection on to the clipboard.
	Properties	Allows the User to set various properties.
Audio	Play	Begins playing the selected channel.
	Stop	Stops playing the selected channel.
	Mute	Stops the playing of audio
View	Tool Bar	Display or hide the tool bar (providing access to pull-down menu functions).
	Status Bar	Display or hide the status bar normally situated at bottom of the screen.
	Web Bar	Display or hide the tool bar section that provides access to the web browser functions.
Help	Help Topics	Brings up a list of available online help topics.
	About . . .	Displays summary information regarding this application, such as version number, copyright information, and so on.

What is claimed is:

1. A method for monitoring the forwarding of real-time information to at least one user having access to a communications network comprising:

generating delivery-commencement indications of real-time information forwarded to the user by means of the communications network, wherein the real-time information comprises a plurality of packets forwarded over the communications network to the user,

verifying the operational status of the user's access to the communications network during delivery of the real-information, and

generating delivery-termination indications of the real-time information forwarded to the user.

2. The method of claim **1** wherein the verifying step indicates abnormal termination of the user's access to the communications network, and wherein the generated delivery-termination indications then also comprises indications of the abnormal termination.

3. The method of claim **1** further comprising updating a database with information provided by the delivery-commencement and the delivery-termination indications.

4. The method of claim **1** wherein the commencement and termination indications further comprise time information.

5. The method of claim **1** wherein the operational status comprises an active/working status.

6. The method of claim **1** wherein the step of verifying further comprises forwarding over the communications network messages concerning the operational status of the user's access to the communications network.

7. The method of claim **6** wherein the messages concerning the operational status of the user's access to the communications network are initiated by the user.

8. The method of claim 6 wherein the messages concerning the operational status of the user's access to the communications network are received by the user and responded to by the user.

9. The method of claim 6 wherein the communications network further comprises at least one server computer, and wherein the messages concerning the operational status of the user access to the communications network are initiated by the server computer.

10. The method of claim 6 wherein the indications of delivery-commencement and of delivery-termination are stored on the server computer.

11. The method of claim 1 wherein the indications of delivery-commencement and of delivery-termination are stored at the user.

12. The method of claim 11 wherein the indications that are stored at the user are later forwarded over the communications network to the server computer.

13. The method of claim 1 further comprising a step of determining the total delivery time of the real-time information to the user from the delivery-commencement and the delivery-termination indications.

14. The method of claim 13 further comprising a the step of determining the content of the real-time information delivered during the total delivery time.

15. The method of claim 13 wherein the total delivery time is determined as the total elapsed time between delivery-commencement and delivery-termination indications during which the user's access to the communications network was also verified to be in an active/working operational status.

16. The method of claim 1 wherein the real-time information comprises audio information, or video information, or advertising information.

17. The method of claim 1 further comprising generating indications of the content of the real-time information.

18. The method of claim 1 wherein an identifier is provided for the user.

19. The method of claim 18 wherein commencement and termination indications are associated with the identifier.

20. The method of claim 1 wherein the communications network includes the Internet.

21. The method of claim 1 wherein the communications network includes a satellite network.

22. The method of claim 1 wherein the communications network includes a cable TV network.

23. The method of claim 1 wherein the communications network includes a private data network.

24. A method for monitoring the forwarding of real-time information to at least one user having access to a communications network comprising:

generating delivery-commencement indications of real-time information to the user, wherein the real-time information comprises a plurality of packets comprising audio information, or video information and is forwarded over the communications network to the user, and wherein the commencement indications further comprise time information,

verifying the operational status of the user's access to the communications network during delivery of the real-information, wherein the operational status includes abnormal termination,

generating delivery-termination indications of the real-time information to the user, wherein the termination indications further comprise time information and indications of any abnormal termination, and

updating a database with information provided by the delivery-commencement and the delivery-termination indications.

25. The method of claim 24 wherein the step of verifying further comprises forwarding over the communications network messages concerning the operational status of the user's access to the communications network.

26. The method of claim 24 further comprising a step of determining the total delivery time of the real-time information to the user from the delivery-commencement and the delivery-termination indications.

27. The method of claim 26 wherein the total delivery time is determined as the total elapsed time between delivery-commencement and delivery-termination indications during which the user's access to the communications network was also verified to be in an active/working operational status.

28. The method of claim 24 further comprising generating indications of the content of the real-time information, and wherein the database is updated with information provided by the content indications.

29. A method for forwarding real-time information to one or more users having access to a communications network comprising:

processing one or more streams of audio or visual information into one or more streams of packets for forwarding over the communications network, wherein at least one stream of packets comprises audio or video information,

forwarding the digital packets to the users in response to information selection signals received from the users,

verifying the operational status of the users' access to the communications network during delivery of the real-time information, and

updating a database with indications of: (i) which streams of packets were received by which users, (ii) the time when delivery of each stream to each user commenced, and (iii) the time when delivery of each stream to each user terminated.

30. The method of claim 29 wherein the operational status includes abnormal termination, and wherein the termination time of each data stream further comprises indications of any abnormal termination.

31. The method of claim 29 wherein the step of verifying further comprises forwarding over the communications network to the users messages querying the operational status of the users' access to the communications network.

32. The method of claim 29 wherein the messages concerning the operational status of the users' access to the communications network are initiated by the users.

33. The method of claim 32 wherein the messages concerning the operational status of the users' access to the communications network are received by the user and responded to by the user.

34. A method for a user having access to a communications network to obtain real-time information comprising:

forwarding selection signals over the communications network from the user indicating the real-time information desired,

receiving one or more streams of packets forwarded to the user over the communications network in response to the selection signals, wherein at least one stream of packets comprises audio or video information, and

verifying the operational status of the communications network access during delivery of the real-information.

35. The method of claim 34 wherein an identifier is provided by the user.

36. The method of claim 34 wherein the step of verifying further comprises responding to messages forwarded to the

user concerning the operational status of the user's access to the communications network.

37. The method of claim **34** further comprising the step of forwarding termination signals from the user indicating that termination of the streams of packets is requested.

38. The method of claim **37** wherein the termination signals from the user are voluntary.

39. The method of claim **37** wherein the termination signals from the user are involuntary.

40. A system for a user to obtain real-time information over a communications network information comprising a programmable device,

wherein the programmable device has access to the communications network, and

wherein the programmable device includes user software for causing the computer to forward selection signals from the programmable device indicating the real-time information desired,

receive one or more streams of packets forwarded to the programmable device in response to the selection signals, wherein at least one stream of packets comprises audio or video information, and

verify the operational status of the programmable device during delivery of the real-time information.

41. The system of claim **40** wherein the programmable device comprises a personal computer, or a personal digital assistant, or a telephone, or a mobile phone, or a terminal device, or a television set-top box, or a game console.

42. The system of claim **40** wherein the user software further causes the programmable device to initiate and forward over the communications network messages concerning the programmable device's operational status.

43. The system of claim **40** wherein the user software further causes the programmable device to respond to messages forwarded to the programmable device concerning the programmable device's operational status.

44. The system of claim **40** wherein the user software forwards over the communication network a unique identifier.

45. The system of claim **44** wherein the identifier is provided by the programmable device.

46. The system of claim **44** wherein the identifier is provided by the user software.

47. The system of claim **40** wherein the user software comprises an Internet browser.

48. The system of claim **40** wherein the user software further causes the programmable device to display a channel guide, a program guide, or a multimedia frame.

49. The system of claim **40** wherein the programmable device's operational status comprises its access to the communication network.

50. A software product comprising user software on a computer readable medium for causing a programmable device having access to a communications network to forward selection signals from a user indicating real-time information desired,

receive one or more streams of packets forwarded to the user in response to the selection signals, wherein at least one stream of packets comprises audio or video information, and

verify the operational status of the computer during delivery of the real-information.

51. The product of claim **50** wherein the user software further causes the programmable device to respond to messages forwarded to the programmable device concerning the programmable device's operational status.

52. The product of claim **50** wherein the user software further causes the programmable device to initiate and forward over the communications network messages concerning the programmable device's operational status.

53. The product of claim **50** wherein the user software forwards over the communication network a unique identifier.

54. The product of claim **50** wherein the user software comprises an Internet browser.

55. The product of claim **50** wherein the user further causes the programmable device to display a channel guide, a program guide, or a multimedia frame.

56. The product of claim **50** wherein the user software is provided in a form that is downloadable over the communications network.

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ARBITRON

Online Holiday Listening Exceeds Seven Million Hours in December According to Arbitron Internet Broadcast Ratings 01 20 04

NEW YORK, January 20, 2004 – Listening to holiday music over the Internet was 7 million hours on 11 stations, seven of which were in the top 50, during the month of December, according to Arbitron Internet Broadcast Ratings.

AOL Classic Holiday was ranked number one with 3,206,211 hours of Total Time Spent Listening (TTSL), the sum total of hours tuned by listeners to a given station or network. AOL Pop Holiday was ranked number four with 957,766 hours of TTSL. MUSICMATCH Contemporary Christmas was ranked number 15 with 577,845 hours of TTSL. AOL R&B Holiday was ranked number 16 with 569,465 hours of TTSL. AOL Country Holiday was ranked number 17 with 568,388 hours of TTSL. AOL Jazz was ranked number 21 with 534,114 hours of TTSL. MUSICMATCH Contemporary Christmas was ranked number 25 with 468,979 hours of TTSL.

MUSICMATCH Artist Match was the top non-commercial Internet Broadcast Station with 2,998,150 hours of TTSL.

Radio@AOL Network and LAUNCH were the top-ranked commercial Internet Broadcasters with 26,235,642 and 15,554,967 hours of Total Time Spent Listening, respectively. AOL reported problems with their server data during December, resulting in ratings that are lower than in prior months. MUSICMATCH was the top-ranked non-commercial Internet Broadcaster with 9,028,512 hours of TTSL. The Adsertion Network was ranked the top sales network with 3,027,913 hours of TTSL. Due to a switch in Content Delivery Networks, tuning for The Adsertion Network is lower for the month. In addition, incomplete data was received for AccuRadio, Beethoven.com and WLS-AM during December.

The top Content Delivery Networks (CDN) were Live365 with 10,265,588 hours of TTSL and StreamGuys with 2,139,438 hours of TTSL. The Total Time Spent Listening for these Content Delivery Networks is the sum of all tuning to stations streamed by the CDN, including commercial and non-commercial stations.

Top Internet Broadcasters and Sales Networks (December 2003)

Rank	Company	Type	TTSL	CUME
1	AOL Radio@Network	commercial	26,235,642	4,530,338
2	LAUNCH	commercial	15,554,967	2,598,710
3	MUSICMATCH	non-commercial	9,028,512	1,638,587
4	The Adsertion Network	sales network	3,027,913	312,169
5	Virgin Radio	commercial	2,182,112	244,674
6	AccuRadio	commercial	1,450,989	401,792
7	Educational Media Foundation	non-commercial	1,332,487	134,410
8	ABC Radio Network	commercial	1,205,232	163,369
9	KillerOldies.com	commercial	558,067	55,862
10	KPLU	non-commercial	382,581	36,283
11	WXPN-FM	non-commercial	339,121	33,390
12	WOXY-FM	commercial	304,440	40,161
13	Emap	commercial	276,442	89,010
14	Beethoven.com	commercial	258,880	32,725
15	WBUR	non-commercial	233,600	57,789

Arbitron Internet Broadcast Stations Monthly Top 50 (December 2003)

Rank	Station/Type/Format	Owner/Network/URL	TTSL	Cume
1	AOL Classic Holiday (commercial) Miscellaneous	AOL Radio@Network music.netscape.com/radio/	3,206,211	849,840
2	MUSICMATCH Artist Match (non-commercial) Miscellaneous	MUSICMATCH www.musicmatch.com	2,998,150	792,786
3	Virgin Radio/1215 AM & 105.8 FM (commercial) Adult Contemporary	Virgin Radio www.virginradio.co.uk	1,209,936	167,540
4	K-LOVE (non-commercial) Contemporary Christian	Educational Media Foundation www.klove.com	1,007,382	93,314
5	AOL Pop Holiday (commercial) Pop	AOL Radio@Network music.netscape.com/radio/	957,766	326,834
6	AOL Top Country (commercial) Country	AOL Radio@Network music.netscape.com/radio/	827,722	327,559
7	AOL Top Pop (commercial) Top 40	AOL Radio@Network music.netscape.com/radio/	788,389	446,891
8	MUSICMATCH Top Hits (non-commercial) Contemporary Hit Radio / Top 40	MUSICMATCH www.musicmatch.com	745,758	298,407
9	AOL Smooth Jazz (commercial) Smooth Jazz	AOL Radio@Network music.netscape.com/radio/	708,807	148,182
10	WLS-AM/890 (commercial) News / Talk	ABC Radio Networks music.netscape.com/radio/	699,130	88,115
11	Virgin Radio Classic Tracks (commercial) Classic Rock	Virgin Radio www.virginradio.co.uk	657,907	82,448
12	AOL Classic Rock (commercial) Classic Rock	AOL Radio@Network music.netscape.com/radio/	650,653	198,626
13	AOL Awesome 80s (commercial) 80s	AOL Radio@Network music.netscape.com/radio/	643,275	206,598
14	MUSICMATCH Artist On Demand (non-commercial) Miscellaneous	MUSICMATCH www.musicmatch.com	642,546	130,368
15	MUSICMATCH Traditional Christmas (non-commercial) Miscellaneous	MUSICMATCH www.musicmatch.com	577,845	161,727
16	AOL R&B Holiday (commercial) R&B	AOL Radio@Network music.netscape.com/radio/	569,465	192,114

17	AOL Country Holiday (commercial) Country	AOL Radio@Network music.netscape.com/radio/	568,388	258,484
18	AOL Lite Rock (commercial) Soft Rock	AOL Radio@Network music.netscape.com/radio/	567,640	98,695
19	Killer Oldies (commercial) Adult Alternative	KillerOldies.com www.killeroldies.com	558,067	55,862
20	AOL Top Jams (commercial) Miscellaneous	AOL Radio@Network music.netscape.com/radio/	542,036	414,281
21	AOL Jazz Holiday (commercial) Miscellaneous	AOL Radio@Network music.netscape.com/radio/	534,114	169,057
22	AOL Love Songs (commercial) Love Songs	AOL Radio@Network music.netscape.com/radio/	525,184	164,137
23	AOL Top Alternative (commercial) Alternative	AOL Radio@Network music.netscape.com/radio/	509,416	263,672
24	AOL Pop Rock (commercial) Rock	AOL Radio@Network music.netscape.com/radio/	473,953	148,525
25	MUSICMATCH Contemporary Christmas (non-commercial) Miscellaneous	MUSICMATCH www.musicmatch.com	468,979	128,914
26	AOL Oldies (commercial) Oldies	AOL Radio@Network music.netscape.com/radio/	437,414	161,005
27	AOL R&B SlowJams (commercial) R&B	AOL Radio@Network music.netscape.com/radio/	391,865	156,867
28	AOL R&B Fresh (commercial) R&B	AOL Radio@Network music.netscape.com/radio/	385,278	141,361
29	AOL Super 70s (commercial) 70s	AOL Radio@Network music.netscape.com/radio/	383,022	113,167
30	The Sean Hannity Show (commercial) News / Talk	ABC Radio Network music.netscape.com/radio/	370,256	74,465
31	AOL New Age (commercial) New Age	AOL Radio@Network music.netscape.com/radio/	362,208	82,253
32	MUSICMATCH GenreMatch (non-commercial) Miscellaneous	MUSICMATCH www.musicmatch.com	358,094	130,120
33	WXPN-FM (non-commercial) Adult Alternative	WXPN-FM www.xpn.org	339,121	33,390
34	MUSICMATCH Country Hits (non-commercial) Country	MUSICMATCH www.musicmatch.com	335,633	68,124

35	Air 1 (non-commercial) Contemporary Christian	Educational Media Foundation www.air1.com	325,105	44,150
36	AOL 90s Country (commercial) 90s	AOL Radio@Network music.netscape.com/radio/	323,060	133,852
37	MUSICMATCH Soft Hits (non-commercial) Soft Rock	MUSICMATCH www.musicmatch.com	321,412	70,014
38	WOXY-FM (commercial) Modern Rock	WOXY-FM www.woxy.com	304,440	40,161
39	AOL 90s Alternative (commercial) Alternative	AOL Radio@Network music.netscape.com/radio/	276,108	121,540
40	KPLU (non-commercial) Miscellaneous	KPLU www.kplu.org	263,511	24,389
41	Beethoven.com (commercial) Classical	Beethoven.com www.beethoven.com	258,880	32,725
42	AOL Modern Gospel (commercial) Modern Gospel	AOL Radio@Network music.netscape.com/radio/	255,326	58,154
43	AOL Acoustic Rock (commercial) Rock	AOL Radio@Network music.netscape.com/radio/	242,952	77,152
44	AOL Classical 101 (commercial) Classical	AOL Radio@Network music.netscape.com/radio/	235,131	74,052
45	Virgin Radio The Groove (commercial) Black / Urban R&B	Virgin Radio www.virginradio.co.uk	232,887	37,971
46	MUSICMATCH Classic Rock (non-commercial) Rock	MUSICMATCH www.musicmatch.com	231,995	52,805
47	MUSICMATCH 80's Hits (non-commercial) 80s	MUSICMATCH www.musicmatch.com	228,978	64,207
48	WBUR (non-commercial) Miscellaneous	WBUR www.wbur.org	227,937	56,837
49	AOL Christian (commercial) Christian	AOL Radio@Network music.netscape.com/radio/	224,311	72,219
50	AOL XtremeAltRock (commercial) Rock	AOL Radio@Network music.netscape.com/radio/	220,798	164,883

Notes:

1. **TTSL** (Total Time Spent Listening), sometimes referred to as Aggregate Tuning Hours (ATH), is the total number of hours tuned to a given station or network in the reported time period.
2. **Cume Persons** is an estimate of the total number of unique listeners who had one or more listening sessions lasting five minutes or longer during the reported time period. This estimate is derived using an algorithm that takes

into account unique media player GUIDs, unique IP addresses and other variables during the reported time period.
3. The ratings may not reflect all tuning for the measured stations or channels since Arbitron may have received incomplete or unusable server data.
4. As Arbitron Internet Broadcast Ratings (powered by MeasureCast technology) transitions to a subscription-only service, some stations previously reported in the ratings have elected not to subscribe to the service and will no longer be included.
5. The 128K MP3 and all Ogg streams for Virgin Radio/1215 AM & 105.8 FM are not currently measured by Arbitron Internet Broadcast Ratings.
6. AOL reported problems with their server data during December, resulting in ratings that are lower than prior weeks.
7. Due to a switch in Content Delivery Networks, tuning for The Adsertion Network is lower for the month.
8. Incomplete data was received for AccuRadio, Beethoven.com and WLS-AM.

About Arbitron
Arbitron Inc. (NYSE: ARB) is an international media and marketing research firm serving radio broadcasters, cable companies, advertisers, advertising agencies and outdoor advertising companies in the United States, Mexico and Europe. Arbitron's core businesses are measuring network and local market radio audiences across the United States; surveying the retail, media and product patterns of local market consumers; and providing application software used for analyzing media audience and marketing information data. Arbitron Internet Broadcast Services measures the audiences of audio and video content on the Internet, commonly known as webcasts. The Company is developing the Portable People Meter, a new technology for radio, television and cable ratings.

Arbitron's marketing and business units are supported by a world-renowned research and technology organization located in Columbia, Maryland. Arbitron has approximately 825 full-time employees; its executive offices are located in New York City.

Through its Scarborough Research joint venture with VNU, Inc., Arbitron also provides media and marketing research services to the broadcast television, magazine, newspaper, outdoor and online industries.

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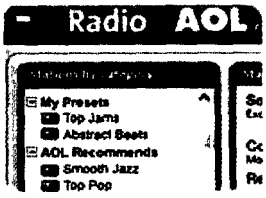

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Features Overview

Catch original programming on AOL.
Listen to original in-studio performances and guest celebrity DJs Or tune in topical talk programs

Worth talking about.
Live chat programs feature experts on topics as varied as Hollywood, travel, finance and health.

Stream more smoothly at any speed.
Ultravox™ technology enhances clarity via dial-up. Dolby AAC technology gives high-speed users CD-quality sound

Powered by an improved AOL® Media Player.
AOL® 9 0 Optimized integrates an updated media player that lets you save and share more media formats

Get amped.
AOL leverages Winamp® technology for powerful MP3 digital playback capabilities

It's included and easy-to-use.
Radio@AOL is included at no additional charge for AOL members

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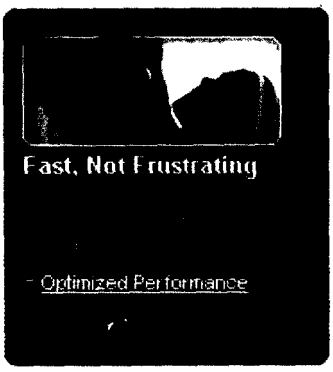

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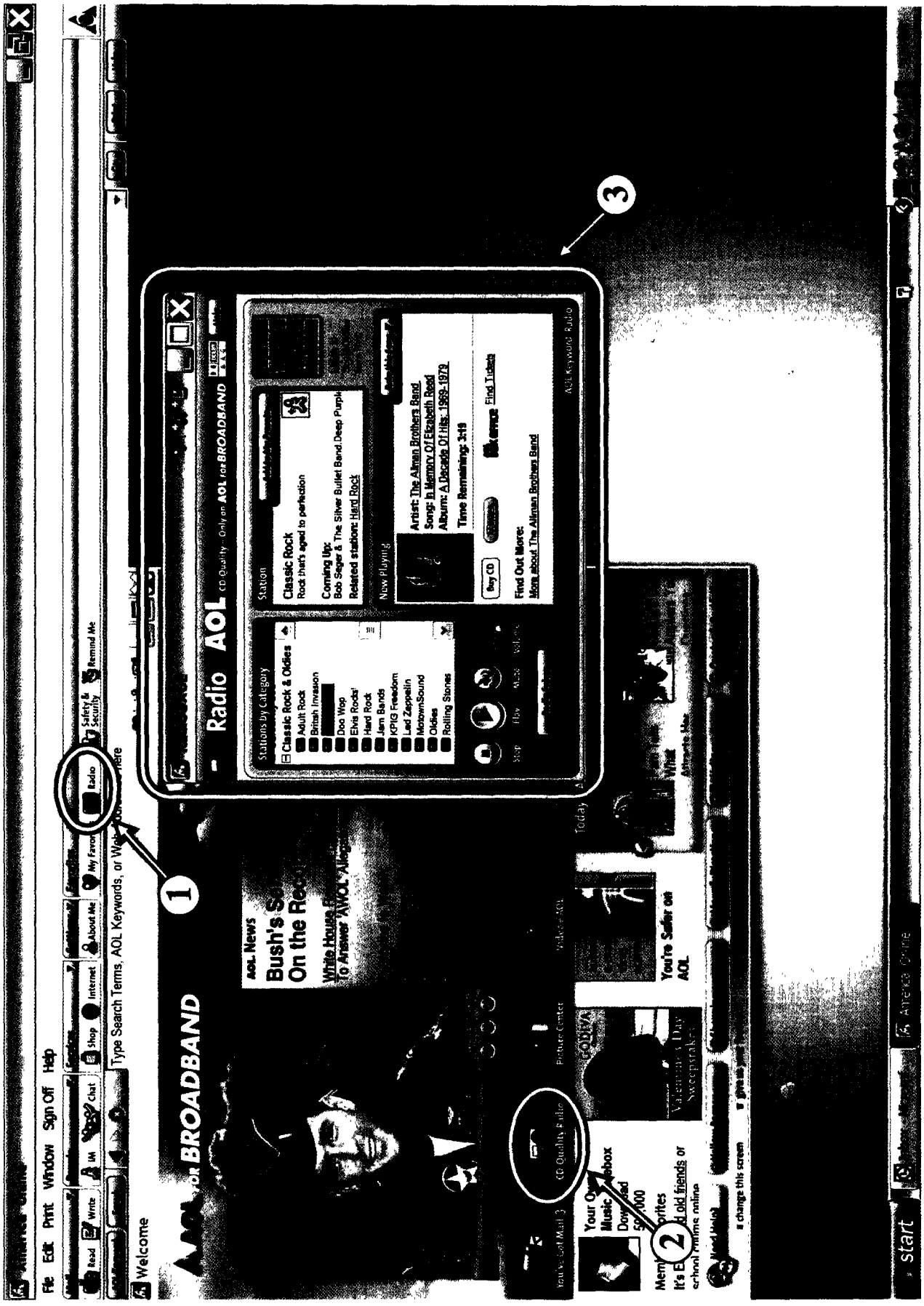
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Jam Bands
KPIG Freedom
Led Zeppelin
MotownSound
Oldies
Rolling Stones
Station
Classic Rock
Rock that's aged to perfection
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Artist: The Allman Brothers Band
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ARBITRON

America Online's Radio@ Network Will Now Be Measured in Arbitron's Internet Broadcast Ratings 06 10 03

NEW YORK, June 10, 2003 - Arbitron Inc. (NYSE: ARB) announced today that America Online®'s Radio@ Network has subscribed to, and will now be measured in, Arbitron's Internet Broadcast Ratings (powered by MeasureCast technology).

The AOL® Radio@ Network encompasses Radio@AOL, Radio@AOL for Broadband, Radio@Netscape and Spinner.com. For the week of May 19 – 25, the AOL Radio@ Network had 1,249,774 Cume Persons, the estimated number of unique listeners tuning in for more than five minutes. Also, the AOL Radio@ Network had 4,888,916 hours of Total Time Spent Tuning, the sum total of hours tuned by listeners to a given station or network. The AOL Radio@ Network will be included among Arbitron's Top Internet Broadcast Networks and Internet stations beginning with data for the week of May 26 – June 1 to be released on June 12.

The Radio@AOL Network offers more than 175 "best-of-breed" music, news, sports, entertainment, and seasonal stations, as well as celebrity stations from today's hottest stars and terrestrial streams from some of the most respected names in broadcasting.

"America Online is one of the world's foremost consumer brands. Its subscription to Arbitron's Internet Broadcast Ratings sends an important signal to advertisers that the AOL Radio@ Network is serious about their plans for Internet Broadcast advertising," said Steve Morris, president and chief executive officer, Arbitron Inc.

"A healthy and growing Internet Broadcast advertising market requires credible third party ratings and the AOL Radio@ Network is playing a crucial role in leading the industry forward," said Bill Rose, vice president and general manager, Arbitron Internet Broadcast Services.

"The number of online radio listeners is growing tremendously and we are thrilled that so many are tuning into the AOL Radio@ Network to enjoy a top quality listening experience and our broad selection of premier programming. As our audience expands, this new relationship with Arbitron helps us provide advertisers with the credible independent audience measurement they need," said Jim Van Huysse, general manager, the AOL Radio@ Network.

Designed to transform the conventional radio experience, the AOL Radio@ Network offers convenient 24/7 access to a vast selection of original and third-party programming, contextual information, and integrated commerce In addition to over 175 "best-of-breed stations," recently enhanced versions of Radio@AOL and Radio@AOL for Broadband provide listeners with new features that promote convenience and sharing, and offer dramatically improved sound quality.

About AOL® Entertainment
AOL Entertainment, a part of America Online, Inc., delivers a wide range of programming, products, and services across the entertainment spectrum, including games, movies, music, radio, sports, television, and ticketing. AOL Entertainment provides unique and compelling ways for the Internet's largest and most-engaged audience to experience exclusive premieres, get the latest news and reviews, access their favorite celebrities and even behind-the-scenes, and interact with fans from around the world. AOL Entertainment provides programming to AOL's flagship service, AOL® for Broadband service, and leading Web properties. America Online, Inc. is a wholly owned subsidiary of AOL Time Warner Inc. (NYSE: AOL). Based in Dulles, Virginia, America Online is the world's leader in interactive services, Web brands, Internet technologies, and e-commerce services.

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This press release contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. The statements regarding Arbitron in this document that are not historical in nature, particularly those that utilize terminology such as "may," "will," "should," "likely," "expects," "anticipates," "estimates," "believes" or "plans," or comparable terminology, are forward-looking statements based on current expectations about future events, which Arbitron has derived from information currently available to it. These forward-looking statements involve known and unknown risks and uncertainties that may cause our results to be materially different from results implied in such forward-looking statements. These risks and uncertainties include whether we will be able to:

- *renew contracts with large customers as they expire;*
- *successfully execute our business strategies, including timely implementation of our Portable People Meter and our MeasureCast Ratings services, as well as expansion of international operations;*
- *effectively manage the impact of further consolidation in the radio industry;*
- *keep up with rapidly changing technological needs of our customer base, including creating new products and services that meet these needs; and*
- *successfully manage the impact on our business of any economic downturn generally and in the advertising market in particular, and the impact on costs of data collection due to privacy concerns.*

Additional important factors known to Arbitron that could cause forward-looking statements to turn out to be incorrect are identified and discussed from time to time in Arbitron's filings with the Securities and Exchange Commission, including in particular the risk factors discussed under the caption "ITEM 1. BUSINESS - Business Risks" in our Annual Report on Form 10-K.

The forward-looking statements contained in this document speak only as of the date of this release, and Arbitron undertakes no obligation to correct or update any forward-looking statements, whether as a result of new information, future events or otherwise.

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