US007711564B2

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

(10) **Patent No.: US 7,711,564 B2**
(45) **Date of Patent: May 4, 2010**

(54) **CONNECTED AUDIO AND OTHER MEDIA OBJECTS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1173 days.

(21) Appl. No.: **10/186,175**

(22) Filed: **Jun. 27, 2002**

(65) **Prior Publication Data**

US 2003/0021441 A1 Jan. 30, 2003

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/563,664, filed on May 2, 2000, now Pat. No. 6,505,160, which is a continuation-in-part of application No. 10/027,783, filed on Dec. 19, 2001, now Pat. No. 7,289,643.

(60) Provisional application No. 60/263,490, filed on Jan. 22, 2001.

(51) **Int. Cl.**
G10L 11/00 (2006.01)
G10L 21/00 (2006.01)

(52) **U.S. Cl.** **704/270**; 704/273

(58) **Field of Classification Search** 84/609; 380/28; 455/556.2, 3.06; 705/1, 54; 713/176; 725/110, 112; 704/273, 270; 382/100; 709/219
See application file for complete search history.

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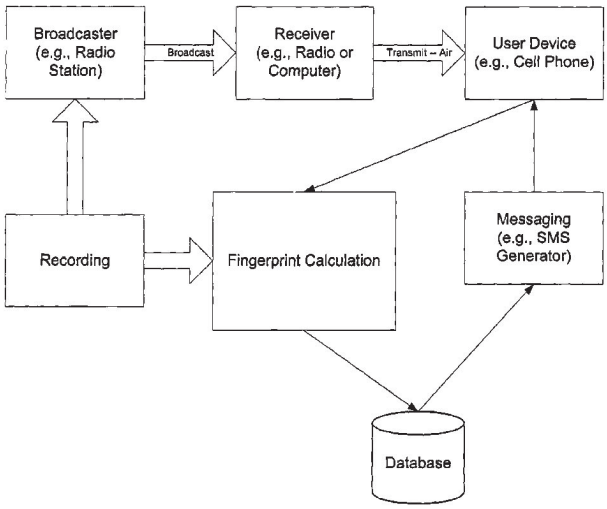
(57) **ABSTRACT**

The presently claimed invention relates generally to steganography and fingerprinting or hashing. In one embodiment, a method includes: obtaining a first set of plural-bit data, the first set of plural-bit data corresponding to at least a portion of steganographically encoded data in a media signal in the form of a digital watermark; obtaining a second set of plural-bit data, the second set of pural-bit data corresponding to a fingerprint or hash of the media signal. THe fingerprint or hash includes a reduced-bit representation of the media signal, and the first set of plural-bit data is not dependent on information in the second set of plural-bit data. The method further includes carrying out a first action associated with the first set of plural-bit data; and carrying out a second action associated with the second set of plural-bit data. Other embodiments are described and claimed as well.

45 Claims, 4 Drawing Sheets



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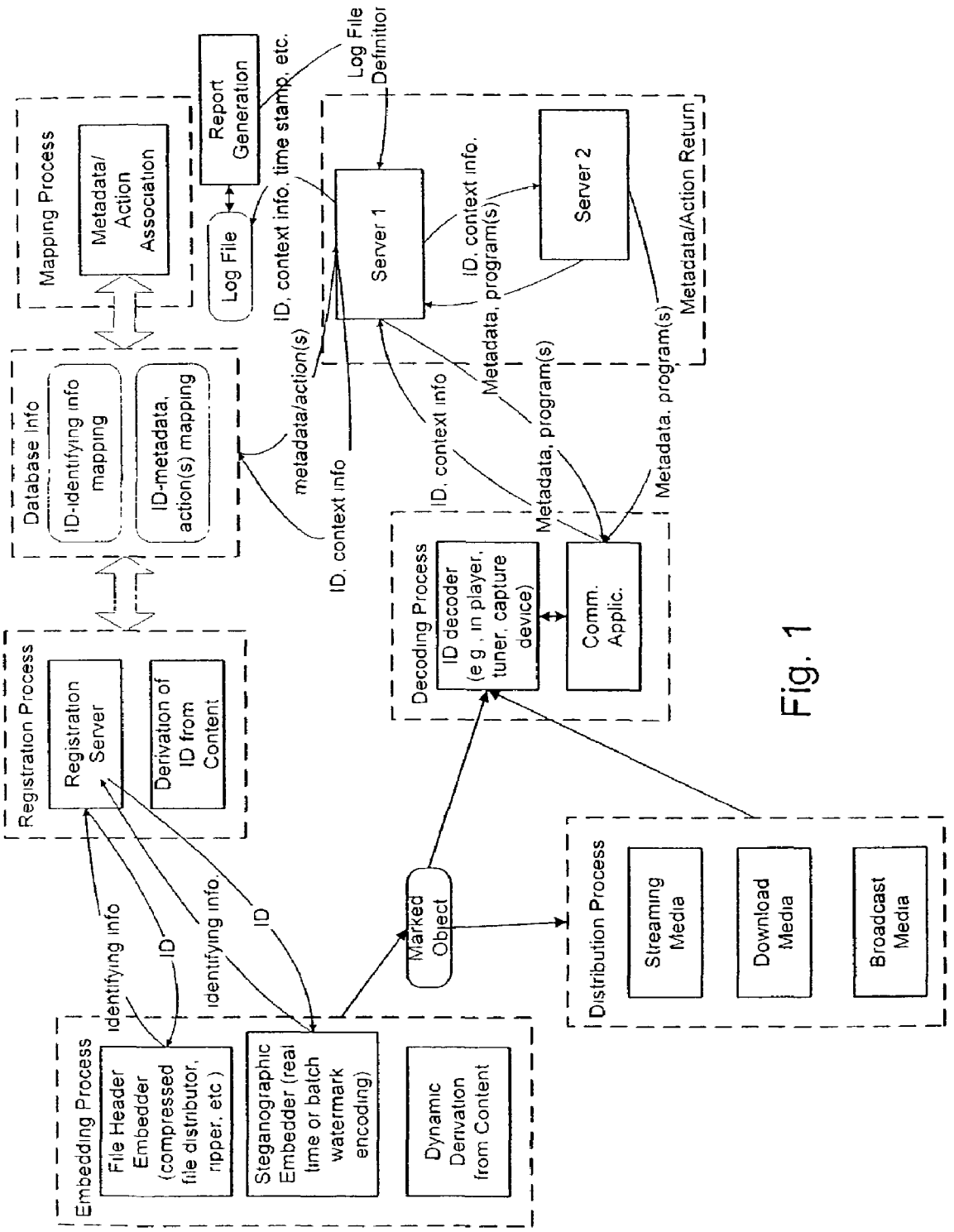

Mapping Process
Metadata/ Action Association
Report Generation
Log File
Log File Definition
ID, context info, time stamp, etc.
Server 1
Server 2
ID, context info.
Metadata, program(s)
Metadata/Action Return
Database Info
ID-identifying info mapping
ID-metadata, action(s) mapping
metadata/action(s)
ID, context info
Metadata, program(s)
Registration Process
Registration Server
Derivation of ID from Content
Decoding Process
ID decoder (e g , in player, tuner, capture device)
Comm. Applic.
identifying info
ID
Marked Object
Distribution Process
Streaming Media
Download Media
Broadcast Media
Embedding Process
File Header Embedder (compressed file distributor, ripper, etc)
Steganographic Embedder (real time or batch watermark encoding)
Dynamic Derivation from Content

Fig. 1

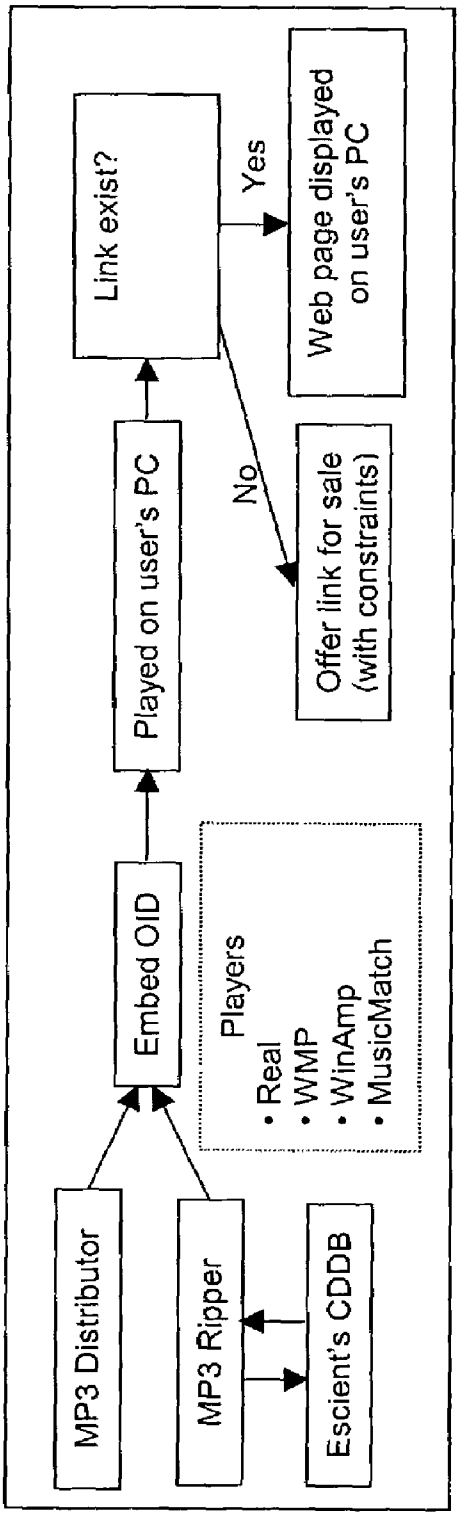

MP3 Distributor
MP3 Ripper
Escient's CDDB
Embed OID
Players
• Real
• WMP
• WinAmp
• MusicMatch
Played on user's PC
Link exist?
Yes
No
Web page displayed on user's PC
Offer link for sale (with constraints)

Fig. 2

FIG. 3

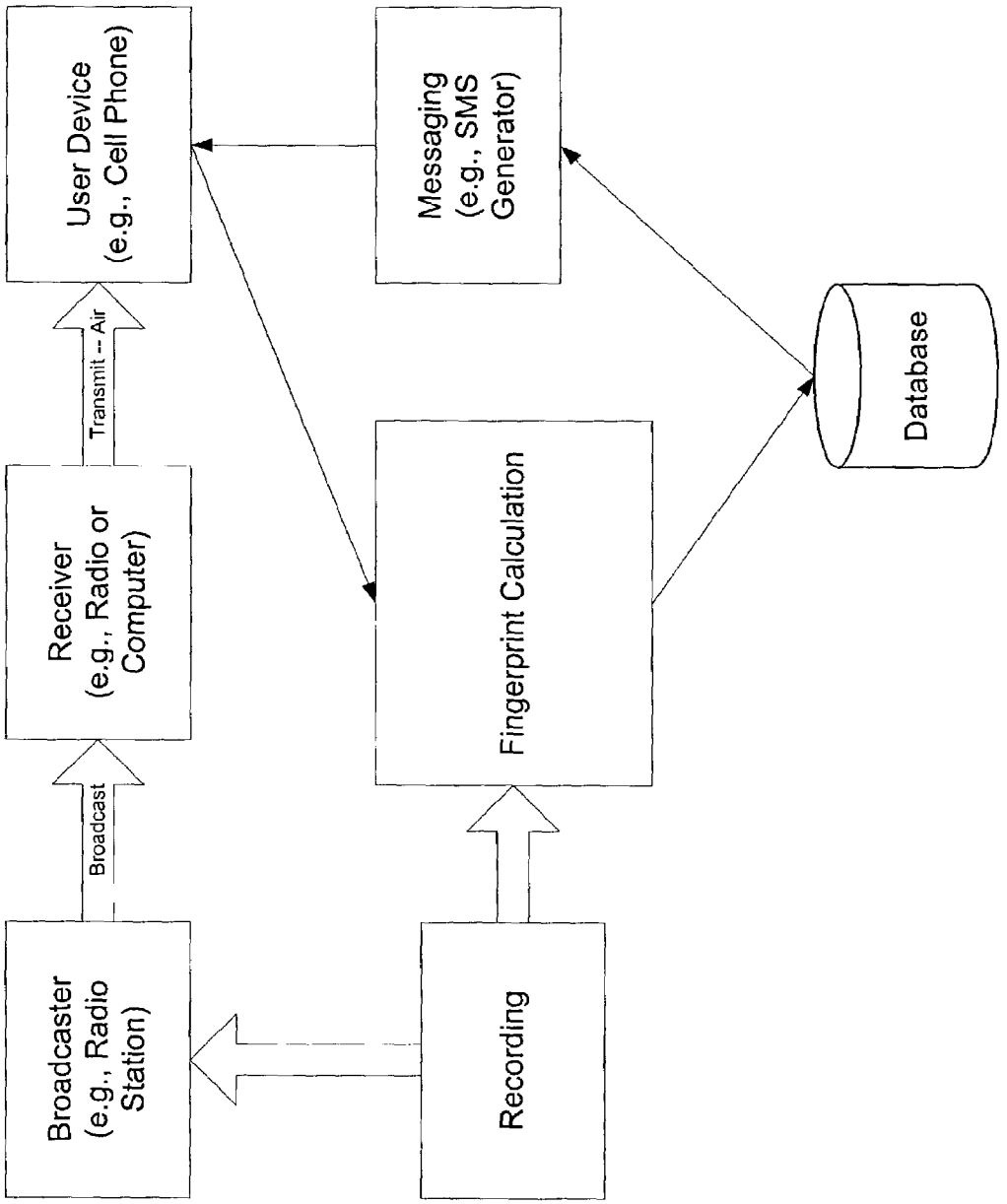
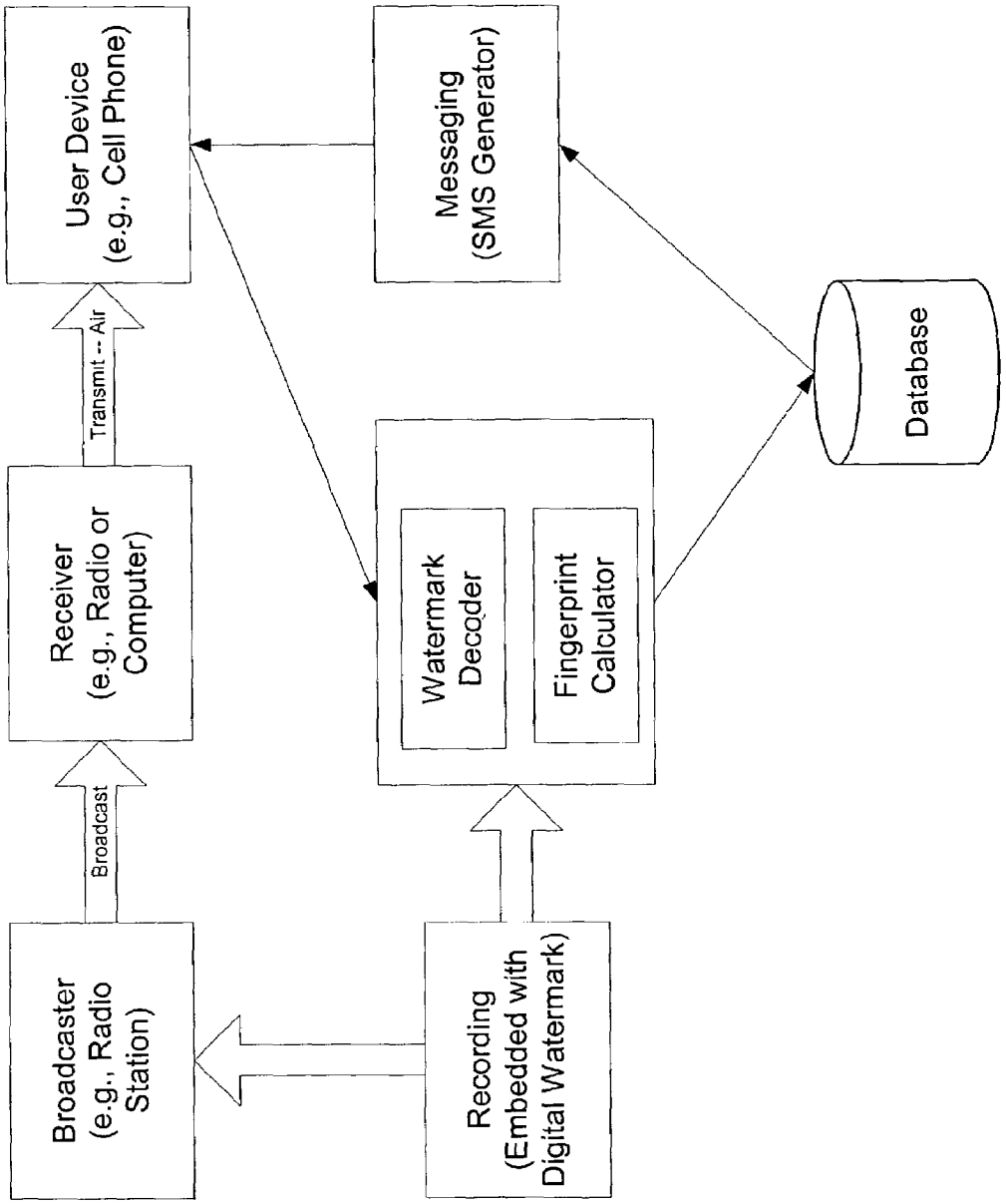

Broadcaster (e.g., Radio Station)
Broadcast
Receiver (e.g., Radio or Computer)
Transmit -- Air
User Device (e.g., Cell Phone)
Recording
Fingerprint Calculation
Messaging (e.g., SMS Generator)
Database

FIG. 4


Broadcaster (e.g., Radio Station)
Broadcast
Receiver (e.g., Radio or Computer)
Transmit -- Air
User Device (e.g., Cell Phone)
Recording (Embedded with Digital Watermark)
Watermark Decoder
Fingerprint Calculator
Messaging (SMS Generator)
Database

CONNECTED AUDIO AND OTHER MEDIA OBJECTS

RELATED APPLICATION DATA

The present patent application is a continuation in part of U.S. patent application Ser. No. 09/563,664, filed May 2, 2000, now U.S. Pat. No. 6,505,160. The present application is also a continuation in part of U.S. patent application Ser. No. 10/027,783, filed Dec. 19, 2001 (published as US 2002-0126872 A1), now U.S. Pat. No. 7,289,643, which claims the benefit of U.S. Provisional Application No. 60/263,490, filed Jan. 22, 2001. Each of these U.S. patent documents is herein incorporated by reference.

The present application si also related to the following U.S. Patent documents: U.S. patent application Ser. No. 09/476,686, filed Dec. 20,1999; U.S. Provisional Application No. 60/134,782, filed May 19, 1999; U.S. patent application Ser. No. 08/746,613 filed Nov. 12, 1996 (now U.S. Pat. No. 6,122,403); U.S. patent application Ser. No. 08/649,419, filed May 16, 1996 (now U.S. Pat. No. 5,862,260); PCT Application PCT/US96/06618, filed May 7, 1996; and U.S. patent application Ser. No. 081508,083, filed Jul. 27, 1995 (now U.S. Pat. No. 5,841,978). Each of these U.S. patent documetns is herein incorporated by reference.

The present patent application also claims the benefit of U.S. Provisional Patent Application Nos. 60/305,086, filed Jul. 12, 2001 and 60/351,565, filed Jan. 22, 2002. These provisional applications are herein incorporated by reference.

TECHNICAL FIELD

The present invention relates to linking audio and other multimedia data objects with metadata and actions via a communications network, e.g., computer, broadcast, wireless, etc.

BACKGROUND AND SUMMARY

Advances in computer and wireless networking, multimedia coding, and higher bandwidth communication links are creating many new ways to distribute and enjoy multimedia content, such as music and movies. Coding formats for audio like MPEG 1 Layer 3 (MP3) have already caused significant changes in music delivery to consumers. Despite the advances in technology, content distributors and broadcasters still need to address how to effectively promote and sell content.

This disclosure describes systems and processes for linking audio and other multimedia data objects with metadata and actions via a communication network, e.g., computer, broadcast, wireless, etc. Media objects are transformed into active, connected objects via identifiers embedded into them or their containers, or stored in a remote database based upon the content itself. These identifiers can be embedded by the owner or distributor of the media object, or automatically created from the media object itself. In the context of a user's playback experience, a decoding process extracts the identifier from a media object and possibly additional context information and forwards it to a server. The server, in turn, maps the identifier to an action, such as returning metadata, redirecting the request to one or more other servers, requesting information from another server to identify the media object, etc. If the identifier has no defined action, the server can respond with an option for the user to buy the link and control the resulting action for all objects with the current identifier. The linking process applies to broadcast objects as well as objects transmitted over networks in streaming and compressed file formats.

Further features will become even more apparent with reference to the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating examples of media object linking processes and systems.

FIG. **2** is a diagram illustrating media object linking applications.

FIG. **3** is a functional block diagram illustrating an audio identification system according one embodiment of the present invention.

FIG. **4** is a functional block diagram illustrating an audio identification system according to another embodiment of the present invention.

DETAILED DESCRIPTION

Linking Audio and Other Media Objects via Identifiers

The following sections describe systems and processes for linking audio and other media objects to metadata and actions via an identifier. For the sake of illustration, the disclosure focuses on a specific media type, namely audio signals (e.g., music, sound tracks of audio visual works, voice recordings, etc.). However, these systems, their components and processes apply to other types of media signals as well, including video, still images, graphical models, etc. As described further below, an identifier attached to an audio signal is used to connect that signal with metadata and/or programmatic or device actions. In the context of this document, the terms "media object" and "audio object" refer to an electronic form of a media signal and audio signal, respectively. The linking of media signals applies to objects that are transmitted over wire networks (such as a computer network), wireless networks (such as a wireless telephone network), and broadcast (AM, FM, digital broadcast, etc.).

There are a number of ways to associate an identifier with an audio object. One way to associate the identifier is to insert it in the form of a numeric or alphanumeric code (e.g., binary or M-ary code) in the electronic file in which the audio is stored. Another way to associate the identifier is to embed it as auxiliary data in the audio signal using steganographic methods, such as digital watermarking or other data hiding techniques. Yet another way is to derive the identifier from the audio signal, the table of contents, the file system structure, or its container (e.g., an electronic file or physical package for data like flash memory, Digital Versatile Disk (DVD), minidisk, or compact disk (CD). The physical media may have identifying characteristics, such as a unique identifier or encoded metadata, or other attributes from which an identifier can be derived (e.g., CD disk wobble).

When the identifier is associated with metadata or actions, it transforms the media object into a "linked" object. The identifier travels with the object through distribution, including in some cases, through physical distribution in packaged media and through electronic distribution (broadcast or network communication). The identifier may travel within the same band as the audio object, such as a watermark, or via a separate band, such as a file header or footer or separate broadcast band. A decoding device or programmatic process extracts the identifier from the object and uses it to retrieve related data or actions ("metadata"). In the case of an audio

object, like a song, the metadata typically includes the title, artist, lyrics, copyright owner, sound recording owner, information about buying or sampling opportunities and URLs to this type of data as well as web sites and other programs and devices. Linked actions include device or programmatic processes for electronically establishing a license, transferring content (either streaming or download), sending an email, recording marketing data about a transaction, etc. The identifier allows a fan of a particular type of music or artist to get more information about the music and to buy more music. From the perspective of the artists and record labels, the identifier provides an additional opportunity to promote their music and sell content, concert tickets, etc.

In addition, in some implementations where identifier-linking transactions are monitored, it enables the vendors of music to gather data about electronic transactions triggered by the link. For example, users of information may choose to provide information about them when they register their decoding device or software with the system. A user ID or other context information may then be recorded when the identifier is extracted and used to trigger a transaction. Many entities involved in the distribution of media signals can benefit from the linking capability. Artists can link their music to information about themselves and provide electronic buying opportunities for music, concert tickets, clothing, etc. Rights holding organizations can use the link to inform users about them and licensing opportunities. In some cases, the link may also be used to monitor playing and distribution of copies of the music. Record labels can link their music to information about the artist, the label, electronic buying opportunities, etc. Electronic retailers can increase sales by linking users to opportunities to sample and buy additional music (via download or streaming delivery over a wire or wireless network). Conventional brick and mortar retailers can use linking to provide information about the music and to provide buying opportunities. Radio stations and other broadcasters can use the linking capability to bring users to their web sites, creating advertising revenue, to provide electronic buying opportunities for music, concert tickets, clothing items, etc. These and other forms of linked metadata and actions may be implemented in various combinations in different application scenarios.

Depending on the application, the identifier may identify the media object in which it is embedded, or entities, things or actions other than that particular media object. One type of identifier is an object ID that identifies an audio object. This identifier may be a number associated with the object, such as its International Standard Recording Code (ISRC). Another type of identifier is distributor ID that identifies the distributor of the audio object. Another type of identifier is a broadcaster ID that identifiers the broadcaster of the audio object. Of course, more than one identifier may be encoded into an audio object or its container. In the event that an object ID is not encoded with an audio object, but instead, a distributor or broadcaster identifier is encoded with the object, other context information, such as the time of play back or distribution, location of distribution, etc. may be used to identify the audio object as part of the linking process. An example is a radio station that marks its broadcasts with a station ID and maintains a playlist database with the air times of each audio object. At decoding time, the station ID is extracted and used along with context information such as the air time of the audio object to look up the audio object or its corresponding metadata and actions. This approach enables the linking system to provide audio object specific metadata or actions even without requiring a unique object identifier in every audio object.

System Implementation

FIG. **1** is a diagram of a system configuration of linked media objects. In this configuration, an identifier links audio objects to metadata via an electronic network, such as the Internet, a wireless network, or a broadcast network. As depicted in FIG. **1**, an embedding process may be used to encode an identifier in an audio object or its container. In some cases, an embedding process encodes the identifier in the audio file (e.g., a tag in a file header or footer), in the audio signal (a digital watermark), or in the physical packaging. The identifier may also be derived as a function of the audio signal or other information in the file or physical packaging (e.g., track information on a CD). In the case of dynamically derived identifiers, an embedding process is not necessary because the identifier can be derived from the content at decoding time.

In some application scenarios, the embedding process interacts with a registration process to get an identifier. The embedding process provides information about the object (e.g., a title and artist name, an ISRC, name of distributor, etc.). In response, the registration process provides an identifier and stores a database record of the association between identifier and the object or other information used in decoding to identify the object, such as its distributor or broadcaster. The registration process may be used to assign an identifier to an audio object and to distributors or broadcasters of audio objects. The embedding and registration processes may occur before the audio object is distributed to consumers, or sometime thereafter, such as when a user transfers (e.g., "rips") a media object from one format to another (e.g., a packaged format to an electronic file format such as a compressed file format).

Once registered, an interactive or automated mapping process associates the identifier with data or actions. The registration process creates a database of identifiers and associates the identifiers with corresponding media objects, distributors, broadcasters, etc. The mapping process associates the identifiers with corresponding metadata or actions.

Once associated with an audio object and metadata, the identifier transforms the audio object into a linked object. The identifier remains with the object through distribution, although some embedding processes are more robust than others to intentional or unintentional distortion/removal of the identifier. There are a variety of different distribution scenarios. Some examples depicted in FIG. **1** include transferring an audio object over a computer network, streaming the object over a computer network, or broadcasting it (e.g., AM/FM broadcasting, digital broadcasting, broadcasting over wireless carriers, etc.). Whatever the distribution process, a user ultimately receives the linked object in a player, tuner, or capture device.

To activate the linked object, a decoding process extracts the identifier and uses it to access associated data or actions. The decoding process may be implemented as a separate program or device, or integrated into a player, tuner, or some other capture device, such as a listening devices that converts ambient audio waves to an electronic signal and then extracts the identifier from the signal.

In the configuration shown in FIG. **1**, the decoding process forwards the extracted identifier to a communication application, which in turn, forwards it in a message to a server. The decoding process or the communication application may add additional context information to the message sent to the to a server. The context information may relate to the user, the user's device, the attributes of the session (time of playback, format of playback, type of distribution (e.g., broadcast or transmitted audio file), etc.) Based on identifier and optional

context information, the server determines an associated action to perform, such as re-directing an identifier or context data to another server, returning metadata (including programs, content, etc.), downloading content, logging a transaction record. To find the associated action or actions, the server maps the identifier to actions based on the information established in the mapping process. The server may: 1) look up the data and actions in a local database stored in its memory subsystem; 2) route the identifier to one or more other servers via the network, which in turn look up related actions and data associated with the identifier; or 3) perform some combination of actions 1 and 2.

In the first case, server **1** returns data or actions associated with the identifier. The server may look up related data based on the identifier alone, or based on the identifier and other context information. Context information may be information provided by the user, by the user's computer or device, or by some other process or device. In the second case, the server looks up one or more addresses associated with the identifier and forwards the identifier and/or possibly other context data to secondary servers at these addresses via conventional networking protocols. Again, this context data may include data from the user, the user's computer, some other device or database. For example, server **1** might query a remote database for instructions about how to process an identifier. These instructions may specify data to return to the communication application or to forward to another server, which in turn, looks up associated data and returns it to the communication application. A server may return data that an audio player displays to the user or uses to control rendering of the content. For example, the server can tell the player that the object contains inappropriate content for children. The player or user can make decisions about whether or how to play the material based on this information.

Both the server and the player can adopt a set of rules. The server rules may be used to control what the server returns in response to an identifier and context data. The player rules may be used to control what the player displays to the user or how it renders the content based on data returned from a server.

Either the first server, or a server one or more levels of indirection from the identifier may return data and programmatic actions to a player via the communication application. Each server in these levels of indirection receives a database key, such as an identifier or context information, from the previous server, and uses it to look up corresponding actions. These actions may include returning data or programs to the communication application or to previous servers in the routing path of the message from the communication application. Also, the servers may route requests for information or actions to other servers. The server or servers may return data or perform actions in response to the identifier (or other context data) that do not directly impact the decoding process, or the device in which it operates.

The system depicted in FIG. **1** allows several different interested parties to establish services linked via the identifier. For example, server **1** can be configured to provide generic promotional and/or licensing information associated with an identifier. If the content owner, distributor, retailer, artist or other related party wishes to provide information or services for a connected object, then server **1** may also route the identifier for that object, and possibly context information, the address of the communication application, and instructions, to servers maintained by these entities. These servers, in turn, provide promotional, sales, or licensing information, and electronic buying or licensing opportunities specific to that entity back to the consumer over the network via the communication application.

In the context of a network configuration, Internet protocols may be used to return data to the communication application or to the device or system in which it operates. The communication application may be implemented in a web browser, such as Internet Explorer or Netscape Navigator. Examples of ways of exchanging information between a client player and a server include returning a web page with metadata and program scripts designed to run on the end user's system. The metadata itself may include active links, such as URLs to other network resources, such as a web site or some other network service. The path of the identifier from the decoding process, and the return path from a server to the communication application may include one or more hops through a wire or wireless connection using standard wire and wireless communication protocols like TCP/IP, HTTP, XML, WAP, Bluetooth, etc. In addition, data returned to the user may be routed through one or more servers that may forward the data, and in some cases, augment the data or modify it in some fashion.

FIG. **2** is a diagram illustrating applications of the system depicted in FIG. **1**. In the application scenarios depicted in FIG. **2**, an embedding process encodes an object identifier (OID) into an audio file, such as an ID3 tag in the header of an MP3 file or audio frame headers in the MP3 file. FIG. **2** shows two embedding scenarios. The first is an MP3 distributor that embeds OIDs in MP3 files before transmitting them over a network, such as the Internet, typically via a web site interface. The second is a file ripping process where a programmed computer or other device extracts an audio object from packaged media such as a CD and converts it into a coded file format like MP3. In the latter case, the ripping process may extract metadata from the CD, such as the table of contents, and use this metadata as a key to a database (CDDB) to get information about the songs on the CD, such as title, artists, etc. The table of contents or other metadata from a package medium, such as optical or magnetic storage or flash memory, may be hashed into an index to a database entry that stores information about the media signal stored on the medium. The ripping process uses the information returned from the database to identify the audio objects on the packaged media so that they can be associated with an OID. This is an example of identifying information used to associate an OID with an audio object. As part of the coding process, the ripping process inserts the OID in the file header of the MP3 file.

Later, when a user opens or plays the marked MP3 in a player, such as a software player like the real player, Liquid Audio player, Windows Media Player (WMP), WinAmp, MusicMatch, etc., a plug-in software module in the player extracts the OID and forwards it to a server via an Internet connection. The plug-in may establish its own Internet connection, or pass the OID to an Internet Browser, which in turn, establishes a connection (if one is not already present) with the server. As an intermediate step, the plug-in may display a window with user options, such as "learn more about the song", "play the song", or both. The user can then choose to get more information by actuating the first or third options in the user interface window, which cause the plug-in to forward the OID to the server.

The server then returns a web page associated with the OID, or re-directs the OID to another server (e.g., one maintained by the content distributor or owner), which in turn, returns a web page of information about the object and links to related actions (e.g., a link to a licensing server, a link to a server for buying and downloading related music etc.). The

licensing server may be programmed to download software players and new music offerings compatible with those players. For instance, the licensing server may provide software for decrypting, decoding, and playing electronically distributed music according to usage rules packaged with the electronically distributed music. In this application scenario, the linking of the MP3 file enables the content owner to market music and products that promote the sale of audio objects in other formats, included formats protected with encryption, watermark copy managements schemes, etc.

In the event that a media object is not linked, the decoding and server processes can be programmed to enable the user to purchase a link for the object. For example in one scenario, the player plug-in displays a graphic for a link information indicating that the link is available after determining that an OID is not in the file. If the user clicks on the graphic, the plug-in displays more information about the procedure for purchasing or renting a link. This information may be provided in conjunction with querying the server and displaying information returned from the server, or alternatively, providing pre-programmed information incorporated into the plug-in. If the user is interested in purchasing the link, he or she can then enter input (e.g., click on a button such as "Get Link") that initiates the process of registering an OIL) with the object and associating metadata or actions with the OID. The process of registering the OID and associating the OID with metadata or actions may be performed as described in this document. This scenario provides yet another mechanism for transforming content into connected content.

There are many possible variations to the applications scenarios illustrated in FIG. **2**. During the file ripping process (or some other embedding process), the embedder may generate a unique ID from the metadata read from the packaged media on which the media object resides. One example of such an ID is the number derived from CD metadata currently used to index information in the CDDB database. This ID may then be embedded in the audio object or its file header/footer. During OID registration, the registration process may inform the embedding process that the OID (and thus, the object for which it was derived) has not been associated with metadata or actions. In this case, the user may be given an opportunity to purchase the link, either at the time of ripping, or in the future, wherever the object travels. In the latter case, the OID in the object is associated with an option to buy the link and customize the data and/or actions associated with that link. Rather than link to promotional information, the OID gives users an option to buy or rent the link and provides them with an opportunity to customize it (e.g., linking it to a custom web site). Once customized, other users that open or play the file will then be able to link to the customized information or actions.

To assert control over the type of customization that users may perform, the registration and mapping processes can place constraints on the types of metadata and actions that users can link to a media object.

In the multimedia content industry, there are typically many rights holders and entities involved in the distribution process. This may present a conflict when linking a media object to one entity. One way to address this problem is have an object link to many different entities. For example, the server could map an OID to many entities and return links to retailers, distributors, record labels and artists. Another way to address it is to encode additional information about the distributor in the OID. For example, the OID includes fields that identify the object and its distributor. If a user activates the link to purchase products, including media objects, then the distributor name is logged with the purchase and that distributor is credited with royalties associated with the transaction. The distributor field may also be used as a key to look up the appropriate action for the OID, such as re-directing the OID to the web server of the entity associated with that OID. In this approach, even if the OID directs a user to a record label's website, the distributor field can be used to credit the distributor with a royalty for the linking transaction.

The entity responsible for maintaining a web site linked via on identifier can make deals with online resources for providing data about a media object such as lyrics, song titles, radio station play lists. The website may link to this information; access it via a database manager, etc.

File Identifiers

One form of identifier is an identifier that is inserted in an audio object file, but in a distinct field from the audio signal itself. Some examples are file headers and footers. This file identifier may be assigned before or after distribution of the audio object to consumers. In addition, it may be derived from the audio signal or other information in the file. For example, an identifier generator may derive a unique or sufficiently unique identifier from a portion of a music signal. A variety of methods for generating a unique numbers based on a unique collection of numbers may be used.

The process of embedding a file identifier may be done at the time of encoding or transcoding a file. For example, the file identifier may be inserted during a ripping process, such as when a device or programmatic process converts a song from a format stored on packaged media, like a CD or DVD, to an electronic, and compressed form, such as MP3 or some other audio codec. As another example, the file identifier may be inserted when a device or programmatic process transcodes an electronic music file from one codec format to another. Yet another example is where a file is taken from a digital or analog uncompressed format, and placed in another format for distribution.

Identifiers Embedded in Audio Signal

Another way to associate an identifier with an audio signal is to embed the identifier in the audio signal using steganographic methods, such as digital watermarking or other data hiding techniques. Many of such techniques have been developed and are described in published articles and parents. Watermarking methods are described in U.S. patent application Ser. No. 09/503,881 (now U.S. Pat. No. 6,614,914). Other examples of methods for encoding and decoding auxiliary signals into audio signals include U.S. Pat. Nos. 5,862,260, 5,940,135 and 5,945,932. For more information on steganographic applications, see the patent documents incorporated herein by reference.

The steganographic embedding method may be performed in a batch process. Consider a distributor of electronic music via the Internet or some other network, or a broadcaster of music such as a radio station. In each case, the distributor and broadcaster have a collection of audio objects. The embedding process may operate on this collection of objects in a batch process by retrieving an electronic version, encoding an identifier obtained from the registration process, and returning the marked version for later distribution or broadcasting. In some cases, it is desirable to do watermark embedding in an iterative process in a studio environment to encode the watermark with an intensity that achieves desired perceptibility and robustness requirements.

The steganographic embedding method may also be performed at the time of transmission of an electronic file or broadcast of the audio object. In the case of distribution via a network such as the Internet (e.g., streaming or file download), real time embedding enables the embedding process to

also embed context information that is specific to the consumer (or the consumer's computer) that has electronically ordered the object. For example, when the user requests a file in a streaming or a compressed file format via the Internet using her browser, the distributor's server can request information (perhaps voluntary) about the user to be associated with the transmitted object. Later, the decoding process or the servers that map the identifier to actions or metadata can use this information to determine the types of information to provide or responsive action to perform.

In the case of broadcasting, real time embedding enables the identifier to be steganographically embedded throughout an electronic version of the audio signal just before, or as part of the broadcasting process.

An object or distributor ID (as well as other identifiers or context information) can be embedded in the payload of a watermark that is also used for copy control. Portion of the watermark can be used to control whether the object can be played, transferred, recorded, etc., while another part can be used to carry identifiers and other metadata for linking functions described in this document. Alternatively, entirely separate watermark encoding and decoding methods may be used for copy control and linking functions.

A watermarking process may be used to encode different watermarks in the various channels of an audio signal. Message information may be embedded in one or more channels, while synchronization or orientation signals used to detect and decode the message information may be encoded in other channels. Also, different messages (e.g., different identifiers) may be encoded in different channels. At decoding time, the different identifiers can trigger different actions or link to different data.

In broadcasting applications, an identifier may be encoded along with the broadcast of the associated media signal by modulating a subcarrier of the main carrier frequency used to transmit the media signal. The subcarrier conveys auxiliary data such as the identifier, while the main carrier conveys the associated media signal. To reduce audibility of the auxiliary data (e.g., the identifier(s)) encoded in the sub-carrier, the data can be randomized by applying it to a pseudorandom or random number by some function that may be inverted in the decoding process, e.g., multiplication or exclusive OR functions. One example of sub-carrier encoding and decoding is Active HSDS 97 developed by Seiko Corporation.

Identifiers in Digital Radio Broadcasts

Some forms of digital radio broadcasts support transmission of metadata along with media signals. This metadata can also be used to carry one or more identifiers that are mapped to metadata or actions. The metadata can be encoded at the time of broadcast or prior to broadcasting. Decoding of the identifier may be performed at the digital receiver. In particular, the digital receiver receives the broadcast data, extracts the identifier, and either automatically, or at the user's direction, forwards the identifier to a server to look up the associated metadata or action.

Dynamic Identifier Extraction from Audio Content or Related Data

As noted above, another way to associate an identifier with a corresponding audio signal is to derive the identifier from the signal itself. This approach has an advantage in that the embedding process is unnecessary. Instead, the decoding process generates the identifier from the audio object. A decoder computes a fingerprint of an audio signal based on a specified fingerprinting algorithm. The fingerprint is a number derived from a digital audio signal itself that serves as a statistically unique identifier of that signal, meaning that there is a high probability that the fingerprint was derived from the audio signal in question. One component of a fingerprint algorithm is a hash algorithm. The hash algorithm may be applied to a selected portion of a music file (e.g., the first 10 seconds) to create a fingerprint. It may be applied to discrete samples in this portion, or to attributes that are less sensitive to typical audio processing. Examples of less sensitive attributes include most significant bits of audio samples or a low pass filtered version of the portion. Examples of hashing algorithms include MD5, MD2, SHA, and SHA1. Of course there are many other hashing algorithms that may be suitably interchanged with this aspect of the present invention.

As an aside, fingerprinting may also be used to determine whether an audio signal has been watermarked. The fingerprinting application can evaluate a fingerprint for a received object and compare it with one for a watermarked object (or unmarked object) to determine whether the object is likely to be watermarked. Certain fingerprints can be associated with certain types of watermark methods. Using the fingerprint, a decoding device can select an appropriate watermark decoding system for the object.

While specifically discussed in the context of audio objects, the fingerprinting process applies to other types of multimedia content as well, including still images, video, graphics models, etc. For still images and video, the identifier can be derived dynamically from a compressed or uncompressed version of the image or video signal. The fingerprinting process may be tuned to generate a specific identifier based on the type of file format. For example, the process extracts the file format from the file (e.g., from a header or footer), and then uses a fingerprinting process tailored for that type of file (e.g., a hash of a compressed image or video frame). The dynamic identifier computed by this process may be associated with metadata and/or actions using the processes and systems described in this document.

Now consider fingerprinting in relation to FIG. **3**. A record label (or other producing entity) produces an audio recording (e.g., a song or message). The audio recording (or copies of such) is provided to a broadcaster, such as a radio station or internet broadcaster. The broadcaster broadcasts the audio recording, which is picked up by a receiver or tuner (e.g., in a car radio, personal receiver, business or home radio, computer, etc.). The receiver (e.g., radio or computer) outputs an audio signal corresponding to the audio recording, e.g., through a speaker. A cell phone (or other user device, such as a mobile or handheld device) captures the audio signal and communicates the signal, or a portion of the signal, to a fingerprint calculation server. The fingerprint calculation server calculates a fingerprint of the audio signal. The calculated fingerprint is used to identify the corresponding audio recording (or a related audio signal or metadata) in a database. For example, the database is interrogated with the fingerprint to identify information indexed or otherwise associated with the fingerprint. Of course the database can be local or remotely located with respect to the fingerprint calculator. The database can be originally populated by generating fingerprints of songs or other audio recordings, and then associating in the database metadata (or other audio recordings, etc.) with the fingerprints. While the fingerprint calculator of FIG. **3** is illustrated as receiving input from both the recording and user device, we note that the fingerprint calculator can be distributed as well. A fingerprint can be based on a portion of an audio recording, or based on the entire audio recording. Accordingly, an audio recording may have a plurality of fingerprints associated with it. Metadata can be linked in the database to the fingerprint, the audio recording, or to a song identifier. A fingerprint of the audio signal is compared

against the fingerprints in the database to find a match or a closest approximation. In some implementations, a fingerprint is used to find a set of potential matches.

In an alternative implementation, a fingerprint is calculated by the user device (e.g., cell phone). Once calculated, the user device communicates the fingerprint to the database to identify related information (e.g., metadata, purchase information, etc.). In another alternative implementation, the fingerprint calculation is divided between the fingerprint server and the user device. For example, the fingerprint is partially computed by the user device, and then completed by the server. Preferably, this fingerprint calculation "split" is accomplished so that the user device can send minimal data to the server. This scheme may also help in reducing the computationally complex circuitry needed in the user device to compute a complete fingerprint. In one implementation, the user device computes the least computationally intensive part of the fingerprint algorithm—which should still provide a transmission data reduction. An example of this implementation involves sending to the server only every other two most significant bits, or sending every third or so most significant bit.

Once the audio signal is identified, information related to the subject audio recording can be communicated to the user's device via a text, voice or alphanumeric messaging service, e.g., a short messaging network ("SMN"), short messaging service ("SMS"), alphanumeric messaging, multimedia messaging system (MMS), etc. The information can include artist, album, song title, and/or purchase and delivery options. In one embodiment, the user preferably uses this information and system to: buy, sample, download or e-mail the song to a predetermined computer, obtain CD sales information, obtain information about the song or artist, obtain options to save the CD or song to a personal archive on a website, obtain concert tour info of the identified artist, gather artist background information and fan club information, obtain a download of the identified song to the phone or attached media player or PC, provide song samples or alternative music title suggestions, and/or provide consumer response reporting, etc., etc. Once obtained, the audio recording information can be saved, communicated to a cell phone or user device or communicated to a computer (e.g., the user's home computer), etc. The fingerprint calculator, music database and message generator are preferably maintained within the wireless operator's network. Of course the illustrated modules, or a set of the modules, may reside outside the operator's network, but remain accessible through various communication channels.

Watermarking and Fingerprinting

Digital watermarking and fingerprinting techniques can be combined to provide an enhanced and efficient audio and/or video identification system. A digital watermark is embedded in an audio signal. The watermark preferably includes a unique identifier. The identifier can be used to narrow a search, e.g., by identifying a specific database, a library, or a set of records (e.g., audio recordings or metadata) associated with the identifier. For example, the identifier may identify a database containing songs from Record Label X, or songs that have recently been broadcast (e.g., the last 2–60 minutes). Or the identifier can uniquely identify a song, an album, an artist, etc. A fingerprint is then calculated from the audio signal and compared against the subset of songs determined by the watermark identifier.

To illustrate, consider the system shown in FIG. **4**. A communications device (e.g., user device) communicates an audio signal to a server. The audio signal preferably includes data steganographically embedded therein, e.g., in the form of a digital watermark. The data includes a unique identifier. The server includes a digital watermark decoder. The decoder decodes the digital watermark to obtain the unique identifier. The server preferably includes (or communicates with) a fingerprint calculator. The calculator generates a fingerprint of the audio signal (or a portion thereof). The unique identifier is used to identify a corresponding database, library or data record set. The identified database (or library, etc.) can correspond to a record label, artist, album, music genre, etc. The calculated fingerprint is used to identify a corresponding song from the songs in the selected database (or library or data record set). Additional information can be stored in the database according to each song identifier (or fingerprint). Thus, the unique identifier is used to narrow the universe of possible fingerprints by locating a specific database, library, data record, etc., while the fingerprint is used to identify additional (or related) information within the narrowed universe. This additional information can be conveyed to the communications device. (While the watermark detector and fingerprint calculator of FIG. **4** is illustrated as receiving input from both the recording and user device, we note that the watermark detector and fingerprint calculator can be distributed as well.).

The additional information alternatively can be conveyed to a personal area of a website, for access by the user. Still further, the additional information can be sent to the user's e-mail account, or added to the user's online "favorite" play list. The additional information can also be stored for later streaming or sent to the user's home or office computer media system.

The system is elegant. A consumer obtains easy and instant access to related information and, as an optional business model, can be charged for the voice call and a premium for the informational SMS. Consider the efficiency provided by the use of both watermarks and fingerprints. Computation time can be reduced, data storage can be minimized and consumer feedback can be enhanced.

We note that a digital watermark may also include a so-called orientation or synchronization component. An orientation component is helpful in resolving signal distortion. The orientation signal can be used in properly restore an audio signal to a base form so that a fingerprint generated from the base form will correspond to an originally generated fingerprint. Otherwise, signal distortion or a synchronization may skew the fingerprinting algorithm. Instead of restoring a signal to a base state, clues from the orientation signal can be used to tweak the fingerprinting algorithm to account for image distortion. In some cases the orientation component helps adjust an audio signal's time scale. In other implementations, the orientation component is used in conjunction with additional data, such as copy control information (e.g. copy never, copy no more, copy once, copy freely) or distributor ID to achieve a proper fingerprint calculation. Analogous techniques are disclosed in parent application Nos. 60/257,822 10/027,783 (published as US 2002-0126872 A1) and 60/351,565. Each of these patent documents is herein incorporated by reference. In still other implementations, the digital watermark includes a cue signal indicating a correct time (or time window) for calculating a single fingerprint or multiple sub-fingerprints. The sub-fingerprints when combined can identify the audio.

Registration Process

One way to implement a registration process is to build client and server application programs that communicate over a computer network using standard network communication protocols. The client may be implemented as a software pro-

gram that provides identifying information about an audio object. It can obtain the information by prompting the user for the identifying information, or from extracting it from the audio object or its container. The server may be implemented as a database management program that manages identifiers and corresponding audio objects. When queried to provide an identifier for particular identifying information, the program checks whether it has already assigned an identifier to an object based on the identifying information. If so, it returns that identifier that has already been assigned. If not, it assigns a new identifier number, creates a new entry in the database for that number and its associated identifying information.

The type of identifier used to link audio objects varies with the application. As such, the registration process may vary as well. One type of identifier is a unique identifier for an audio object. Another type of identifier is one that identifies some attribute of the audio object, but does not uniquely identify it, such as a distributor or broadcaster identifier. This type of identifier requires additional context information to uniquely identify the audio object at the time of linking it to actions or metadata. For these types of identifiers, the registration process provides information identifying the attribute of the audio object, such as its distributor or broadcaster. In response, the server provides an identifier that may be embedded in several audio objects that share that attribute.

One example is a broadcaster ID, such as a radio station ID. Audio broadcast by the radio station is embedded (e.g., in the form of a digital watermark) with this radio station ID. To identify the object, context information such as the play time captured at the tuner is used along with the radio station ID extracted from the received audio signal to identify the audio object. The decoding process forwards this information to a server. Using the radio station ID and context information, the server maps the ID to an appropriate action. This may include querying a radio station's playlist database for an object identifier based on the station ID and context information. The server can then map the object identifier to an action or metadata based on the object ID returned from the playlist database. Other scenarios are possible. For example, the server could forward the station ID, context data and decoder address to a radio station server, which in turn, looks up the appropriate action or metadata (e.g., web page) and sends it to the device that decoded the station ID.

Broadcast content can also be associated with object identifiers. One way to implement the identifier assignment process is to allocate a unique set of identifiers with each broadcaster/distributor. Those broadcasters or distributors are then free to assign the identifiers to media objects as they wish. Once they complete the identifier assignment process, they may then associate the identifiers with the metadata or actions in a mapping process.

Embedding Process

The embedding process may be integrated into a software program along with the client of the registration process described in the previous section. This integration of registration and embedding functions is particularly suited to a batch embedder, where processing time required to request an identifier is less of a concern.

In real time embedding, the identifier or identifiers are preferably available for associated audio objects before embedding begins. For example, the identifiers can be maintained in a local database on the embedding computer or device and indexed by object title. Distributor and broadcast identifiers are more straightforward because they may be applied to several different audio objects.

The embedding process may also be implemented in an embedding clearinghouse system. The embedding clearinghouse is a computer or other electronic system that analyzes media objects and embeds one or more links in the media objects. The clearinghouse may be implemented in a server on a network, such as the Internet and operate on content in a "push," "pull," or some combination of push and pull models. In the push model, users and other systems send media objects to the embedding clearinghouse for analysis and embedding. The pull model, the clearinghouse has the capability to search for and gather media objects for embedding and analysis. One example of this pull model is an Internet search process called a spider that crawls the Internet, searching for media objects to analyze and embed with one or more identifying links.

The embedding clearinghouse analyzes a media object (perhaps based on out of band data like a file header or footer) and inserts an identifier. This identifier may link to a metadata and actions, such as re-direction to a web site offering products, services, and information related to the content. The embedding clearinghouse may incorporate search engine technology to execute a key word search based on information from the media object and then associate the media object with a series of related URLs returned from the Internet search. The process may be automatic, or with some user input to select which sub-set of links should be inserted.

The embedding clearinghouse may also offer an identifier embedding services for those wanting to link their media objects with metadata, actions, etc. In this application scenario, the embedding clearinghouse may be implemented as an Internet server that is accessible via a web page using conventional network communication and web protocols. To access the server, users visit a web page using an Internet browser. In exchange for a fee, which may be tendered electronically over the Internet from the user's computer to the server, the server provides an embedding service to embed an identifier into a media object uploaded from the user via the user's computer and Internet connection. The user can select the information to associate with a media object, such as generic identifying information (e.g., title, author, owner), generic licensing information, or special information or actions. The generic information is hosted by the provider of the embedding clearinghouse server, while the special purpose information and actions are accessed through re-direction. In particular, the provider of the clearinghouse server links the embedded identifier to an address or set of addresses of servers that provide the special information or actions. Then at decoding time, the decoding process sends the identifier to the provider's server, which in turn, redirects the identifier to a secondary server or servers that provide special purpose information or actions (e.g., redirect to a web page of the content owner, download related content, provide electronic licensing services, etc.).

Decoding the ID and Embedded Context Data

The implementation details of the decoding process depend on how the identifier is encoded into an audio object or its container. In the case where the identifier is encoded in a file header or footer, the decoder may be a software program or digital hardware that parses the header/footer and forwards it to the communication application. One way to implement this type of decoder is to integrate it into a media player as a plug in program. Examples of media players include Windows Media Player from Microsoft, Liquid Audio player from Liquid Audio, Winamp, RealPlayer from Real Networks, or a system from PacketNetworks designed specifically for cell phones. Preferably, the plug-in gives the user

visual feedback that the identifier has been detected and displays a window with options to access more information or actions available via the link. For example, the user can be presented with a user interfaces prompting the user to click for more formation or buying opportunities. If the user selects these options, the plug-in forwards the user selections and identifier to the communication application, which forwards them to the server (e.g., server **1**, FIG. **1**).

In the case where the identifier is steganographically encoded in the audio object, a corresponding decoder extracts the identifier. This type of decoder may be implemented as a plug in to a software player as described in the previous paragraph. It may also be implemented in a tuner for broadcast content, or in a listening device that captures audio from the ambient environment.

In the case where the identifier is derived from the content or container metadata, the decoder captures the pertinent portion of the audio object, and generates the identifier as described above. This type of decoder can be implemented in a software or hardware player, a tuner, etc.

The decoder may collect identifiers in response to a user request while objects containing these identifiers are being played. For example, when the user is playing music, he may like a song and want to buy it or get more information. This feature may be implemented by building an interface that has a button or voice recognition that enables the user to request information or a buy/license opportunity. Once captured, identifiers can be forwarded along with user instructions to the appropriate server.

However, one particularly useful feature is to enable the user to fetch information and make orders from music as the music is playing. The systems described previously supports this feature because the communications and/or decoding processes can forward an identifier or identifiers, embedded context information, fingerprints, an audio sample, or additional context information (user information, play time, broadcast type, file type, player type, operating system type) to the communication application or server as the music is playing. The user can trigger the linking action by pressing a "fetch" button, or saying fetch to a voice activated input device that causes the decoding device to package a message and invoke the communication application (e.g., Internet browser). In turn, the communication application forwards the message to a server that parses the message and determines the associated action.

In one implementation, the fetch command operates much like "clicking" a hyperlink on a web page. For example, the user may enable her fetch command to obtain more information about a song. The enabled fetch command then seeks out more details on that information, such as similar songs or purchase information for the CD. Adding a "back" browser-like command, which can return the user to a previous web page or link, and a "home" browser-like command, which can return a user to a predetermined web page, enhances this type of browsing. These addition commands allow for navigating the meta-data about the song in a simplified fashion on a mobile device.

The activation of the "fetch" feature may be made on a handheld device that communicates with a decoding device in a tuner via a wireless connection. For example, a user may press a button on a remote control device, like a key chain, which sends a wireless signal to a receiver in the tuner. The receiver invokes the decoding process. The tuner may also send metadata from the server to the remote control device for display using a similar wireless connection. Infrared or RF transceivers, for example, may be used to communicate the data back and forth.

The decoding device may also provide continuous decoding of identifiers. When the user requests a "fetch," the identifier and context information for the current song may be forwarded to the server. Also, the decoding device may automatically fetch generic information such as song title and artist so that this information is immediately available to the user.

Another possible implementation is to temporarily buffer identifiers extracted from some predetermined number of the most recent songs, titles, etc. These identifiers can be stored along with other metadata, such as a time stamp, to inform the user when they were captured. The user can then select one or more of the items to send to the server for more information or related actions.

These features may be implemented in one or more devices. While the example above discusses a remote control device and a separate tuner with a decoder, these functions may be integrated into a single device, such as a car stereo, phone handset, personal digital assistant, and a variety of other types of players or tuners.

The identifier enables dynamic linking. Dynamic linking enables the identifier encoded with a media object to remain fixed, while the metadata or actions associated with that identifier can be changed. To change the associated metadata, the mapping process edits the identifier database to associate new metadata or actions with an identifier. The mapping process can be automated to change metadata or actions associated with an identifier at periodic intervals or in response to system events. In addition, a user may change the associated metadata or actions interactively at any time. To facilitate access to the database, a web-based interface can be added to the database.

Dynamically linked data returned from a server to a player environment can be displayed to the user in a variety of ways. One way is to display it in a web page or user interface window of a player. The data can be animated by scrolling it across the visual display. The data can also be displayed in the form of HTML links, which, when activated, cause the download of other data or initiate actions, such as playing streaming content from a server.

Server Types

As discussed elsewhere, the servers used to link identifiers to actions may be programmed to provide a variety of actions including:

- returning data and HTML links (e.g., in the form of an HTML document, scripts, etc.)
- downloading media signals in streaming or file format
- performing an electronic transaction (selling products like CDs, DVDs, concert tickets, etc. via computer transaction using credit cards, digital money, etc.)
- establishing a license to use a linked media object
- re-directing to another server
- performing database look up operations for related information, links, actions
- performing database look up to uniquely identify a media object based on distributor/broadcaster ID and other context information
- creating a transaction log

This is by no means in exhaustive list. Another type of server action is to initiate a process of searching a database, a collection of databases or the internet for additional information related to a linked media object. This type of search service may be performed continuously and the results associated with the identifier. Then, in response to a request from a decoding process, the server can return a digest of the results with links to web pages for additional information.

Communication Application

The implementation details of the communication application are highly dependent on the type of communication link and protocols used to connect the decoding process to a server. Above, an Internet browser is provided as an example. A browser may be implemented in conventional PCs, handheld devices, wireless phones, stereo systems, set top boxes, etc. However, the communication application need not be based on computer network protocols. For wireless devices, where the marked content is played on wireless carrier frequencies, the communication application can employ wireless communication technology to forward identifiers and context information to servers that map this information to actions or metadata and return it via a wireless carrier frequency to user's handset.

Tracking Transactions and Report Generation

As depicted in FIG. **1** and described above, the servers for mapping identifiers to actions may be programmed to dispense a transaction log into a log file. A report generation process can then enable users to define and request queries of data from the log file based on a particular identifier, a particular type of context information (time frame, geographic location, user demographics, etc.), a particular action, etc.

Capture Devices

As noted above, the decoding process may be implemented in a variety of devices or software that process media objects. These devices and software include programmable devices such as personal computers, servers, personal digital assistants, telephone handsets, set-top boxes, personal stereos, hi-fi components, tuners, receivers, televisions, etc. as well as hardwired devices that may be incorporated into these systems and devices.

In some contexts, it is useful to implement a recording function (affectionately referred to as a "bookmark"). This is particularly true in devices that receive a broadcast or stream of media content and need to capture at least a portion of it to decode an identifier. Examples of these devices are radio receivers, and wireless telephone handsets. The record function may be automatic or user activated. In the latter case, the user actuates an input device to control the record process and optionally the record duration. For example, the user may hear a song that she likes and press record. The device, in turn, records at least a part of the object that is currently being received (an audio, visual or audio visual signal). The user can then decide contemporaneously or at a later time to execute the identifier decoding process on the recorded signal. The recording function can be designed to execute for a predetermined or user specified duration.

In the case of radio and television tuners/receivers, the record function can be used to capture a media signal as it is received. In the case of a telephone handset, the record function can be used for a variety of functions, such as recording part of a telephone conversation, recording speech or other ambient audio through a microphone, or recording a media signal received by the handset via a wireless communication channel. The recordings can be compressed and stored in local memory on the device. In addition, they may be annotated with metadata about the media signal, such as a time stamp to show time of capture, a location stamp to show location of capture, metadata extracted from the object (in band or out of band data), etc. A global positioning device may provide the location stamp. Some wireless phone systems are capable of computing location of a telephone handset via triangulation. This location data may be used to provide geographic location coordinates or the name of nearby landmark, city name, etc.

The metadata may be displayed on a display device to help the user remember the context of a particular recording. In addition, it may be provided as context information along with an identifier to a server that links the identifier and context information to metadata or actions.

An audio capture device may provide part of the context information, such as song title, artist name and album information. A web service may retain the activation of that song such that the user can browse for more information about that song from the web, either using the same capture device or a PC at a later time. This enables information about the song to be presented in a format that is applicable to the detector device as well as enable the user to interact with the information when the time is better. For example, they may hear the song on the drive to work, and want to learn more while at work, either from their cell phone or desktop PC.

The web services can include information such as:

- Saved song list
  - Buy CD
  - Hear all CD song samples
- Music information
  - Concert tickets & info
  - Fan clubs
- Similar Music
- Share play lists
- Streaming and downloading
- Related merchandise sales

Transmarking

In some applications, it may be useful to convert auxiliary information embedded in a media signal from one format to another. This converting process is referred to as transmarking. Transmarking may include converting an out of band identifier like a tag in a header/footer to a watermark or vice versa. It may also involve converting a message in one watermark format to another. The process involves a decoding operating on an input media object, and an encoding of the decoded information into the media object. It may also involve a process for removing the mark originally in the input object to avoid interference with the newly inserted mark.

There are a variety of reasons to perform transmarking. One is to make the embedded information more robust to the types of processing that the media object is likely to encounter, such as converting from one watermark used in packaged media to another watermark used in compressed, and electronically distributed media, or a watermark used in radio or wireless phone broadcast transmission applications.

This type of transmarking process may be performed at various stages of a media object's distribution path. As suggest previously, an identifier in a watermark or file header/footer may be encoded at the time of packaging the content for distribution, either in an electronic distribution format or a physical packaged medium, such as an optical disk or magnetic memory device. At some point, the media signal may be converted from one format to another. This format conversion stage is an opportunity to perform transmarking that is tailored for the new format in terms of robustness and perceptibility concerns. The new format may be a broadcast format such as digital radio broadcast, or AM or FM radiobroadcasts. In this case, the identifier may be transmarked into a watermark or other metadata format that is robust for broadcast applications. The new format may be a compressed file format (e.g., ripping from an optical disk to an MP3 format). In this case, the identifier may be transmarked into a file header/footer or watermark format that is robust and compatible with the compressed file format.

The transmarking process may leave an existing embedded identifier in tact and layer an additional identifier into the media object. This may include encoding a new watermark that does not interfere with an existing watermark (e.g., insert the new watermark in unmarked portions of the media object or in a non-interfering transform domain). It may also include adding additional or new identifier tags to headers or footers in the file format.

Amplifying an Embedded Identifier

Rather than converting embedded data to another format, an amplifying process may be used to renew an identifier that has become weakened or separated due to processing of the media object in which it is embedded. In this case, a decoder and encoder pair may be used to determine the current identifier and re-encode it. Of course, the encoder can also choose to embed a new or additional identifiers as well.

If the previous identifier is lost, the encoder can query an identifier database established in the registration process, passing identifying information about the media object. The database uses the identifying information to find an associated identifier and returns it to the encoder for embedding in the media object.

Concluding Remarks

Having described and illustrated the principles of the technology with reference to specific implementations, it will be recognized that the technology can be implemented in many other, different, forms.

To provide a comprehensive disclosure without unduly lengthening the specification, each of the above-mentioned patents and patent applications is herein incorporated by reference. These patents and patent applications provide additional implementation details. They describe ways to implement processes and components of the systems described above. Applicants expressly contemplate that the processes and components described in these applications may be used in various combinations, and in some cases, interchangeably with processes and components described above.

The section headings in this application are provided for the reader's convenience and are not intended to limit the scope of the present invention. Of course, the subject matter found under one heading can be combined with subject matter found under other headings.

It should be appreciated that a "user device," such as referred to with respect to FIGS. **3** and **4**, may include a cell phone, telephone, computer—including a handheld computer, Palm device, laptop, personal digital assistant (PDA), web tablet—recorder, MP3 or other audio player device, DVD or other video playback device, communications device (e.g., a wireless transceiver), or a combination of such devices with a communications device, etc., etc., etc. Of course this list is not exhaustive.

We note that the database can be located remotely or locally with respect to the fingerprint calculator (FIG. **3**) and fingerprint calculator/watermark decoder (FIG. **4**). Additionally, while FIGS. **3** and **4** have been illustrated as communicating data identified in the database through a messaging service, the present invention is not so limited. Indeed, a server associated with fingerprint calculator (and watermark detector) and/or the database can communicate with the user device, or the database (and/or the fingerprint calculator/watermark detector) can be integrated with the messaging service.

We also note that an alternative implementation of the FIGS. **3** and **4** system is for a user device to decode a digital watermark embedded in an audio signal and to compute a fingerprint or hash of the audio signal, and then communicate the watermark (or watermark identifier) and fingerprint to a server/database. In another implementation, the user device decodes the watermark to obtain an identifier and then communicates the identifier and a portion of the audio signal to the fingerprint server/database. It is also important to realize that while the FIGS. **3** and **4** implementations are described with respect to audio, our inventive techniques can be also used to link video signals to related information.

The particular combinations of elements and features in the above-detailed embodiments are exemplary only; the interchanging and substitution of these teachings with other teachings in this and the incorporated-by-reference patents/applications are also contemplated.

We claim:

1. A method of linking a signal to metadata or actions, the signal comprising plural-bit data encoded in the form of a digital watermark, said method comprising:

utilizing a configured multi-purpose electronic processor, decoding the digital watermark embedded in the signal to obtain the plural-bit data;

utilizing a configured multi-purpose electronic processor, deriving a hash or fingerprint from the signal itself as an identifier of the signal, said act of deriving a hash or fingerprint utilizes Viterbi decoding,

wherein the digital watermark is formed independently of the hash or fingerprint;

executing a first action based on the plural-bit data; and

executing a second action based on the hash or fingerprint.

2. The method of claim **1**, wherein said decoding, deriving, executing a first action and executing a second action are also performed in one or more computer servers.

3. The method of claim **1**, wherein at least one of the decoding and deriving are performed in a user device, and said method further comprises communicating the plural-bit data and the fingerprint to a server.

4. The method of claim **1** wherein the second action comprises identifying a memory location or metadata associated with the plural-bit data.

5. The method of claim **1** where at least one of the first action or the second action comprises searching one or more databases.

6. The method of claim **1** wherein at least one of the first action or the second action comprises content monitoring

7. The method of claim **1** wherein the first action or the second action comprises accessing promotional information.

8. The method of claim **1** wherein the digital watermark is embedded in the signal by an embedding clearinghouse.

9. The method of claim **1** wherein the first action or the second action is conditioned on user input.

10. A physical computer readable medium comprising instructions stored thereon to cause a multi-purpose electronic processor to perform the method of claim **1**.

11. A physical programmed computing device storing instructions in memory, said instructions are executable by said programmed computing device to perform the acts of claim **1**.

12. A programmed computing device storing instructions in memory, said instructions are executable by said programmed computing device to perform the acts of claim **4**.

13. A method comprising:

obtaining a first set of plural-bit data, the first set of plural-bit data corresponding to at least a portion of steganographically encoded data in a media signal in the form of a digital watermark;

obtaining a second set of plural-bit data, the second set of plural-bit data corresponding to a fingerprint or hash of the media signal, the fingerprint or hash being obtained

by utilizing Viterbi decoding, wherein the fingerprint or hash comprises a reduced-bit representation of the media signal, and wherein the first set of plural-bit data is not dependent on information in the second set of plural-bit data;

using at least a programmed electronic processor, carrying out a first action associated with the first set of plural-bit data; and

using at least a programmed electronic processor, carrying out a second action associated with the second set of plural-bit data, the second action utilizes the second set of plural-bit data to at least identify the media signal or information related thereto.

14. The method of claim **13** wherein the first action comprises identifying a memory location or metadata associated with the first plural-bit data.

15. The method of claim **13** wherein at least one of the first action or the second action comprises searching one or more databases.

16. The method of claim **13** wherein at least one of the first action or the second action comprises content monitoring.

17. The method of claim **13** wherein the first action or the second action comprises accessing promotional information.

18. The method of claim **13** wherein the digital watermark is embedded in the media signal by an embedding clearinghouse.

19. The method of claim **13** wherein the first action or the second action is conditioned on user input.

20. A physical computer readable medium comprising instructions stored thereon to cause a multi-purpose electronic processor to perform the method of claim **13**.

21. A programmed computing device storing instructions in memory, said instructions are executable by said programmed computing device to perform the acts of claim **13**.

22. A method comprising:

obtaining data representing a media signal;

utilizing a configured multi-purpose electronic processor, performing a first operation on the data representing the media signal to obtain a first set of plural-bit data there from; and

based at least in part on a result of said act of performing a first operation on the data representing the media signal, determining whether to perform a second operation to obtain a second set of plural-bit data from the data representing the media signal,

where the first et of plural-bit data or the second set of plural-bit data is derived with a hash or fingerprint of the data representing the media signal while the other of the first set of plural-bit data or the second set of plural-bit data is associated with steganographically hidden data,

where information contained in steganographically hidden data is not dependent on information derived with a hash or fingerprint.

23. The method of claim **22** comprising performing the second operation to obtain the second set of plural-bit data from the data representing the media signal when determined based at least in part on the first set of plural-bit data.

24. The method of claim **23** further comprising carrying out an action based at least in part on the second set of plural-bit data.

25. The method of claim **24** where the action comprises searching one or more computer or server databases.

26. The method of claim **24** wherein the action is associated with content monitoring.

27. The method of claim **24** wherein the action involves a transaction.

28. A physical computer readable medium comprising instructions stored thereon to cause a multi-purpose electronic processor to perform the method of claim **22**.

29. A method comprising:

obtaining a media signal;

utilizing a configured multi-purpose electronic processor, deriving or computing a hash or fingerprint of the media signal, the hash or fingerprint having not been embedded or encoded in the media signal,

said act of deriving or computing a hash or fingerprint utilizes Viterbi decoding, and

the hash or fingerprint comprises a reduced-bit representation of the media signal; and

executing an action associated with the hash or fingerprint.

30. The method of claim **29** where the action comprises identifying the media signal or information related to the media signal.

31. The method of claim **29** where the action is conditioned on user input.

32. The method of claim **29** where the action comprises content monitoring.

33. A computer readable medium comprising instructions stored thereon to cause an electronic processor to perform the method of claim **29**.

34. A programmed computing device storing instructions in memory, said instructions are executable by said programmed computing device to perform the acts of claim **29**.

35. A method comprising:

obtaining a hash or fingerprint of a media signal over an electronic communications network,

the hash or fingerprint having been derived or computed with Viterbi decoding, and

the hash or fingerprint comprises a reduced-bit representation of the media signal, the hash or fingerprint having not been embedded or encoded in the media signal; and

obtaining data associated with the hash or fingerprint; and

using at least a programmed electronic processor, carrying out an action based at least in part on the data.

36. The method of claim **35** wherein the data identifies the media signal or information related to the media signal.

37. A physical computer readable medium comprising instructions stored thereon to cause a multi-purpose electronic processor to perform the method of claim **35**.

38. The method of claim **35** wherein the action is associated with content monitoring or content filtering.

39. A programmed computing device storing instructions in memory, said instructions are executable by said programmed computing device to perform the acts of claim **35**.

40. A method comprising:

utilizing a programmed, multi-purpose electronic processor, performing a first operation on data representing a media signal in an attempt to determine a first set of information;

based at least in part on a result or outcome of said act of performing a first operation on the data representing the media signal, deciding whether to perform a second operation to determine a second set of information from the data representing the media signal,

the first set of information or the second set of information is derived or computed with a hash or fingerprint on the data representing the media signal while the other of the first set of information or the second set of information is associated with digital watermark data or steganographically hidden data,

information contained in digital watermark data or steganographically hidden data is not dependent on information derived with a hash or fingerprint.

41. The method of claim **40** further comprising carrying out an action based at least in part on the second set of information.

42. The method of claim **41** where the action comprises searching one or more databases.

43. The method of claim **41** wherein the action is associated with content monitoring.

44. The method of claim **41**, wherein the action involves a transaction.

45. A programmed computing device storing instructions in memory, said instructions are executable by said programmed computing device to perform the acts of claim **40**.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,711,564 B2
APPLICATION NO. : 10/186175
DATED : May 4, 2010
INVENTOR(S) : Levy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page:

The first or sole Notice should read --

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1222 days.

Signed and Sealed this
Eleventh Day of January, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,711,564 B2
APPLICATION NO. : 10/186175
DATED : May 4, 2010
INVENTOR(S) : Kenneth L. Levy, Geoffrey B. Rhoads and Hugh L. Brunk

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

ON THE TITLE PAGE OF THE PATENT

Item (63), under Related U.S. Application Data, line 2:

Delete "which is" and insert the word --and--

ON THE TITLE PAGE OF THE PATENT

Item (60), insert the following:

--Provisional application No. 60/263,490, filed on Jan. 22, 2001.
Provisional application Nos. 60/305,086, filed on July 12, 2001 and 60/351,565, filed on Jan. 22, 2002.--

Signed and Sealed this
Twenty-seventh Day of September, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office