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Other: **Online databases: EPODOC, JAPIO, WPI**

(54) Abstract Title
**A system for distributing audio/video material to a potential buyer**

(57) A material distribution apparatus comprises a material server 1, 6 including a material impairment processor 34 operable to introduce a reversible impairment (eg a visible watermark) into the material to be distributed, and a communications network 2 operable to distribute the impaired material to at least one client processor 4. The client processor 4 comprises an impairment reversing processor 90 operable to reverse the impairment of the material to produce restored material. The material server 1,6 or the client processor 4 includes a material protection processor operable to introduce protection data (eg a digital finger print) into the material. The protection data is imperceptible in the material. The protection data serves to allow the detection of misuse of the material.

Generating an impaired version of the material to be distributed provides a facility for a buyer to sample the material before acquisition, whilst discouraging the buyer from using the impaired material in an unauthorised way. If a buyer decides to acquire the material, the client processor is provided with impairment removal data.

Other data, which is imperceptible in the material, may be introduced into the material.

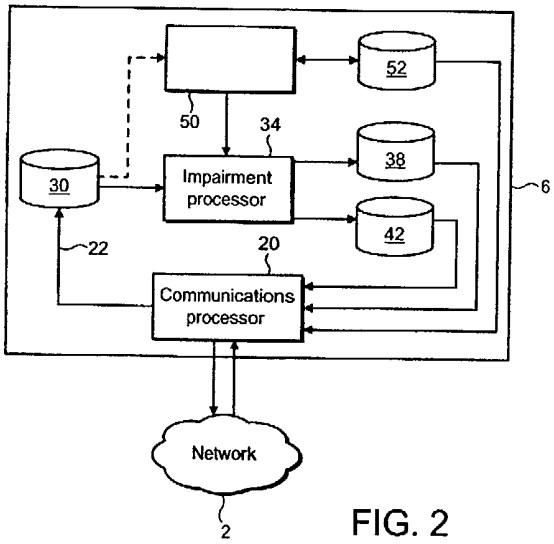


FIG. 2

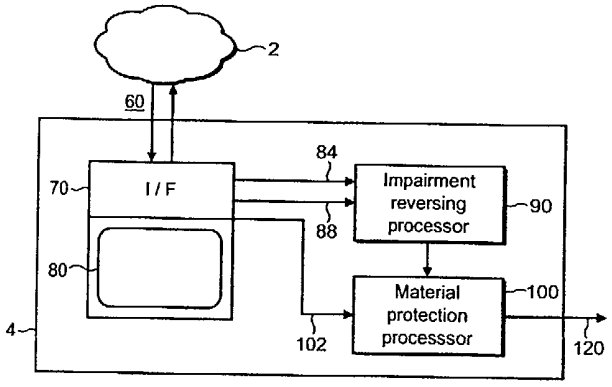


FIG. 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

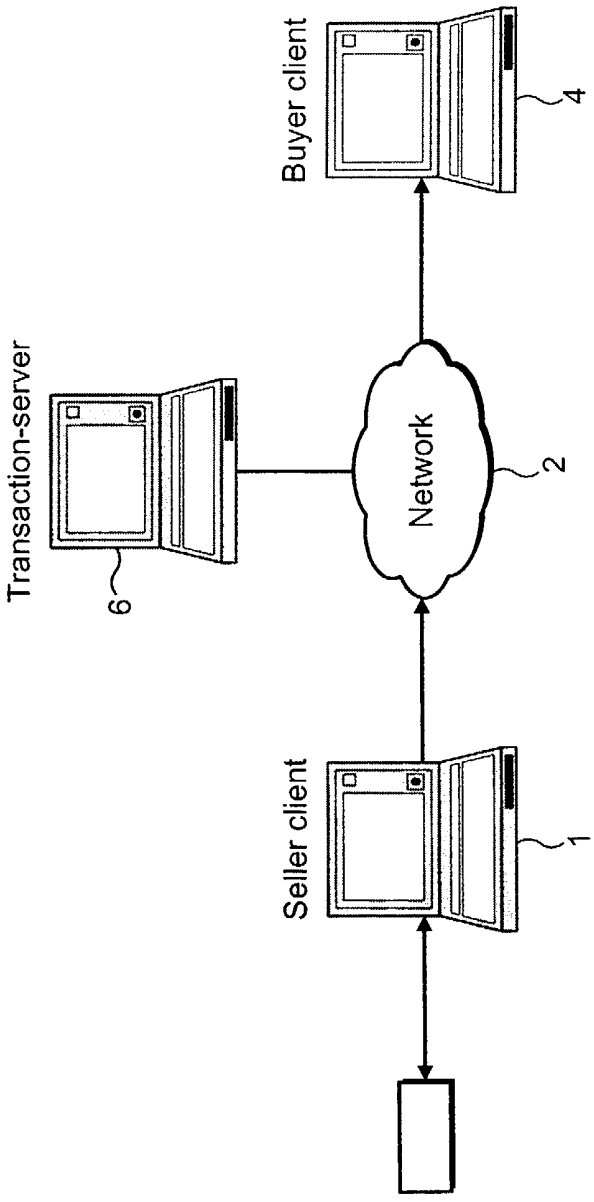
Buyer client
4
Transaction-server
6
Network
2
Seller client
1

FIG. 1

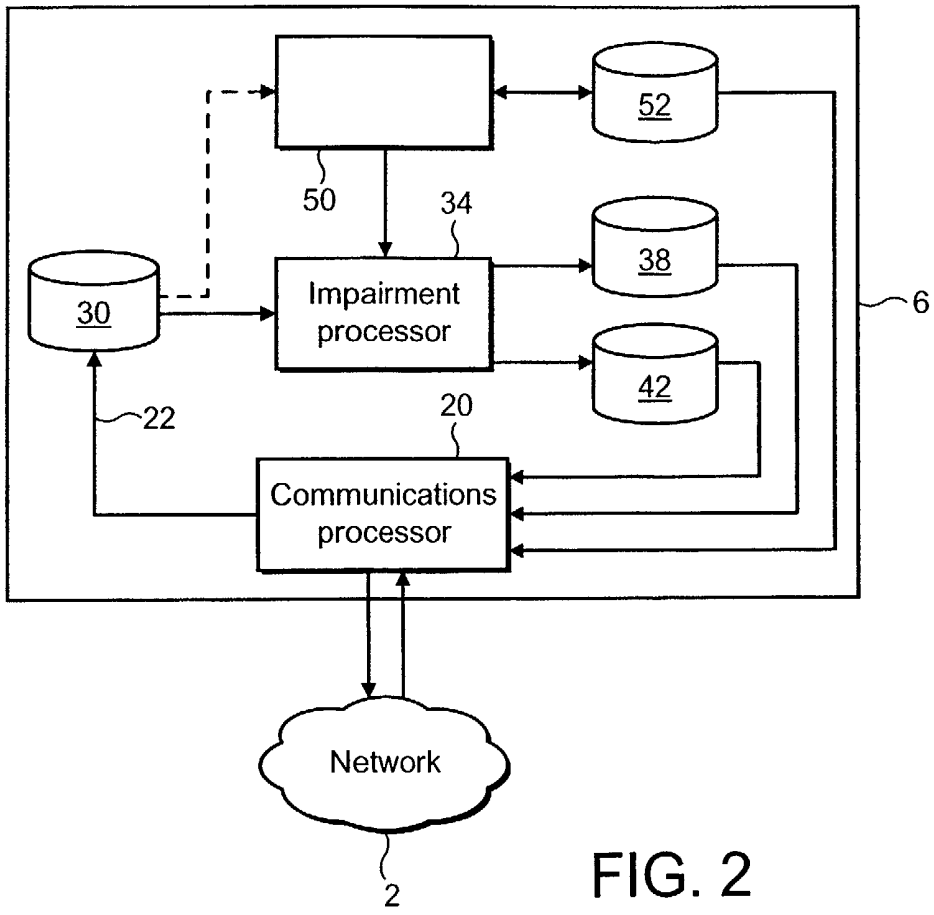
52
50
34
38
30
Impairment processor
6
42
22
20
Communications processor
Network
2

FIG. 2

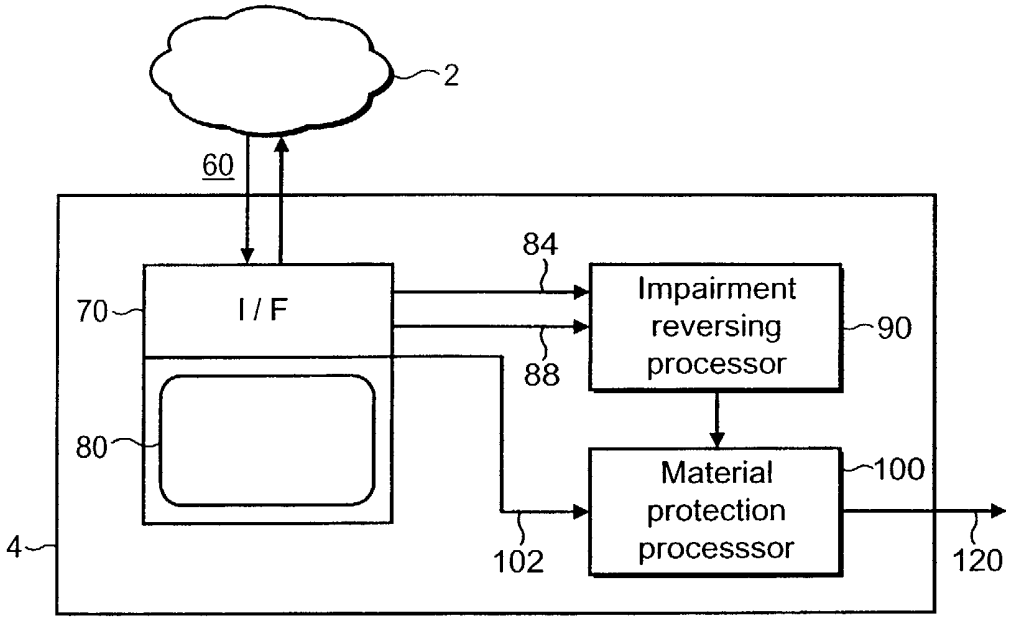
2
60
84
70
I / F
Impairment reversing processor
90
88
80
Material protection processsor
100
4
102
120

FIG. 3

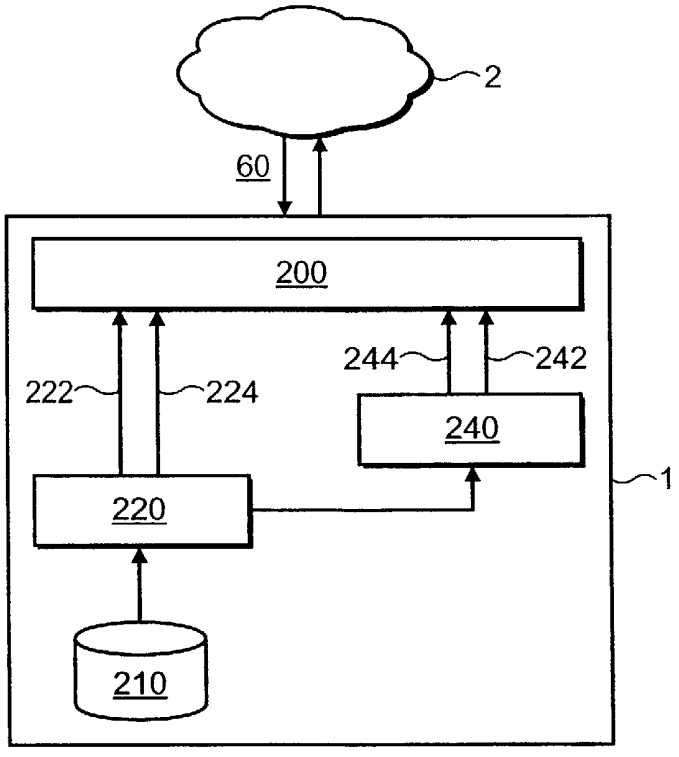
2
60
200
244
242
222
224
240
1
220
210

FIG. 4

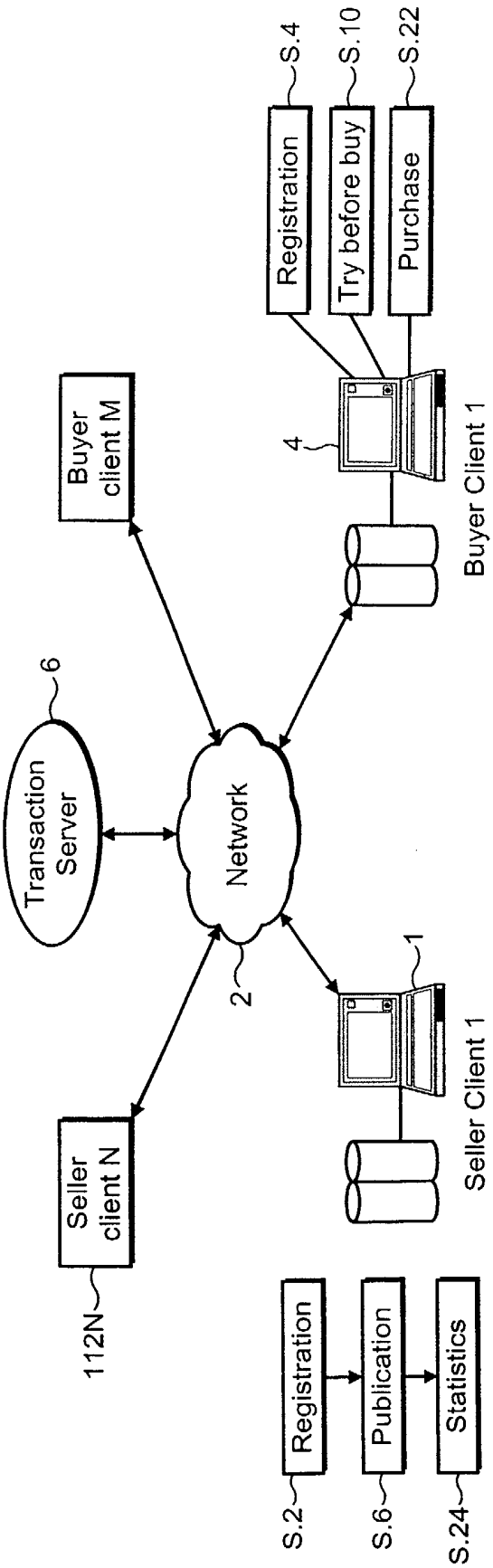
Registration
Try before buy
Purchase
S.4
S.10
S.22
4
Buyer Client 1
Buyer client M
6
Transaction Server
Network
2
1
Seller Client 1
Seller client N
112N
Registration
Publication
Statistics
S.2
S.6
S.24

FIG. 5

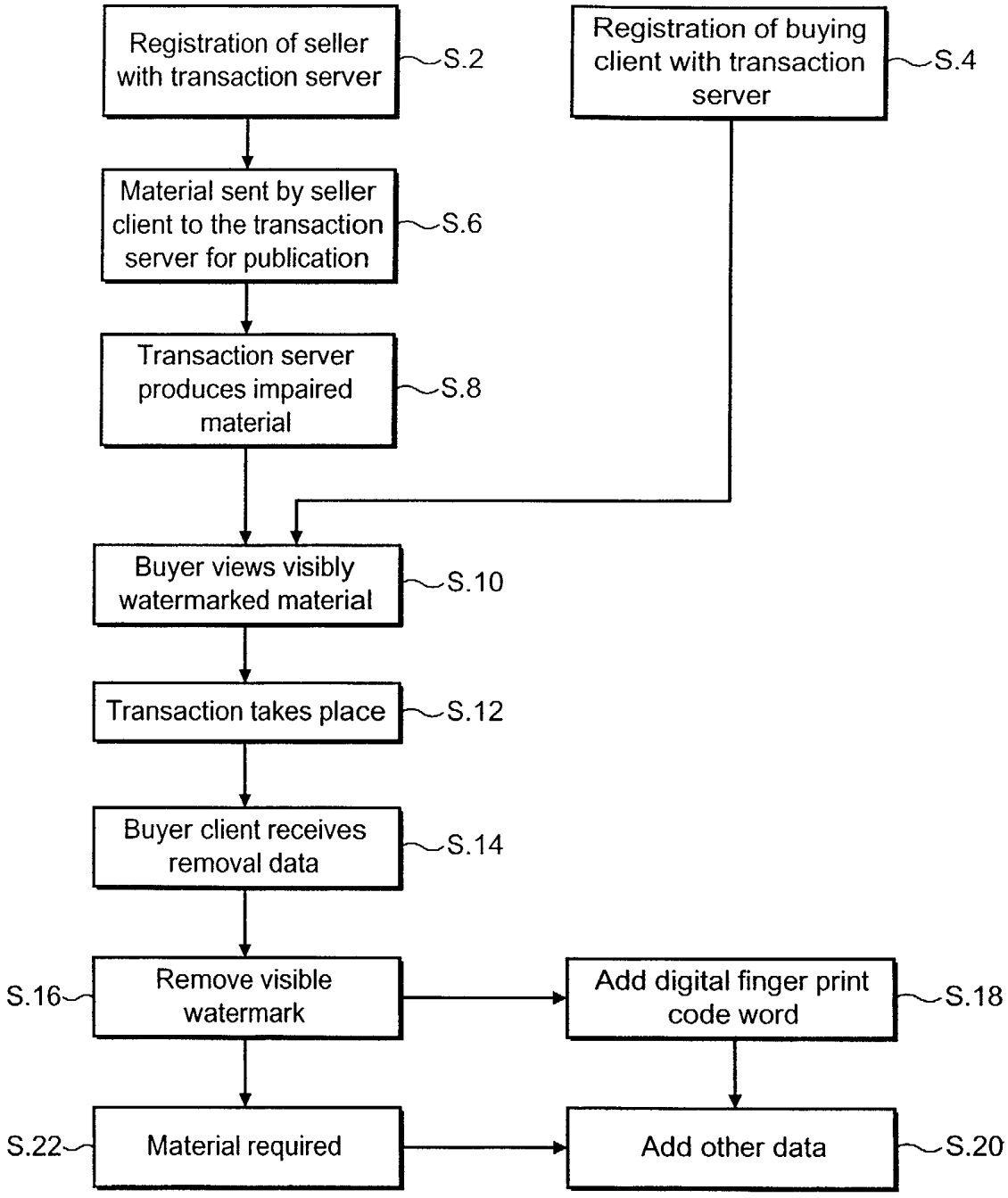
Registration of seller with transaction server
S.2
Registration of buying client with transaction server
S.4
Material sent by seller client to the transaction server for publication
S.6
Transaction server produces impaired material
S.8
Buyer views visibly watermarked material
S.10
Transaction takes place
S.12
Buyer client receives removal data
S.14
S.16
Remove visible watermark
Add digital finger print code word
S.18
S.22
Material required
Add other data
S.20

FIG. 6

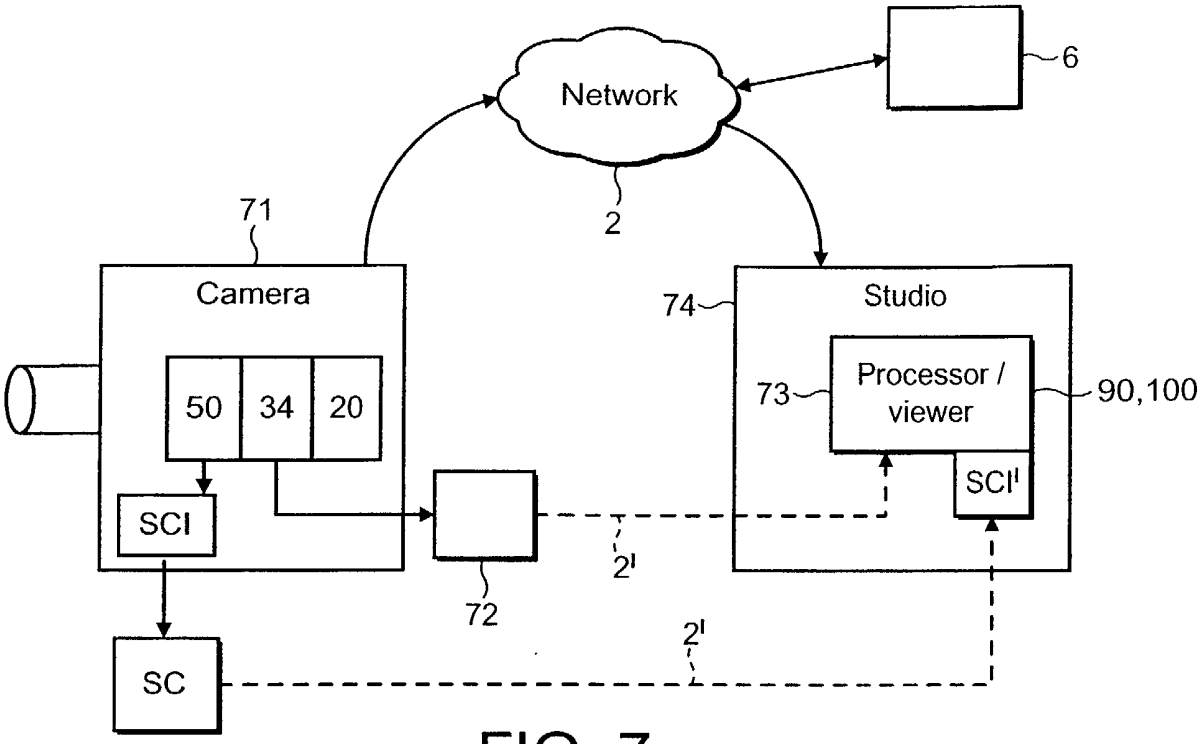
Network
6
2
71
Camera
74
Studio
50
34
20
73
Processor / viewer
90,100
SCI
SCI'
2'
72
2'
SC

FIG. 7

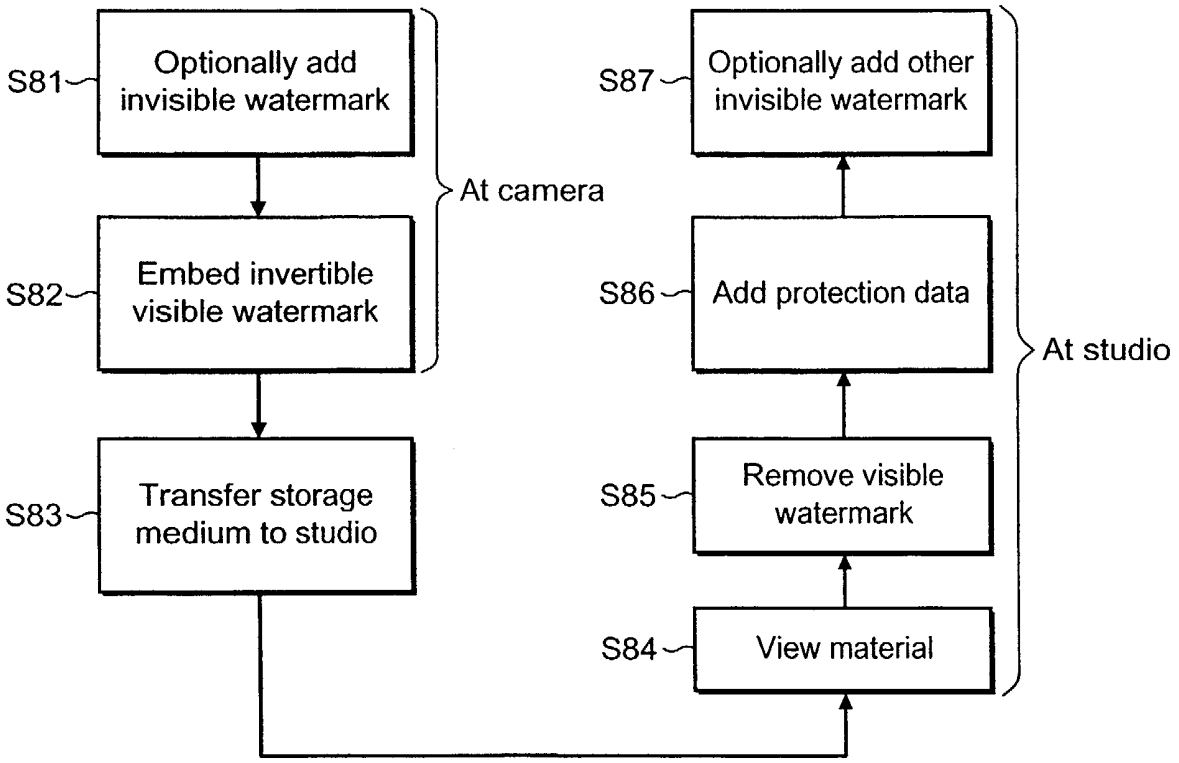
S81
Optionally add invisible watermark
S82
Embed invertible visible watermark
S83
Transfer storage medium to studio
At camera
S87
Optionally add other invisible watermark
S86
Add protection data
S85
Remove visible watermark
S84
View material
At studio

FIG. 8

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# MATERIAL DISTRIBUTION APPARATUS

## Field of Invention

The present invention relates to material distribution apparatus and to methods for distributing material.

"Material " means information signals representing audio, data and image material where image material includes still images, moving images and video.

In this specification the terms "seller" and "buyer", which are used in relation to material, are used for convenience and ease of description. It will be appreciated that these terms do not simply mean someone (seller) who transfers outright ownership to someone else (buyer) for a consideration, usually money. Often, material is licensed to a user (buyer) by a licensor (seller) who allows the licensee to use the material in accordance with defined terms or business rules. Thus the terms seller and buyer have more general meanings and include intermediaries acting on behalf of other persons who may be the ultimate owners of the material and the ultimate users thereof.

## Background of the Invention

Material such as audio/video material, data and software programs may be produced for variety of different applications. One of the fields of greatest demand for audio/video material is in the entertainment field where an increase in the number of television channels, particularly in Europe has fuelled an increase in the demand for audio/video productions.

Today, a business profile of the production and consumption of material is characterised by a growing number of independent production companies, which both generate material and have a demand for material to produce for example, audio/video productions. The management and distribution of material, to many interested parties whether or not for commercial reasons, therefore represents a technical problem.

In co-pending International patent application number PCT/GB01/01493 (I-00-74) there is disclosed a multimedia transaction processor for facilitating the sale of multimedia material. A multimedia transaction processor includes a media server operable to store multimedia material from a seller client, and to store metadata representing the content of the multimedia material and data identifying the seller

providing the multimedia material. The metadata and the identifying data are stored in association with the multimedia material. An access processor is operable to retrieve from the server possible multimedia material content items corresponding to requested multimedia content by generating meta data from the data requesting the multimedia content. The generated meta data is compared with the meta data stored in association with the multimedia material, and from the comparison possible multimedia content items are retrieved from the server. Data representative of the possible multimedia content items are communicated to a buying client processor. A transaction controller is operable, in response to selection data, to communicate data requesting the selected multimedia content items to the seller client identified by the stored identification and to complete the transaction with the buyer. The multimedia transaction processor provides a facility for clients to sell and to buy multimedia material in order to fulfil a particular need.

## Summary of Invention

According to a first aspect of the present invention there is provided a material distribution apparatus, comprising

a material server including, a material impairment processor operable to introduce a reversible impairment into the material to be distributed,

a communications network operable to distribute said impaired material to at least one client processor, wherein said client processor comprises

an impairment reversing processor operable to reverse said impairment of said material to produce restored material, and

a data introduction processor operable to introduce data into said restored material, said introduced data being introduced into said restored material with the effect that the introduced data is at least difficult to perceive in said material.

According to a second aspect of the present invention there is provided a material distribution apparatus, comprising

a material server including a data introduction processor operable to introduce data into material to be distributed, said introduced data being introduced into said material with the effect that the introduced data is at least difficult to perceive in said material, and a material impairment processor operable to introduce a reversible impairment into said material,

a communications network operable to distribute said impaired material to at least one client processor, wherein said client processor comprises

an impairment reversing processor operable to reverse said impairment of said material to produce client restored material.

As explained above, the business profile for the production and consumption of audio/video material is characterised by many clients having a requirement to buy and sell material. There is therefore a requirement for providing controlled access to material which sellers wish to distribute to potential buyers. However, there remains a technical problem of providing a facility for controlling use of the distributed material. For example, the material may be distributed subject to certain conditions, which the owner or seller would prefer to monitor. Furthermore, the owner of the

material has a requirement for enforcing intellectual property rights in the material, for example, to prevent unauthorised copying.

Preferably the communications network provides a bandwidth sufficient to communicate the material. In some embodiments the communications network may include electronic communications channels, the Internet, an Intranet, an Extranet, the Postal system, and couriers. Preferred embodiments of the invention use electronic communications channels for example the Internet.

Generating an impaired version of the material to be distributed provides a facility for a buyer to sample the material before acquisition, whilst discouraging the buyer from using the impaired material in an unauthorised way. If a buyer decides to acquire the material, the buyer client processor is provided with an impairment removal processor, which is arranged to remove the impairment from the material and to restore the material substantially to its original form. In some embodiments the impairments may be a "watermark", which for the example of video material would be a visible watermark.

The buyer may acquire the material following completion of a transaction. For example the buyer acquiring the material may purchase the material from a seller.

A further advantage of the material distribution apparatus according to embodiments of the present invention is provided by the data introduction processor acting as a material protection processor. In one embodiment of the first aspect of the invention, the material protection processor is operable, upon request by the buyer for acquisition, to introduce protection data into the recovered material, the introduction of the protection data being difficult to perceive or being substantially imperceivable.

In preferred embodiments the protection data is introduced into the recovered material contemporaneously with the removal of the visible watermark. Advantageously, for the case where the material protection processor forms part of the buyer client processor, the material protection processor and the impairment reversing processor form part of a tamper proof processing unit, such as, for example a secure or sealed software engine.

In an alternative embodiment, according to the second aspect of the invention, the material protection processor forms part of the material server and is operable to

introduce the protection data into the material before the reversible impairment is introduced.

The protection data is configured to allow the detection of misuse of the material. For example the protection data may be arranged to identify the version of the material acquired by the buyer, the buyer, and/or the buyer client processor. The protection data may be an identification code word or words, known as a digital fingerprint. A digital fingerprint is introduced into material to the effect that it is difficult for a user to perceive the presence of the finger print. By identifying the code word(s) from the version of the material acquired by that buyer it is possible for the owner of the intellectual property rights to assert those rights in the material, should the material be used in a way which is contrary to the wishes of the owner. An example of a digital fingerprinting scheme is disclosed in [1].

The data introduction may introduce into the material other imperceptible data which is additional to the protection data or instead of the protection data. That other data may be introduced at the material server before the impairment or at the client processor after impairment removal. The other data may identify the material, or be other metadata relating to the material and or be data identifying a person who has an interest (such as owner of the IPR) in the material. Preferably the other data includes a Universal Material Identifier (UMID) [4]. The other data may be embedded in the material using the embedding techniques disclosed in [2].

According to a third aspect of the present invention there is provided a system for protecting material, comprising:

first apparatus including a material impairment processor operable to introduce a reversible impairment into said material; and second apparatus including an impairment reversing processor operable to reverse said impairment of said material to produce restored material; the system including a processor operable to introduce data into the material.

In a preferred embodiment, the first apparatus is a camera-recorder.

Preferably, the introduced data is protection data as discussed above. The introduced data may alternatively be, or additionally be, other data as discussed above. The introduced data may be generated and introduced at the first or second apparatus.

Removal data, needed to remove the perceptible impairment and restore the original material is transferred to the second apparatus. That may be done on a data carrier, preferably a secure data carrier such as a smart card or via a secure communications link.

As will be appreciated from the foregoing discussion, in preferred embodiments the material may include audio material, video material and data material. A perceptible impairment may be added to audio.

The above-mentioned and other aspects and features of the present invention are defined in the appended claims.

## Brief Description of the Drawings

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, where like parts are provided with corresponding reference numerals, and in which:

Figure 1 is a schematic representation of a material distribution apparatus;

Figure 2 is a schematic block diagram of a material transaction processor forming part of the material distribution apparatus shown in Figure 1;

Figure 3 is a schematic block diagram of a buying client data processor material distribution apparatus shown in Figure 1;

Figure 4 is a schematic block diagram of a vendor client data processor material distribution apparatus shown in Figure 1;

Figure 5 is a part schematic part flow diagram illustrating a process whereby a client acquires material from the material distribution apparatus shown in Figure 1;

Figure 6 is a flow diagram illustrating a process of acquiring material from the material distribution apparatus shown in Figure 1;

Figure 7 is a schematic diagram of a further system in which the present invention may be practised; and

Figure 8 is a flow diagram illustrating the operation of the system of Figure 7.

## Description of Preferred Embodiments

Figure 1 presents a general arrangement for distributing media material from a seller to a buyer. As shown in Figure 1, a seller client processor 1 is connected via a network 2 to a buyer client processor 4. The network 2 may include a communications network such as the Internet or an Intranet or any convenient communications network having sufficient bandwidth to communicate material to be distributed. Preferably the network is a broadband network. Also connected to the network 2 is a transaction server 6.

It is known to use "Digital Rights Management" software to protect material against misuse. Many companies provide such software, e.g. SealedMedia, Microsoft, InterTrust Technologies, and others. Such software, which is designed to be secure against unauthorised modification, allows the providers of material to securely distribute material over computer networks and to control the use of the material by users. Accordingly it will be appreciated by those skilled in the art to provide tamper proof software packages for facilitating the distribution of material to clients remotely via a network.

Generally as will be explained, the transaction server 6 provides a facility for distributing material such as audio, video material to buyer clients via the network 2. As will be explained, the distribution of the material is arranged such that the distributed material can be identified. To this end, data is embedded in the distributed material which can serve to identify either a version of the material distributed to the buyer client processor or the owner of the material. The owner can be for example the originator of the material, a licensee of the material or a distributor of the material or anyone who has, or acquires, Intellectual Property Rights in the material.

As will be explained shortly, an advantage is provided by the material distribution apparatus shown in Figure 1 by arranging for the material to be impaired in a user perceivable way before it is distributed. The impairment may be for example a visible watermark. As such any person receiving the impaired material will be unlikely to want to use such material due to the presence of the visible watermark. However, the watermark is added in a reversible way, preferably using encryption,

such that upon acquisition of the material, the impairment (watermark) can be removed by the buyer client processor 4 in order to restore the original material. Examples of techniques for introducing watermarks using encryption are disclosed in [3]. In a preferred embodiment, an invisible watermark is introduced into the material before the introduction of the visible watermark.

The buyer client processor 4 includes a viewer which allows the buying client to review the impaired material. If the buyer decides to acquire the video, and pays for it, the buyer is then allowed to remove the watermark and restore the original material. For that purpose, the buyer client includes a removal processor 90. According to a preferred embodiment, the buyer client processor also includes a material protection processor included in the buyer client processor 4 which is arranged to introduce protection data into the recovered material. Protection data may be for example a digital fingerprint code word which identifies not only the version of the material but the buyer and/or the client processor 4 acquiring the material. Accordingly, any misuse of the material, such as copying, may identify the user that has misused the material. The processor(s) in the buyer client processor 4 for removing the visible watermark and introducing the protection data are secure against tampering by unauthorized people.

A more detailed block diagram of the transaction server 6 is shown in Figure 2. As shown in Figure 2, the transaction server 6 is connected to the network 2 via a communications processor 20. Connected to the communications processor via a channel 22 is an audio/video (A/V) store 30. Connected to the A/V store 30 is an impairment processor 34. The impairment processor 34 is connected to two further stores which are a store for impaired A/V material 38 and a store 42 for removal data. Store 42 stores decryption keys and other data needed to remove a watermark and restore the original material and which is generated by the impairment processor. Both the store 38 for impaired A/V material and the store 42 for removal data are connected to the communications processor 20. Optionally, the transaction server 6 may also include an invisible watermark processor 50 and a meta data store 52. The invisible watermark processor 50 is connected to the impairment processor 34. An output channel from the invisible watermark processor 50 is connected to the meta data store 52 which also has an output channel connected to the communications processor 20.

As mentioned above, the transaction server 6 provides a facility for distributing material to the buyer client processor 4 connected via the network 2. The transaction server receives via the communications processor 20, material to be distributed and which is sent to the buyer client processor 4 from e.g. from the seller client 1. The material to be distributed is then stored in the data store 30 which, for the present example embodiment stores A/V material. The impairment processor 34 is arranged to receive the A/V material from the data store 30 and introduce a perceivable impairment into the material which is commonly referred to as a visible watermark (WM). The watermarked A/V material is then stored in the second data store 38.

As explained in [3] (co-pending patent application number 0029852.1 (I-00-146)) a visible watermark can be introduced into material in a way which is reversible and which is applied in accordance with an encryption process. Accordingly, it would be difficult for a user receiving the visibly watermarked material to remove the visible watermark. However, the visible watermark can be removed in accordance with a decryption key and other removal data with the effect of removing the visible watermark and restoring the original material. Accordingly, a decryption key and other removal data (corresponding to the encryption key and other data used to visibly watermark the material) is stored in the removal data store 42. For distribution, the impaired material data store 38 and the removal data store 42 are connected to the communications processor 20. As will be explained, the removal data store may also include further security information such as fingerprint code words to be introduced into the material to indicate the version of the material and/or the buyer client processor 4 and/or the buyer who acquires the material.

Optionally, the transaction server 6 may also include an invisible watermark processor 50 which is operable to introduce an invisible watermark into the material before the material is forwarded to the impairment processor 34 to introduce the visible watermark. The invisible watermark processor 50 may include an arrangement for embedding metadata into the material. The metadata may include a UMID [4] or a unique identifier, which has an effect of identifying the material in which the metadata is embedded. The unique identifier is therefore communicated to and from a metadata store 52. The metadata store 52 is also connected to the communications processor 20.

A block diagram of the buyer client processor 4 is shown in Figure 3. In Figure 3, the buyer client processor 4 is shown connected to the network 2 via a communications link 60 which connects to a secure interface 70. The interface 70 includes a reproduction device 80. The interface is connected via first and second channels 84, 88 to an impairment reversing processor 90. An output of the impairment reversing processor 90 is fed to a material protection processor 100, which also receives an input from the interface 70.

A buyer wishing to acquire material may download the visibly watermarked material via the network 2 using the interface 70. The interface 70 is arranged to display the A/V material to the client albeit with the visible watermark present ( and thus does not need to be secure). The display device 80 may also include other reproduction means such as audio reproduction apparatus. Having viewed the visibly watermarked material, the buyer may decide to acquire this material. Accordingly, the buyer can indicate via the interface 70 that he/she wishes to acquire the material. The interface 70 therefore communicates with the communications processor 20 in the transaction server 6. The communications processor 20 of the transaction server 6 is arranged to communicate the removal data. The removal data is securely communicated to the buyer client processor using for example known cryptographic techniques. The removal data is received via the interface 70 and fed via the connecting channel 84 to the impairment reversing processor 90. The impaired material is received via the second connecting channel 88 and the impairment reversing processor operates to reverse the visible watermarking process to the effect of removing or "washing" the visible watermark from the material to restore the original material. The material is then fed to the material protection processor 100.

In order to prevent the buyer from misusing the material, such as copying the material or using it in a way which is inconsistent with the wishes of the distributor, the impairment reversal processor and the material protection processor 100 are arranged to automatically and securely restore the original material and introduce the protection data into the material before making the material available to the buyer via an output channel 120. To this end, the material protection processor 100 may receive the protection data from the transaction server via the network 2, the protection data

being sent in a secure manner. Alternatively, the protection data may be generated in the buyer client 4 by the protection processor 100.

An example of protection data, which may be introduced into the material, is an invisible watermark which is a digital identification code word or "fingerprint". An example of a digital finger printing scheme is disclosed in [2] and a brief description of embedding and recovering data is presented at the end of this specific description. In addition, for example, another invisible watermark may be embedded which is for example an identifier and /or metadata received from the metadata store 52 of the transaction processor 6. Preferably, the identifier is a unique identifier such as a UMID. Alternatively, the metadata and/or identifier may be generated within the material protection processor 100.

If a digital fingerprint is to be added to the material, then the identification code word (digital fingerprint) may be communicated as part of the protection data and received via the input channel 102. The material protection processor 100 therefore introduces the identification code word into the material, which identifies the buyer and/or version of the material acquired by the buyer client processor 4 and/or the processor 4 itself.

As will be appreciated, the arrangement of the buyer client processor 4 and transaction processor 6 to provide a means for reviewing visibly watermarked material and removing the visible watermark and then adding protection data to the recovered material provides a more secure arrangement for distributing the material to clients.

An example of a seller client processor 1 is shown in Figure 4. In Figure 4, the seller client processor 1 is connected to the network 2 via a communications processor 200. The seller client processor includes a material store 210, which for the example embodiment includes A/V material. The seller client processor may include an invisible watermark processor 220 and a visible watermark processor 240. The invisible watermark processor 220 and the visible watermark processor 240 operate substantially as described for the invisible watermark processor 50 and the impairment processor 34 as described for the transaction server 6 respectively and so repetition of the explanation will not be given. However, the presence of the invisible watermark processor 220 and the visible watermark processor 240 provides a facility for introducing respectively the invisible and visible watermarks into the material in the

seller client processor rather than in the transaction server 6. Accordingly, therefore a unique identifier which is embedded as part of an invisible watermark or other meta data is communicated to the communications processor 200 and then to the transaction server 6 for storage in the meta data store 52 via connecting channels 222, 224. Correspondingly, the impaired material including the visible watermark is fed from a connecting channel 242 with the decryption key and other removal data via a connecting channel 244 to the communications processor 200 for communication via the network to the transaction server 6. The seller client processor may interact with the transaction processor 6 to generate the invisible watermark and the visible watermark.

As will be appreciated therefore in combination the seller client processor 1 and the transaction server 6 form a material server and in other embodiments, the seller client processor and the transaction server may form a unified material server. In summary, the operation of the material distribution apparatus shown in Figure 1 is shown in Figure 5 and will be described with reference to a flow diagram shown in Figure 6.

As shown in Figure 5, several buyer and seller client processors may be connected to the network 2 and may have access to the transaction server 6. As shown in Figure 5, the first step of a seller and a buyer is to register with the transaction server 6. Registration may require depositing funds and/or providing bank details in order that a transaction can be performed; other information may be required for registration. As shown in Figure 6, the first step S2, S4 is for the seller to register with the transaction server using the seller client processor 1and for the buyer to register with the transaction server using the buyer client processor 4. At step S6, the A/V material is provided by the seller client 1 to the transaction server by communicating the A/V material to the transaction server. At step S8, the transaction server 6 produces an impaired version of the material by adding the visible watermark. The buyer then views the visibly watermarked material at step S10 using the buyer client processor 4 by accessing the transaction server via the network.

If the buyer then decides that he/she wishes to acquire the material then a transaction takes place. The transaction may be for example an exchange of money by transfer of funds from the buyer's account to the seller's account. Following

completion of the transaction at step S12, the buyer receives, at S14, via the network the removal data needed to remove the visible watermark and restore the original material. At step S16, the visible watermark is removed by the impairment reversing processor and the original material is restored. A digital code word which acts as a fingerprint to identify the version of the material distributed to the buyer client is added at step S18 by the material protection processor. Optionally at step S20, an invisible watermark is added to the A/V material, which may include a unique identifier of the originator of the material. At step S22, the buyer acquires the protected material without the visible watermark.

As will be appreciated the buying client processor 4 may be a secure apparatus in that the apparatus may be closed to the buyer and include tamper-proof features to prevent the buyer from accessing and disrupting the introduction of the protection data into the material and to prevent the buyer from accessing the removal data.

A further step indicated as S.24 shown in Figure 5 involves generating statistical data for the seller. The statistical data may include, inter alia, for example the number of times potential buyers have received the impaired material, the rate of acquisition of the material and financial data such as sales prices.

**Further Embodiments**

The embodiments described above with reference to Figures 1 to 6 provide a material distribution apparatus in which the material protection processor forms part of the buyer client processor. However, in alternative embodiments the material protection processor may form part of the transaction server 6. As such, for example, the invisible watermark processor 50 of the server 6 may form the material protection processor, in which protection data may be introduced into the material before it is transmitted to the buyer client processor.

In a modification of the system of Figure 5 the seller client processor 1 and the transaction-server 6 are coupled via the communications network 2 and the system is configured so that visibly watermarked is transferred from said seller client processor 1 to the or each buyer client processor 4 via the communications network 2, bypassing the transaction server 6. In one version of this embodiment the buyer client processor 4 is operable to receive the removal data separately from the material. For

example the seller client is operable to provide the removal data to the transaction server 6, and the buyer client processor is operable to receive the removal data from the transaction server 6 once the buyer has paid for the material.

Further system of Figures 7 and 8.

Referring to Figure 7, a camera-recorder 71 is used to create audio/video material, which is stored on a data storage medium, e.g. tape 72. The camera-recorder 71 includes an impairment processor 34 and optionally also an invisible watermark processor 50 as described above. It may also include a communications processor 20 as described above for communicating with a network 2 also as described above. The impairment processor 34 introduces an invertible impairment into the video recorded by the camera. The impairment processor also generates removal data with which the impairment may be removed and the original video restored. The removal data may be downloaded onto a smart card SC via a smart card interface SCI or to a transaction server 6 via the communications processor 20 and the network 2.

Referring to Figure 8, at the camera, video is recorded and at step S81 an invisible watermark is optionally introduced in to the video using the processor 50. The visible impairment is introduced at step S82 using the impairment processor 34. If an invisible watermark is provided the impairment is introduced after the invisible watermark. The removal data is generated and stored on the smart card or downloaded to the server 6 in a secure manner as known in the art.

The impaired (and invisibly watermarked) video is stored on a tape 72 and at step S83 physically transferred by a transmission channel 2' to a studio 74. The channel 2' may be the postal service, a courier, or simply the camera operator carrying the tape.

Referring to Figures 7 and 8, the studio 74 contains apparatus for reviewing (S84) the video on the tape and a processor 90 as described above for removing the impairment and restoring the original video (S85). The studio may also include a processor 100 for introducing the protection data and preferably also metadata as described above (S86, S87). The removal data is transferred to the processor 100 using the smart card which downloads the removal data via a smart card interface SCI' or the removal data is transferred in a secure manner via the network 2 from the server 6.

**Embedding and Recovering Data**

A short explanation will now be given of a process through which data may be embedded and recovered from material. This process is suitable for embedding invisible watermarks in material and embedding identification code words to form digital finger prints. Further details are provided in [1].

Generally, an example arrangement for embedding data may comprise a pseudo-random sequence generator, a modulator, a Wavelet transformer, a combiner and an inverse Wavelet transformer.

The pseudo-random sequence generator produces a Pseudo Random Bit Sequence (PRBS), which is fed to the modulator. The modulator is operable to modulate each copy of a PRBS, with each bit of payload data to be embedded. In preferred embodiments, the data is modulated by representing the values of each bit of the PRBS in bipolar form ('1' as +1, and '0' as –1) and then reversing the polarity of each bit of the PRBS, if the corresponding bit of the payload data is a '0' and not reversing the polarity if the corresponding bit is a '1'. The modulated PRBS is then embedded in the material in the transform domain. The Wavelet transformer converts the image into the Wavelet domain. The combiner embeds the payload data into the image, by adding, for each bit of the modulated PRBS a factor $\alpha$ scaled by ±1, in dependence upon the value of the modulated PRBS. Each coefficient of a predetermined region of the Wavelet domain image is encoded according to the following equation:

$$X_i^{'} = X_i + \alpha_n W_{n,i}$$

Where $X_i$ is the i-th wavelet coefficient, $\alpha_n$ is the strength for the $n$-th PRBS and $W_{n,i}$ is the $i$-th bit of the $n$-th modulated PRBS of the payload data to be embedded in bipolar form. Therefore the image is converted from the spatial to the Wavelet transform domain, the combiner adds the PRBS modulated data to the Wavelet domain image, in accordance with application strength $\alpha$ and the image is then inverse Wavelet transformed.

The modulated PRBS effectively forms a spread spectrum signal representing the payload data. As a spread spectrum signal, a reduction can be made in the strength

of the data to be embedded in the image. By cross-correlating the data in the transform domain image to which the modulated PRBS has been added, with a copy of the PRBS, a correlation output signal is produced with a so called correlation coding gain which allows the modulated data bit to be detected and determined. As such, the strength of the data added to the image can be reduced, thereby reducing any perceivable effect on the spatial domain image. The use of a spread spectrum signal also provides an inherent improvement in robustness of the image because the data is spread across a larger number of transform domain data symbols.

Therefore, in order to recover the embedded data from the image, a Wavelet transformer converts the watermarked image into the transform domain. The Wavelet coefficients to which the PRBS modulated data were added by the combiner are then read from the Wavelet bands. These Wavelet coefficients are then correlated with respect to the corresponding PRBS, which was used to embed the data. Generally, this correlation is expressed as the equation below, where $X_n$ is the $n$-th wavelet coefficient and $R_n$ is the $R$-th bit of the PRBS generated by the pseudo random sequence generator.

$$C_n = \sum_{i=1}^{s} X_{sn+i} R_i$$

The relative sign of the result of the correlation $C_n$ then gives an indication of the value of the bit of the embed data in correspondence with the sign used to represent this bit in the embedder.

Various modifications may be made to the embodiments herein before described without departing from the scope of the present invention.

**References**

[1] "Collusion – Secure Fingerprinting for Digital Data", by Dan Boneh and James Shaw, *IEEE Transactions on Information Theory*, volume 44 no. 5, September 1998".

[2] Co-pending UK patent applications numbers 0029859.6, 0029858.8, 0029863.8, 0029865.3, 0029866.1 and 0029867.9.

[3] Co-pending UK patent application number 0029852.1 and 0029850.5.

[4] "UMIDS" J. Wilkinson, *SMPTE Journal* March 2000.

## CLAIMS

1. A material distribution apparatus, comprising

a material server including, a material impairment processor operable to introduce a reversible impairment into the material to be distributed,

a communications network operable to distribute said impaired material to at least one client processor, wherein said client processor comprises

an impairment reversing processor operable to reverse said impairment of said material to produce restored material, and

a data introduction processor operable to introduce data into said restored material, said introduced data being introduced into said restored material with the effect that the introduced data is at least difficult to perceive in said material.

2. A material distribution apparatus, comprising

a material server including a data introduction processor operable to introduce data into material to be distributed, said introduced data being introduced into said material with the effect that the introduced data is at least difficult to perceive in said material, and a material impairment processor operable to introduce a reversible impairment into said material,

a communications network operable to distribute said impaired material to at least one client processor, wherein said client processor comprises

an impairment reversing processor operable to reverse said impairment of said material to produce client restored material.

3. A material distribution apparatus as claimed in Claim 1 or 2, wherein said introduced data includes protection data configured to allow the detection of misuse of the material.

4. A material distribution apparatus as claimed in Claim 3, wherein said data introduction processor is arranged to introduce protection data which serves to identify one or more of: a version of said material; the client processor; and the acquirer of the material.

5. A material distribution apparatus as claimed in Claims 1, 2, 3 or 4, wherein said data introduction processor is arranged to introduce other data which identifies a person having an interest in the material and/or which is metadata relating to the material.

6. A material distribution apparatus as claimed in Claim 5, wherein said other data includes a UMID.

7. A material distribution apparatus as claimed in Claim 5 or 6, wherein a said person having an interest in the material is the originator of said material and/or the owner of said material, the distributor, licensee or any other party having an interest in the intellectual property rights of said material.

9. A material distribution apparatus as claimed in any preceding Claim, wherein said client processor includes a viewer operable to receive data said impaired material from said communications network and to reproduce said impaired material.

10. A material distribution apparatus as claimed in Claim 9, wherein said material includes video material and said apparatus includes a display device for displaying said impaired material.

11. A material distribution apparatus as claimed in any preceding Claim, wherein said material impairment processor is operable to produce said impairment of said material using an impairment algorithm dependent on an encryption key, said impairment processor producing removal data corresponding to the algorithm, said impairment reversing processor being operable to reverse said encrypted impairment in accordance with said removal data.

12. A material distribution apparatus as claimed in any preceding Claim, wherein said material server comprises a seller client processor, said apparatus being

configured so that material is transferrable from said seller client to the or each said client processor via said communications network.

13. A material distribution apparatus as claimed in claim 12 when dependent on claim 11, wherein the client processor is operable to receive the removal data separately from the said material.

14. A material distribution apparatus as claimed in claim 13, comprising a further server, the seller client being operable to provide the said removal data to the further server, and the said client processor being operable to receive the removal data from the further server.

15. A material distribution apparatus as claimed in any one of Claims 1 to 11, wherein said material server comprises

a seller client processor and a transaction-server coupled via said communications network, said seller client being operable to communicate said material to said transaction-server for distribution.

16. A material distribution apparatus as claimed in Claim 15, wherein said seller client includes

said data introduction processor,

said material impairment processor, and

a communications processor operable to communicate, to said transaction processor, said material into which the data has been introduced and which is impaired.

17. A material distribution apparatus as claimed in Claim 16, wherein said transaction server includes a processor operable to store said impaired material, wherein, in response to a request from said client processor to acquire said material, said secure server is operable to communicate said impaired material to the client processor.

18. A material distribution apparatus as claimed in any preceding Claim, wherein said communications network includes the Internet, Extranet, Intranet or the like.

19. A buyer client processor operable to acquire material in a material distribution apparatus as claimed in any preceding Claim, said buyer client processor comprising

an impairment reversing processor operable to remove said impairment of said material to produce restored material.

20. A buyer client processor operable to acquire in a material distribution apparatus as claimed in Claim 1, said buyer client processor comprising

an impairment reversing processor operable to reverse said impairment of said material to produce restored material, and

a data introduction processor operable to introduce data into the said restored material.

21. A buyer client processor as claimed in Claim 19, wherein the data introduction processor is a material protection processor operable to introduce protection data into said restored material, said introduced protection data being at least difficult to perceive in the material.

22. A buyer client processor as claimed in Claim 21, wherein said protection data serves to identify one or more of: a version of material; an acquirer of said material; and the buyer client processor.

23. A buyer client processor as claimed in claim 19, 20, 21 or 22, operable to acquire material from a material server of the material distribution apparatus.

24. A buyer client processor as claimed in Claim 23, wherein said material server comprises a seller client processor, said buyer client processor being configured to receive material from said seller client via said communications network.

25. A buyer client processor as claimed in claim 24 for receiving material in a system according to claim 11, wherein the buyer client processor is operable to receive the removal data separately from the said material.

26. A buyer client processor as claimed in claim 25, comprising a further server, the seller client being operable to provide the said removal data to the further server, and the said client processor being operable to receive the removal data from the further server.

27. A seller client processor operable to provide material in a material distribution apparatus according to any of Claims 1 to 18, said seller client processor comprising

a material impairment processor operable to introduce a reversible impairment into the material to be distributed and to produce corresponding removal data, and

a communications processor operable to communicate said impaired material and said removal data to said transaction processor.

28. A seller client processor as claimed in Claim 27, comprising

a data introduction processor operable to introduce data into said material.

29. A seller client processor as claimed in claim 28, wherein the introduced data includes protection data configured to allow the detection of misuse of the material.

30. A seller client processor as claimed in claim 29, wherein said data introduction processor is arranged to introduce protection data which serves to identify one or more of: a version of said material; the client processor; and the acquirer of the material.

31. A seller client processor as claimed in claim 28, wherein said data introduction processor is arranged to introduce other data which identifies a person having an interest in the material and/or which is metadata relating to the material.

32. A seller client processor as claimed in claim 31, wherein said other data includes a UMID.

33. A seller client processor as claimed in any one of claims 27 to 32, which is operable to provide material to a material server of the material distribution apparatus.

34. A seller client processor as claimed in any one of claims 27 to 32 configured so that material is transferrable from said seller client to the or each said client processor via said communications network.

35. A seller client processor as claimed in as claimed in claim 34 for use in an apparatus according to claim 11, wherein the seller client processor is operable to send removal data separately from the said material.

36. A seller client processor as claimed in claim 35, operable to provide the said removal data to a further server.

37. A method of distributing material comprising

introducing a reversible impairment into the material to be distributed,

distributing said impaired material to at least one client processor,

reversing said impairment of said material to produce client reproduced material, and

introducing data into said restored material with the effect that the introduced data is at least difficult to perceive in said restored material.

38. A method of distributing material comprising

introducing data into material to be distributed with the effect that the introduced data is at least difficult to perceive in said material,

introducing a reversible impairment into the material to be distributed,

distributing said impaired material to at least one client processor, and

reversing said impairment of said material to produce restored material.

39. A method according to claim 37 or 38, wherein the introduced data is protection data configured to allow detection of misuse of the restored material.

40. A method according to claim 39, wherein said introduced data is protection data which serves to identify one or more of: a version of said material; the client processor; and the acquirer of the material.

41. A system for protecting material, comprising:

first apparatus including a material impairment processor operable to introduce a reversible impairment into said material; and second apparatus including an impairment reversing processor operable to reverse said impairment of said material to produce restored material; the system including a processor operable to introduce data into the material.

42. A system according to claim 41 wherein the first apparatus includes the data introduction processor operable to introduce data into material, said introduced data being introduced into said material with the effect that the introduced data is at least difficult to perceive in said material.

43. A system according to claim 41 wherein the second apparatus includes the data introduction processor operable to introduce data into material, said introduced data being introduced into said material with the effect that the introduced data is at least difficult to perceive in said material

44. A system according to claim 41, 42 or 43 wherein the first apparatus is a camera-recorder for producing and recording video signals as the said material.

45. A system according to claim 44, wherein the second apparatus is a video signal processor.

46. A system according to claim 41, 42, 43, 44 or 45, wherein the impairment processor generates impairment removal data.

47. A system according to claim 46, comprising a communications channel for transferring the removal data from the first apparatus to the second apparatus, the first and second apparatus each having a communications interface with the network.

48. A system according to claim 46 wherein the first apparatus has an interface for transferring the protection data to a secure data carrier, and the second apparatus has an interface for receiving the protection data from a secure data carrier.

49. A method of transferring material comprising the steps of introducing a reversible impairment into said material at a first apparatus; transferring the impaired material to a second apparatus; and at the second apparatus reversing said impairment of said material to produce restored material; the method including the further step of introducing into the material data which is substantially imperceptible in the material.

50. A data signal representing impaired material communicated between the material server and the client processor of the material distribution apparatus claimed in any of Claims 1 to 18.

51. A computer program providing computer executable instructions, which when loaded onto a data processor configures the data processor to operate as the buyer client processor of anyone of Claims 19 to 26.

52. A computer program providing computer executable instructions, which when loaded onto a data processor configures the data processor to operate as , the seller client processor of anyone of Claims 27 to 36.

53. A computer program providing computer executable instructions, which when loaded onto a data processor configures the data processor to operate as , or the material distribution apparatus of Claims 1 to 18.

54. A computer program providing computer executable instructions, which when loaded on to a data processor causes the data processor to perform the method according to any of Claims 37 to 40.

55. A computer readable medium recorded thereon information signals representative of the computer program claimed in any of Claims 51 to 54.

56. A material distribution apparatus, a transaction server, a buying client data processor or a seller client data processor as hereinbefore described with reference to Figures 1 to 6 of the accompanying drawings.

57. A method of distributing material as herein before described with reference to the accompanying drawings.

58. A system substantially as hereinbefore described with reference to Figures 7 and 8 of the accompanying drawings.

**Application No:** GB 0121195.2 **Examiner:** Graham Russell
**Claims searched:** 1-58 **Date of search:** 24 May 2002

# Patents Act 1977
# Search Report under Section 17

## Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T):

Int Cl (Ed.7): G06F 17/60

Other: Online: EPODOC, JAPIO, WPI

## Documents considered to be relevant:

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| A | WO 01/97128 A1 | (MARKANY) see page 3 lines 9-19 | |
| X,E | WO 01/43337 A1 | (DVD EXPRESS) see page 3 and page 6 line - page 7 line 9 | 41 |
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