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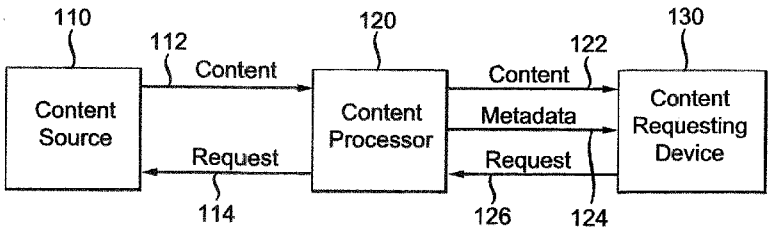


FIG. 1

(57) Abstract: A method, apparatus and system for enhancing content includes receiving a request for content from a playback device. The content request is processed to obtain information identifying at least one of the requested content and the playback device. Metadata is generated for enhancing the content based on the identifying information for the content and the identifying information for the requesting playback device. For instance, the received information for the requesting playback device can include a profile for the playback device. The generated metadata is communicated to the playback device along with the content for manipulation and ultimate reproduction of the content.

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METHOD, APPARATUS AND SYSTEM FOR VIDEO ENHANCEMENT

TECHNICAL FIELD OF THE INVENTION

The present principles generally relate to video enhancement and, more specifically, to transmission of metadata for use in enhancing audio/video content.

BACKGROUND OF THE INVENTION

For many films and television shows, visual effects shots make up a significant portion of the time and money involved in producing such content. Transmission of such content also occupies a large amount of bandwidth. This problem only increases when higher resolution, such as 4K is involved. Currently, upscaling or enhancing of video content is a generic process. That is, there is no adjustment to the enhancement process based on the content being enhanced or the hardware being used for reproduction and playback of the content. What is needed is a system and method for transmission and enhancement for reproduction lower resolution visual effects (which can be produced at reduced cost) . It is further necessary to enhance the content in an efficient and cost effective manner.

SUMMARY

Embodiments of the present principles provide a method, apparatus and system for content enhancement.

In one embodiment of the present principles, a method for enhancing content includes receiving a content request from a playback device, the content request including identifying information for the content requested and the playback device issuing the content request, generating metadata for enhancing the content requested based on the identifying information for the content requested and the identifying information for the playback device issuing the content request and communicating the content requested and the generated metadata to the playback device.

In an alternate embodiment of the present principles, an apparatus for content enhancement includes a network interface communicating with at least one content source and at least one playback device, a memory for storing at least one of program routines, playback device profiles and data and a processor for executing

the program routines. In such an embodiment, the processor is configured to receive a content request from a playback device, the content request including identifying information for the content requested and the requesting playback device, generate metadata for enhancing the content requested based on the identifying information for the content and the identifying information for the requesting playback device and communicate the content requested and the generated metadata to the playback device.

In an alternate embodiment of the present principles, a method of enhancing content at a playback device includes communicating a content request including information representative of the content requested and information identifying the playback device, receiving the content requested and metadata for enhancing the content based on the identifying information for the content and the identifying information for the playback device, processing the content and metadata to generate enhanced content and reproducing the enhanced content for display.

In an alternate embodiment of the present principles, a device for enhancing and reproducing content includes an interface that transmits a content request signal including data representative of the requested content and data identifying the playback device to a content processor and receives requested content and metadata for enhancing the content. A decoder decodes the content and metadata. A processor processes the content and metadata to generate enhanced content and reproduces the enhanced content for display.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects, features and advantages of the present principles will be described or become apparent from the following detailed description of the preferred embodiments, which is to be read in connection with the accompanying drawings.

In the drawings, wherein like reference numerals denote similar elements throughout the views:

FIG. 1 depicts a high level block diagram of a system for enhancing audio/video content in accordance with an embodiment of the present principles;

FIG. 2 depicts a high level block diagram of a processing device used in the system for enhancing audio/video content in accordance with an embodiment of the present principles;

FIG. 3 depicts a flow diagram of an exemplary method for enhancing audio/video content in accordance with an embodiment of the present principles;

FIG. 4 depicts an exemplary representation of a MPEG4 Part 14 Container file in accordance with an embodiment of the present principles; and

FIG. 5 depicts a flow diagram of an exemplary method for enhancing playback of content in accordance with an embodiment of the present principles.

It should be understood that the drawing(s) is for purposes of illustrating the concepts of the present principles and is not necessarily the only possible configuration for illustrating the principles.

DETAILED DESCRIPTION

It should be understood that the elements shown in the figures may be implemented in various forms of hardware, software or combinations thereof. Preferably, these elements are implemented in a combination of hardware and software on one or more appropriately programmed general-purpose devices, which may include a processor, memory and input/output interfaces. Herein, the phrase "coupled" is defined to mean directly connected to or indirectly connected with through one or more intermediate components. Such intermediate components may include both hardware and software based components.

The present description illustrates the principles of the present disclosure. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the disclosure and are included within its scope.

All examples and conditional language recited herein are intended for instructional purposes to aid the reader in understanding the principles of the disclosure and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions.

Moreover, all statements herein reciting principles, aspects, and embodiments of the disclosure, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

Thus, for example, it will be appreciated by those skilled in the art that the block diagrams presented herein represent conceptual views of illustrative circuitry embodying the principles of the disclosure. Similarly, it will be appreciated that any flow charts, flow diagrams, state transition diagrams, pseudocode, and the like represent various processes which may be substantially represented in computer readable media and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.

The functions of the various elements shown in the figures may be provided through the use of dedicated hardware as well as hardware capable of executing software in association with appropriate software. When provided by a processor, the functions may be provided by a single dedicated processor, by a single shared processor, or by a plurality of individual processors, some of which may be shared. Moreover, explicit use of the term "processor" or "controller" should not be construed to refer exclusively to hardware capable of executing software, and may implicitly include, without limitation, digital signal processor ("DSP") hardware, read only memory ("ROM") for storing software, random access memory ("RAM"), and nonvolatile storage.

Other hardware, conventional and/or custom, may also be included. Similarly, any switches shown in the figures are conceptual only. Their function may be carried out through the operation of program logic, through dedicated logic, through the interaction of program control and dedicated logic, or even manually, the particular technique being selectable by the implementer as more specifically understood from the context.

In the claims hereof, any element expressed as a means for performing a specified function is intended to encompass any way of performing that function including, for example, a) a combination of circuit elements that performs that function or b) software in any form, including, therefore, firmware, microcode or the like, combined with appropriate circuitry for executing that software to perform the function. The disclosure as defined by such claims resides in the fact that the functionalities provided by the various recited means are combined and brought together in the manner which the claims call for. It is thus regarded that any means that can provide those functionalities are equivalent to those shown herein.

The present principles are directed towards a method, apparatus and system for enhancing/manipulating audio/video content by transmitting metadata related to

applications that support the enhancement/manipulation of the audio/video content along with the audio/video content. The enhancement metadata can be used by a receiving device to perform operations such as upscaling, sharpening video, providing additional high dynamic range for video, providing higher sound fidelity, and any other content manipulations that can be performed by the receiving device. In alternate embodiments, additional metadata can be used by software/hardware/additional video/audio processors to provide such enhanced content. It should be noted that the terms playback device, receiving device and requesting or client device can be used interchangeably throughout the teachings of the present principles and are used to identify a device capable of requesting content and one having received the content are capable of manipulating/enhancing the content in accordance with generated metadata.

In various embodiments of the present principles, the metadata can be generated using various analysis algorithms and the like at a head end or other "upstream" entity where metadata describing source material or content can be generated before the source content is encoded into another format. For example, source content can be in a resolution existing in a 4K or 8K format. In various embodiments, the algorithms are implemented to analyze the source content to derive various metadata involving areas of high contrast, regions featuring different gradients of color, areas of complex luminance, regions involving complex textures, regions involving faces, and the like. The source content in a particular format, e.g. 4K or 8K, can then be encoded into a lower resolution (2K) and transmitted for broadcast or streaming. The metadata that was generated can also be transmitted as part of this broadcast/stream. When the metadata and the lower resolution (2K) content is received by a receiving device, the metadata is used to enhance the received lower resolution (2K) material where areas of certain interest (as expressed in the metadata) can have finer detail, while other regions which don't have corresponding metadata are not enhanced. Encoding the content at a lower resolution and attachment of the metadata for enhancing the content at an end user device allows for a reduction in the amount of bandwidth necessary for transmission and thus more efficient use of bandwidth.

In various embodiments of the present principles, some devices may not utilize all of the generated metadata because a manufacturer of such devices can ascribe a higher priority to some functionality (e.g., High Dynamic Range (HDR)) over other

functionality (e.g., textures). It is also possible that a manufacturer prefers to enhance certain aspects of a picture (e.g., sharpness) over or instead of other aspects (e.g., atmospheric effects). Additionally, some manufacturers may not want their "preferences" to be known and/or the manufacturers can have custom algorithms that they want applied to the source content where they would not want to have the custom metadata available for a 3rd party to use or generate. This can be necessary in order to preserve a trade secret for the manufacturer or when a manufacturer does not want to disclose what specific metadata is of interest when enhancing received content. In such instances, certain metadata would go unused and thus, would be generated and transmitted needlessly.

In one embodiment of the present principles, in order to properly and efficiently transmit content to a user, metadata is individually produced for each requesting user based on at least the capabilities of a requesting playback device. As such, capabilities of such devices must be known or learned. In one embodiment of the present principles, when a playback device requests content, a content processor of the present principles receives the request for content, the request including information identifying at least the requesting playback device. In one embodiment, the identifying information includes information regarding the capabilities of the requesting playback device for enhancing/manipulating content. In an alternate embodiment of the present principles, each type of device that can request content can have an individual respective profile identifying metadata requirements for enhancing content. Such information is used to generate the metadata when a request for content is received. In one embodiment, the profile for each device can be stored in a head end unit generating the metadata and can identify the types of metadata utilized by the device. In alternate embodiments of the present principles, the profile for a requesting device can be provided and transmitted by the device with a signal requesting audio/video content. In various embodiments of the present principles, the metadata can describe a variety of different aspects of the original audio/video content. For example metadata can be described as follows:

MD = {MD1, MD2, MD3,...., MDX}, wherein MD1-MDX each represent metadata for a respective content feature.

In one embodiment, for each manufacturer or device, there may be an interest in receiving certain metadata identified in a profile for the respective devices of such a manufacturer or device. For example, such interest can be expressed as follows:

Manufacturer 1 = {MD3, MD7, MD10, MD12, ..., MD49}
Manufacturer 2 = {MD1, MD3, MD31, ..., MD101}

Additionally, in alternate embodiments of the present principles, other metadata can be made available for anyone (general public) to use, where such metadata is transmitted in the open and can be expressed as follows:

General Public = {MD1, MD2, MD4, MD6, ..., MDX}

In alternate embodiments of the present principles, manufacturer-specific metadata can be individually encrypted based on encoding that devices of a respective manufacturer configured to receive the metadata are programmed to decrypt.

FIG. 1 depicts a high level block diagram of an embodiment of a system 100 for enhancing audio/video content in accordance with an embodiment of the present principles. The system 100 of FIG. 1 illustratively includes a content source 110, a content processor 120, and a content requesting/playback device 130. In the embodiment of FIG. 1, the content source 110 stores or alternatively has access to content for processing by the content processor 120 and reproduction by the content requesting device 130. In various embodiments of the present principles, the content source 110 can comprise a source of content including, but not limited to, at least one of a broadcast content source, a camera, a server, or storage device such as a hard drive, flash storage, magnetic tape, optical disc, and the like.

In response to a request for content received form a playback device, the content processor 120 of FIG. 1 receives content from the content source 110. In accordance with the present principles, the request for content further includes identifying information for the requested content and the requesting playback device. In the embodiment of FIG. 1, the content processor 120 generates metadata 124 based on the information received identifying the content and the information received identifying the requesting playback device. In one embodiment of the

present principles the identifying information for the requested content received with the content request can include information regarding in which ways the content can be enhanced/manipulated and the identifying information for the requesting playback device can include data identifying the metadata the content requesting device 130 is able or programmed to process. In such an embodiment, metadata is generated for enhancing the content based on how the requested content can be enhanced and based on the capabilities of the requesting playback device for enhancing/manipulating the content.

In an alternate embodiment of the present principles, the content processor of the present principles refers to a profile for the requesting playback device to generate metadata to be used by the playback device for enhancing/manipulating the requested content. In such embodiments, the profile for the playback device identifies the capabilities of the playback device for enhancing/manipulating content and can further identify desired enhancements to be made by the playback device to content depending on, for example, a source of the content, a subject of the content, a location of the presentation of the content, and other factors on which the display of content can be dependent. As described above, each type of device that can request content can have an individual respective profile identifying metadata requirements for enhancing content. The profile for each device can be stored in a head end unit generating the metadata and can identify the types of metadata utilized by the device or can be provided and transmitted by a requesting playback device with a signal requesting audio/video content. Even further, in alternate embodiments of the present principles, a content processor of the present principles can store profiles for content requesting/playback devices in a local memory.

The metadata for enhancing the content generated by the content processor 120 is communicated, in one embodiment, with the content 122 when content is transmitted to the content requesting device 130.

The content requesting device 130 of FIG. 1 can comprise at least one of, but is not limited to, a television, media player, personal electronic device, or the like, that is used for the playback/reproduction and/or display of received content. In one embodiment of the present principles, the content requesting device 130 receives metadata 124 along with requested content 122 from the content processor 120. The content requesting device 130 then processes the metadata 124 to manipulate/ enhance reproduction and/or display of the received content 122. In various

embodiments of the present principles, the processing includes, but is not limited to, upscaling of the content from a lower resolution to a higher resolution.

More specifically in various embodiments of the present principles, when it is desired to view audio/video content, the content requesting device 130 sends a first request signal 126 to the content processor 120 requesting the content. The first request signal 126 can include data identifying the content desired as well as information identifying the requesting device 130. In alternate embodiments, the first request signal 126 can further include data identifying the type of metadata the content requesting device 130 is cable of or configured to process.

Upon receiving the first request signal 126, the content processor 120 transmits a second request signal 114 to the content source 110 requesting the content. Upon receipt of the second request signal 114, the content source 110 searches for and provides the requested content 112 to the content processor 120. The content 112 content can include any number of formats and resolutions. For example, the content can comprise High Definition (2K) or Ultra High Definition (4K) resolutions. Such content 112 can also conform to different video profiles such as Main, Extended, Baseline, and the like that are known for different video standards such as MPEG-2, MPEG-4, H.264, H.265, SVEC, and the like. Upon receipt of the content, the content processor 120 searches for a profile for the requesting device 130 and, if found, processes the content to generate metadata in accordance with the stored profile. That is, the type of metadata generated is based on the stored profile related to the requesting device 130 identified by the first request signal 126. If the requesting device 130 does not have a profile stored in a memory accessible by the content processor 120, the content processor 120 will either generate metadata in accordance with information received with the first content request signal 126 or provide at least one of generic metadata, predetermined metadata, or a default set of metadata to the requesting device 130. The content processor 120 also formats the content received from the content source 110 for transmission 122 to the content requesting device 130. In alternate embodiments of the present principles, the generated metadata is either combined with the content for transmission to the requesting device 130 or transmitted separately from the content to the requesting device 130.

Examples of exemplary metadata fields for video processing include:

Metadata – Luminance
Metadata – Chrominance
Metadata – Block Size
Metadata – Bit Depth
Metadata – Motion Vectors
Metadata – Noise Reduction Parameters
Metadata – Motion Estimation
Metadata – Quantization Levels
Metadata – Color Information for High Dynamic Range
Metadata - Other

It is envisioned that such metadata fields and associated metadata can be used in a processing device within, in one embodiment, the content requesting device 130 to enhance the content being reproduced. For example, in one embodiment of the present principles, the content requesting device 130 can include an upscaling chip (e.g., the "VTV-122x" integrated circuit provided by Marseille Networks) that can process metadata in order to upscale received video for playback. In such an embodiment, the content processor 120 encodes the content in a format able to be decoded by the content requesting device 130 and sends the content 122 and metadata 124 to the content requesting device 130. As described above, in one embodiment, the content and metadata can be combined into a single signal and transmitted together or in alternate embodiments can be transmitted separately 122 and 124 as depicted in FIG. 1.

In accordance with various embodiments of the present principles, the generation of the metadata for the content to be used by the content requesting device can be done on a scene-by-scene or shot-by-shot manner that provides a time code based mapping of image enhancement/manipulation requirements. For example, the generation can include metadata on how best to upscale content from a lower resolution to a higher resolution. In alternate embodiments, the content processing can included encoding of the content or otherwise changing the format or resolution of the content for a receipt device and decoding by a content requesting device 130. For example, some scenes may have a high concentration of visual effects, or shots can include a very detailed image, or can have a very high contrast ratio. These and other factors can require an adjustment to various settings for noise, chroma and scaling to avoid artifacts and maximize the quality of the viewing experience. The enhancements/manipulations can also account for the abilities or limitations of the hardware being used for the playback or display of the content.

The results of the content analysis for providing enhancements/manipulations are translated or otherwise converted to metadata. The metadata can include instructions for the content requesting device 130 on to how to best optimize reproduction and/or playback of the content. For example, the metadata can include code or hardware specific instructions for an upscaler and/or decoder of the content requesting device 130. Examples of such metadata instructions can include generic parameters such as sharpness, contrast, or noise reduction. The metadata can also include specific instructions for different types of devices or hardware. Other possible parameters will be apparent to one skilled in the art given the teachings of the present principles.

In accordance with an alternate embodiment of the present principles, a master or reference file can be created for each piece of content. Such a file can include two elements:

1) Element 1: Scene by scene and/or frame by frame analysis of factors that would affect image quality. This analysis would involve both automated and human quality observation of the before and after comparison, and technical description of factors that would affect image quality. By defining these factors, it is viable for an automated authoring system to provide analysis of conditions that are then capable of being tagged for insertion as metadata.

2) Element 2: The metadata can be encoded into an instruction set for the display and up-scaling chips to adjust their settings, thereby optimizing the viewing experience and minimizing the occurrence of artifacts displayed on the screen.

The creation and use of such master or reference lists allows for the following functionality to occur in the content pipeline:

1) The up-scaling and display chip, depending on generation, will adjust settings of noise reduction, gamma, scaling etc. This developed metadata can be archived based on the content file, and encoding processes developed to support other manufacturer's up-scaling and image control chips.
2) As higher resolution and new viewing formats evolve, this content pipeline can be adapted to repurpose Element 1 of the master file to adapt to new formats in a fully automated process for Element 2.

After such processing, the resulting metadata 124 is communicated to the requesting device 130 for use in enhancing the content. Once received by the requesting device, the metadata is processed to optimize the reproduction or playback of the content. In some embodiments the metadata 124 can be provided with the content 122 as a single signal.

FIG. 2 depicts a high level block diagram of a content processor able to be implemented in, for example, the system of FIG. 1 for enhancing audio/video content in accordance with an embodiment of the present principles. The content processor 120 of FIG. 2 illustratively includes one or more processors 210, a storage device 220 including at least one of a memory 230 and storage 240, and a network interface 250.

In the embodiment of FIG. 2, the processor 210 controls the operation of the content processor 120. For example, the processor 210 analyzes request signals received from, for example, the content requesting device 130 and processes content received from a content source 110 for transmission to the content requesting device 130. The processor 210 is connected to the storage device 220 and network interface 250, and handles the transfer and processing of information between these elements. The processor 210 can be a general processor or a processor dedicated for a specific functionality. In alternate embodiments, the processor can comprise a compilation of multiple processors.

In the embodiment of FIG. 2, the storage device 220 stores control programs/software routines, display information, instructions and data to be executed by the processor 210. In alternate embodiments, the storage device 220 also stores identifying information and profiles for known content requesting devices 130 from which a request for content can be received. Each profile indicates the type of metadata able to be processed by the respective content requesting device 130. The storage device 220 also stores information used and produced by the content processor 120 in executing the content analysis. In various embodiments, the storage device 220 can include any combination, but not limited to, a volatile memory (RAM), non-volatile memory (EEPROM), or other suitable media such as magnetic media (hard drive), optical media (CD/DVD-Rom), or flash based storage. Other types of suitable storage will be apparent to one skilled in the art given the teachings of the present principles.

Referring back to the embodiment of FIG. 2, the network interface 250 connects the content processor 120 with other devices over a network. For example, the network interface 250 connects the content processor 120 with a content source 110 and a requesting device 130 over the network. Examples of suitable networks for the embodiment of FIG. 2 can include Ethernet networks, Wi-Fi enabled networks, cellular networks, and the like. Other types of suitable networks will be apparent to one skilled in the art given the teachings of the present principles. It should be understood that the elements set forth in FIG. 2 are illustrative. The content processor 120 can include any number of elements and certain elements can provide part or all of the functionality of other elements. Other possible implementations will be apparent to one skilled in the art given the benefit of the teachings of the present principles.

FIG. 3 depicts a flow diagram 300 of an exemplary method for enhancing audio/video content in accordance with an embodiment of the present principles. The method 300 begins at step 310 during which a content request from a playback device is received by a content processor of the present principles, the content request including identifying information for the requested content and the requesting playback device. That is, as set forth above with reference to FIG. 1, a first request signal 126 for content is received by the content processor 120 from the content requesting device 130. In the embodiment of FIG. 1, the first request signal 126 includes information identifying the content being requested and the content requesting device 130. The content processor 120 processes the content request to identify characteristics of the content being requested and obtains information identifying characteristics of the content requesting device. The method 300 can then proceed to step 320.

At step 320, metadata for enhancing/manipulating the requested content is generated based on the identifying information for the content and the identifying information for the requesting playback device. That is as described above, in one embodiment of the present principles the identifying information for the requested content received with the content request can include information regarding in which ways the content can be enhanced/manipulated and the identifying information for the requesting playback device can include data identifying the metadata the content requesting device 130 is able or programmed to process. In such an embodiment, metadata is generated as described above for enhancing the content based on how

the requested content can be enhanced and based on the capabilities of the requesting playback device for enhancing/manipulating the content.

As also described above, in an alternate embodiment of the present principles, the content processor of the present principles can refer to a profile for the requesting playback device to generate metadata to be used by the playback device for enhancing/manipulating the requested content. In such embodiments, the profile for the playback device identifies the capabilities of the playback device for enhancing/manipulating content and can further identify desired enhancements to be made by the playback device to content depending on, for example, a source of the content, a subject of the content, a location of the presentation of the content, and other factors on which the display of content can be dependent. Even further, if no profile exists and a determination cannot be made using the information received with the content request, a content processor of the present principles can generate and transmit a plurality of types of metadata and the requesting device 130 can choose which metadata to process for enhancing/manipulating the content. The method 300 can then proceed to step 330.

At step 330, the requested content and the generated metadata are communicated to the requesting playback device. The method 300 can then be exited.

As described above, in alternate embodiments of the present principles, a method of the present principles can further include encoding or otherwise changing of the format or resolution of the content 122 before communication of the content to the requesting device 130.

As described above, in various embodiments, the content 122 can be provided along with the metadata 124 as a single signal. An example of this can be seen in FIG. 4. That is, FIG. 4 depicts an exemplary representation of a MPEG4 Part 14 Container file 400 for communication of a content signal and associated metadata in accordance with an embodiment of the present principles. In the embodiment of FIG. 4, the container file 400 includes the content including video data 410, audio data 420 and subtitle data 430 as well as additional data such as upscaling data 440 and other data 450. In the embodiment of FIG. 4, the metadata 124 is provided as part of the upscaling data 440 and/or other data 450 for transmission with the content. Some exemplary parameters for the metadata can be seen at 460. Included in the embodiment of FIG. 4 is a partial block diagram of the requesting device, providing

one example of how the data in the container file 400 of FIG. 4 can be received by the hardware of the content requesting device 130. In the embodiment of FIG. 4, the provided metadata is focused on upscaling so the video data 410, audio data 420 and subtitle data 430 is received and processed by the video decoder 550 of the content requesting device. The upscaling data 440 and other data 450, including the metadata 124, is processed by a processor (e.g., upscaler 560) of the content requesting device. In certain other embodiments other data 450, including the metadata, could also be processed by the video decoder 550. Once the metadata is received by the requesting device, the requesting device uses the received metadata to enhance/manipulate the content in accordance with the received metadata.

FIG. 5 depicts a flow diagram 500 of an exemplary method for enhancing playback of content in accordance with an embodiment of the present principles. The method 500 begins at step 510 during which a content request including information representative of the requested content and information identifying the playback device is communicated to, for example, a content processor of the present principles. The method 500 can then proceed to step 520.

At step 520, the requested content and metadata for enhancing the content based on the identifying information for the content and the identifying information for the requesting playback device are received. As described above, depending on how the content and metadata are processed and transmitted by the content processor 120, the content and metadata can be received together in a single signal or separately. The method 500 can then proceed to step 530.

At step 530, the content is then processed using the received metadata to enhance/manipulate the content in accordance with the capabilities of the content requesting device 130. The method 500 can then proceed to step 540.

At step 540, once the content is processed using the metadata, the content is output by the content requesting device 130 for reproduction on a display. Other possible implementations and methods for processing the data will be apparent to one skilled in the art. The method 500 can then be exited.

Although embodiments which incorporate the teachings of the present principles have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings. Having described preferred embodiments of a method, apparatus and system for enhancing content (which are intended to be illustrative and not limiting), it is noted

that modifications and variations can be made by persons skilled in the art in light of the above teachings. It is therefore to be understood that changes may be made in the particular embodiments of the disclosure disclosed which are within the scope of the disclosure as outlined by the appended claims.

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CLAIMS

1. A method of enhancing content comprising, at a content processor,

receiving a content request from a playback device, the content request including identifying information for the content requested and the playback device issuing the content request;

generating metadata for enhancing the content requested based on the identifying information for the content requested and the identifying information for the playback device issuing the content request; and

communicating the content requested and the generated metadata to the playback device.

2. The method of claim 1, comprising:

retrieving a profile for the playback device identified in the information included with the content request for use in generating metadata for enhancing the content requested.

3. The method of claim 1, comprising:

storing profiles for playback devices for use in generating metadata for enhancing the content requested.

4. The method of claim 1, wherein the content request further includes information identifying types of metadata able to be processed by the playback device.

5. The method of claim 1, comprising:

encoding the content requested prior to communicating the content requested to the playback device.

6. The method of claim 5, wherein encoding of the content changes at least one of a format and resolution of the content.

7. The method of claim 5, wherein the encoded content and metadata are communicated as a single entity.

8. The method of claim 1, wherein the generated metadata is applied to at least one of the group comprising areas of high contrast, regions featuring different gradients of color, areas of complex luminance, regions involving complex textures and regions involving faces in the content.

9. The method of claim 1, wherein the generated metadata includes instructions for optimizing at least one of the group comprising reproduction of the content, code, hardware specific instructions for the playback device and generic parameters including any of sharpness, contrast and noise reduction for the content.

10. An apparatus for enhancing content, comprising:

a network interface communicating with at least one content source and at least one playback device;

a memory for storing at least one of program routines, playback device profiles and data; and

a processor for executing said program routines;

said processor configured to:

receive a content request from a playback device, the content request including identifying information for the content requested and the requesting playback device;

generate metadata for enhancing the content requested based on the identifying information for the content and the identifying information for the requesting playback device; and

communicate the content requested and the generated metadata to the playback device.

11. The device of claim 10, wherein the content is an audio/video signal.

12. The apparatus of claim 10, wherein said processor is configured to retrieve a profile for the playback device identified in the information included with the content request for use in generating metadata for enhancing the content requested.

13. The apparatus of claim 12, wherein said profile is received as part of the identifying information for the playback device.

14. The apparatus of claim 10, wherein the content request further includes information identifying types of metadata able to be processed by the playback device.

15. The apparatus of claim 10, wherein said processor is configured to encode the content prior to communicating the content to the playback device and the encoded content and metadata are transmitted by the network interface to the playback device as a single entity.

16. The apparatus of claim 10, wherein the generated metadata is to be applied to at least one of the group comprising areas of high contrast, regions featuring different gradients of color, areas of complex luminance, regions involving complex textures and regions involving faces in the content.

17. The apparatus of claim 10, wherein the generated metadata includes instructions for optimizing at least one of the group comprising reproduction and/or playback of the content, code or hardware specific instructions for the playback device and generic parameters including any of sharpness, contrast and noise reduction for the content.

18. A method of enhancing content, comprising, at a playback device,

communicating a content request including information representative of the content requested and information identifying the playback device;

receiving the content requested and metadata for enhancing the content based on the identifying information for the content and the identifying information for the playback device;

processing the content and metadata to generate enhanced content; and

reproducing the enhanced content for display.

19. The method of claim 16, wherein the content is audio/video content.

20. The method of claim 16, wherein said information identifying the playback device comprises a profile for the playback device for use in generating metadata for enhancing the content requested.

21. The method of claim 16, wherein the content request further includes information identifying types of metadata able to be processed by the playback device.

22. The method of claim 16, wherein the content and metadata received by the playback device comprise a single combined signal.

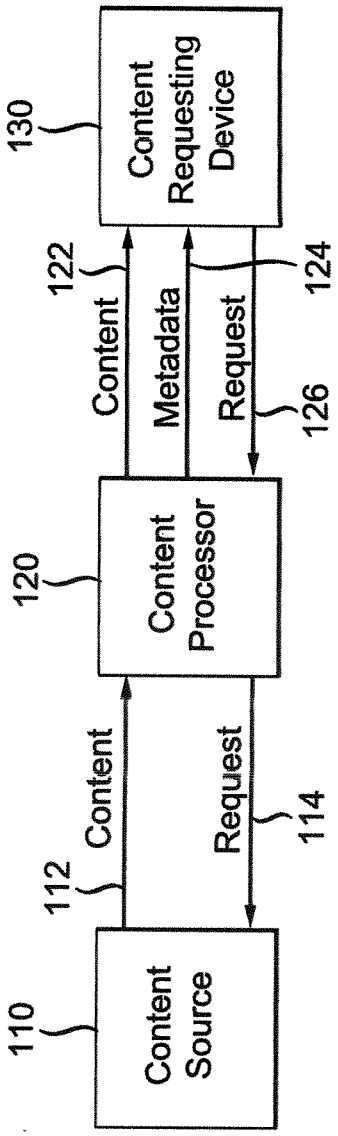

130
Content Requesting Device
122
Content
Metadata
124
Request
126
120
Content Processor
Content
112
Request
114
110
Content Source

FIG. 1

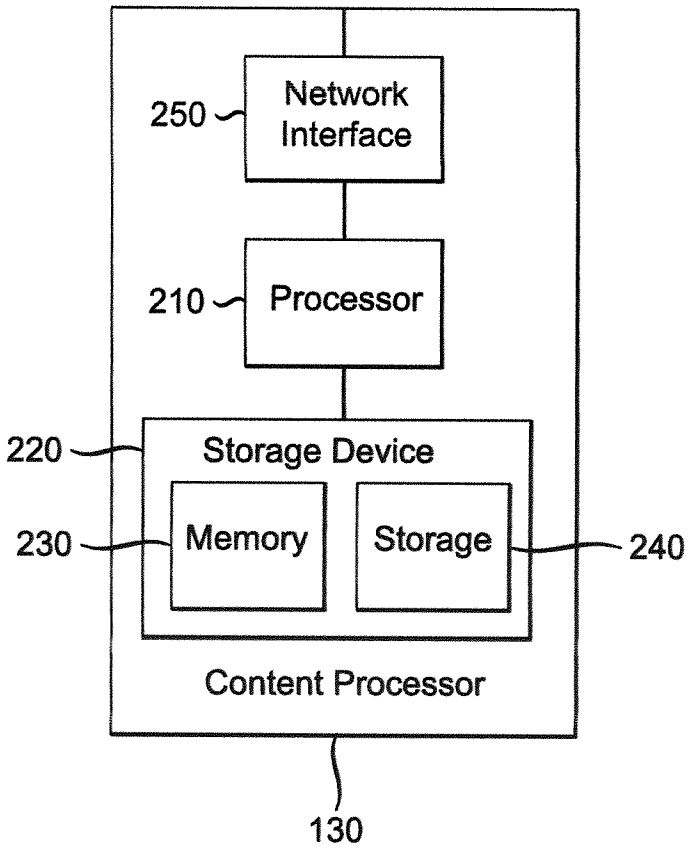

250
Network Interface
210
Processor
220
Storage Device
230
Memory
Storage
240
Content Processor
130

FIG. 2

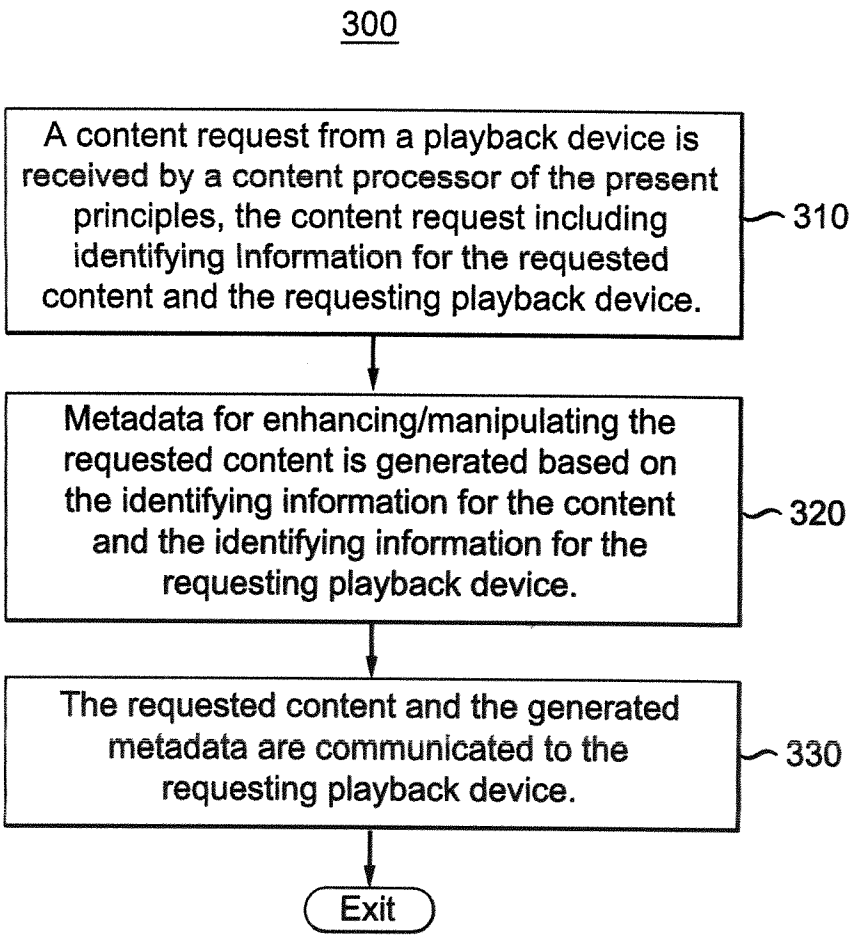

300
A content request from a playback device is received by a content processor of the present principles, the content request including identifying Information for the requested content and the requesting playback device.
310
Metadata for enhancing/manipulating the requested content is generated based on the identifying information for the content and the identifying information for the requesting playback device.
320
The requested content and the generated metadata are communicated to the requesting playback device.
330
Exit

FIG. 3

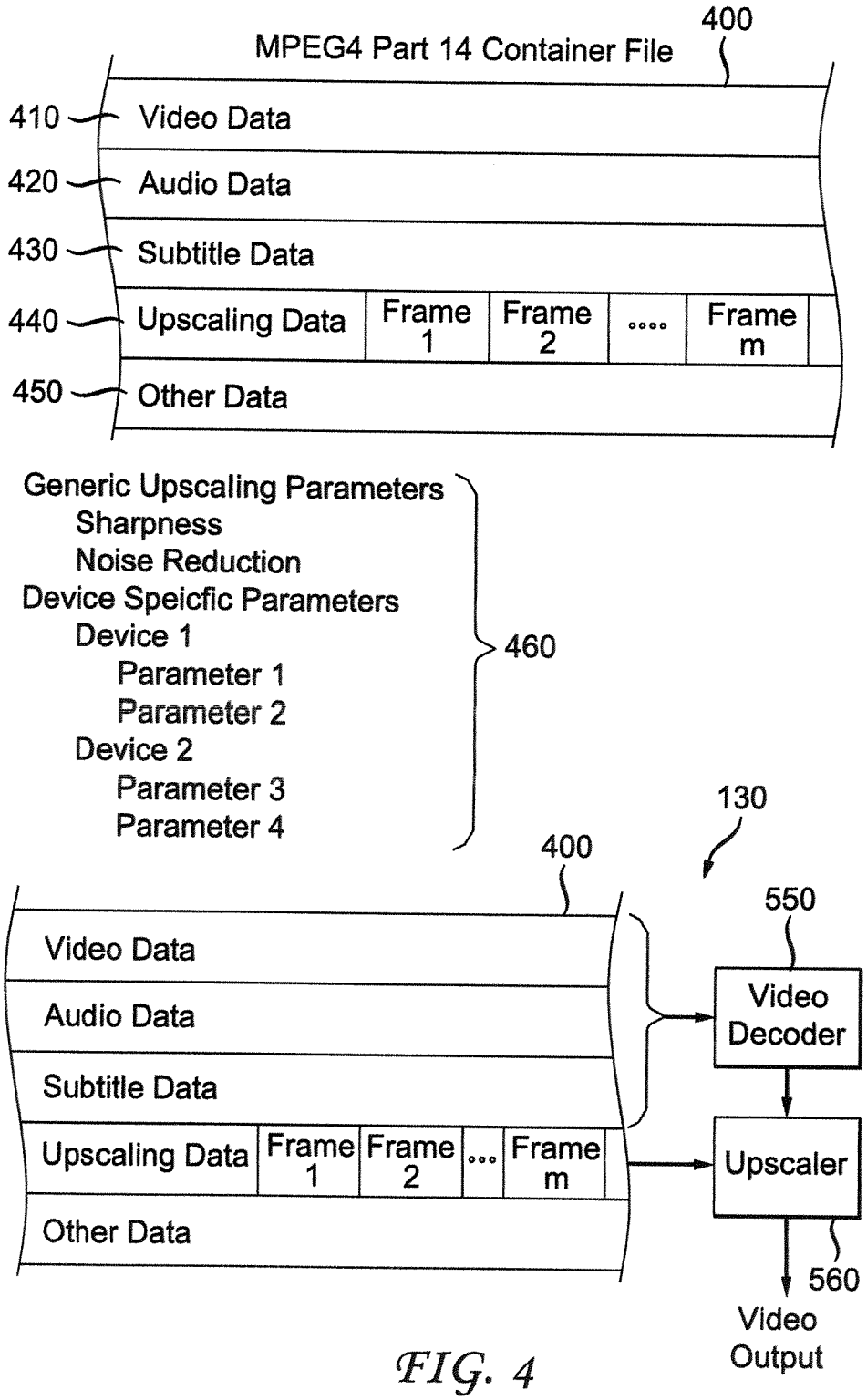

400
MPEG4 Part 14 Container File
410
Video Data
420
Audio Data
430
Subtitle Data
440
Upscaling Data
Frame 1
Frame 2
....
Frame m
450
Other Data
Generic Upscaling Parameters
Sharpness
Noise Reduction
Device Speicfic Parameters
Device 1
Parameter 1
Parameter 2
Device 2
Parameter 3
Parameter 4
460
130
400
550
Video Decoder
Upscaler
560
Video Output

FIG. 4

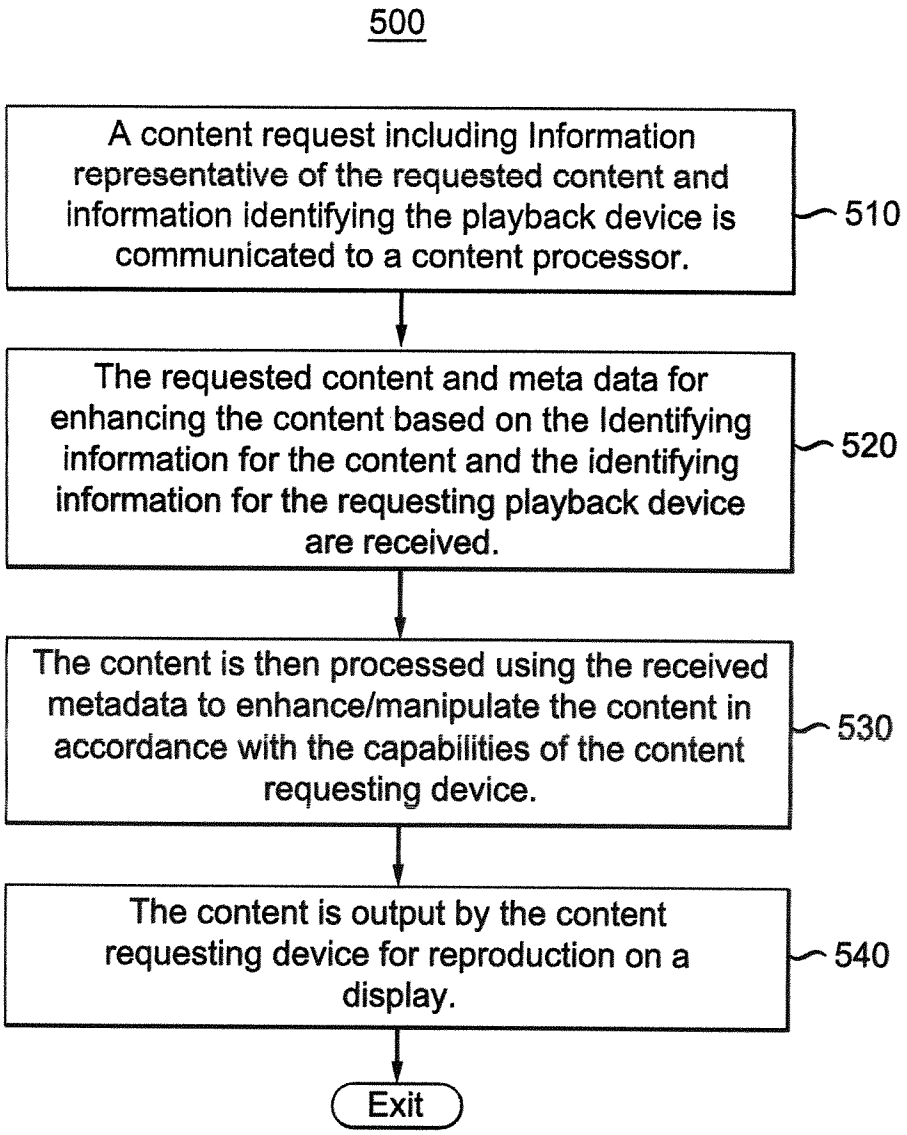

500
A content request including Information representative of the requested content and information identifying the playback device is communicated to a content processor.
510
The requested content and meta data for enhancing the content based on the Identifying information for the content and the identifying information for the requesting playback device are received.
520
The content is then processed using the received metadata to enhance/manipulate the content in accordance with the capabilities of the content requesting device.
530
The content is output by the content requesting device for reproduction on a display.
540
Exit

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/065151

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N21/235 H04N21/658
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/125181 A1 (MONTEMAYOR EDUARDO [US] ET AL) 16 May 2013 (2013-05-16)	1-3,5,6, 8-13, 15-20
A	the whole document	4,7,14

X	EP 1 732 328 A1 (THOMSON BRANDT GMBH [DE]) 13 December 2006 (2006-12-13)	1,2,4,7, 10,14, 18,19, 21,22
A	paragraph [0017] - paragraph [0026]	3,5,6,8, 9,11-13, 15-17,20

A	US 2011/107080 A1 (OHBITSU TOSHIRO [JP]) 5 May 2011 (2011-05-05) paragraph [0052] - paragraph [0063]	1-22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 February 2016	02/03/2016

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2015/065151

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		WO 2010016129 A1	11-02-2010