Digital Imaging and Communications in Medicine (DICOM)

Supplement xxx:

HEVC/H.265 Scalable Profiles Transfer Syntax

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Scope and Field of Application

1 INTRODUCTION

This supplement describes two new Transfer Syntaxes to embed High Efficiency Video Coding (HEVC) Scalable Monochrome Profile / Level 5.1, Scalable Monochrome 12 Profile / Level 5.1, Scalable Monochrome 16 Profile / Level 5.1 and Scalable Main 4:4:4 Profile / Level 4.1 encoded pixel data in DICOM. It does not introduce any new SOP Classes or IODs.

2 IMPROVEMENT OF THE LOSSLESS CONTENT MANAGEMENT

In this supplement, it is proposed to include new profiles in order to offer a more efficient way to store and manage lossless still images. The targeted applications include using HEVC streams to store and exchange lossless images but also the easy production of lossy content out of a stored lossless content. The proposed profiles aim at compressing Monochrome and 4:4:4 images as these are the ones which usually require processing and storage in a lossless format.

The proposed HEVC profiles for monochrome and 4:4:4 lossless support are based on scalability to bring a new efficient way to share and manage lossless images within PACS, and between PACS and other facilities or other devices inside a facility. The proposed new format of lossless stream is composed of a lossy light base (with possibly a high quality) and a lossless heavier complementary stream. By using the profiles introduced below, it is possible to manipulate the lossy and the lossless versions of images without any need for additional transcoding.

The proposed syntax would allow for software encoding roughly 4 times slower than JPEG and decoding of about the same speed as JPEG (please note that these numbers are given as indications and may vary depending on the implementation). By using the proposed syntax a 4% gain can be expected for lossless compression over JPEG2000 and JPEG LS. It will also be possible to produce lossy content at very high quality for a reduced size of file. Indeed, tests show that an average of 6dB can be expected in terms of quality difference between HEVC and JPEG2000 at a given bit-rate. However, the reader should be reminded that these syntaxes' main advantage lie in the extra features they bring rather than the raw compression efficiency.

Transfer Syntax "HEVC/H.265 Scalable Monochrome" will perform consistently with

1) the ISO/IEC 23008-2:2016 HEVC Scalable Monochrome Profile at Level 5.1 except for additional constraints on the enhancement layers of the coded bitstreams.
2) the ISO/IEC 23008-2:2016 HEVC Scalable Monochrome 12 Profile at Level 5.1 except for additional constraints on the enhancement layers of the coded bitstreams
3) the ISO/IEC 23008-2:2016 HEVC Scalable Monochrome 16 Profile at Level 5.1 except for additional constraints on the enhancement layers of the coded bitstreams.

This will enable the storage of monochrome sequences of still pictures with a resolution of 4096x2160, with a bit depth varying from 8 to 16 bits, at 50Hz/60Hz, in a lossless or lossy format and comprising a detachable lossy and lighter version. Such content can typically be produced from CT scanners.

Transfer Syntax "HEVC/H.265 Scalable Main 4:4:4" will perform consistently with the ISO/IEC 23008-2:2016 HEVC Scalable Main 4:4:4 Profile at Level 4.1 except for additional constraints on the enhancement layers of the coded bitstreams. This will enable the storage of RGB video files and sequences of still pictures with a resolution of 1920x1080 and 8 bits per component, at 50Hz/60Hz, in a lossless or lossy format and comprising a detachable lossy and lighter version. Such content can typically be produced when rendering 3D views in 2D.

In order to avoid an increase in the number of transfer syntaxes, 3 HEVC profiles are covered inside the transfer syntax “HEVC/H.265 Scalable Monochrome”. This is deemed acceptable as the main difference between these 3 profiles is the targeted maximum bit depth of the content which can be processed.

The levels defined in this section are meant to constrain the maximum picture size but not the decoder buffer size contrary to what is written in the HEVC specifications. This follows the simple fact that when encoding a video in lossless mode, the compression rate cannot be guaranteed.

It is also important to note that media file format and media applications standards are usually not designed for monochrome or 4:4:4 images. Planning for a future compatibility with such standard is therefore deemed unnecessary.

3 SCOPE OF THE SUPPLEMENT

This proposed supplement includes Addenda to existing Parts of DICOM:
— PS 3.5 Addendum: Data Structures and Encoding
— PS 3.6 Addendum: Data Dictionary
— PS 3.17 Addendum: Explanatory Information

4 LICENSING ISSUES

HEVC has now two pools of patents which define royalties to pay for when buying or using HEVC codecs:

— MPEG-LA patent pool (http://www.mpegla.com/main/programs/HEVC/Documents/HEVCweb.pdf)

— HEVC Advance (http://www.hevcadvance.com/pdf/RoyaltyRatesSummary.pdf)

While MPEG-LA requires a royalty based on the purchase of equipment, HEVC Advance requires companies to pay royalties on the basis of HEVC streams they produce which they sell to customers. Interested readers are encouraged to look for further information with the help of specialized professionals.

Changes to NEMA Standards Publication PS 3.5
Digital Imaging and Communications in Medicine (DICOM)
Part 5: Data Structures and Encoding

8 ENCODING OF PIXEL, OVERLAY AND WAVEFORM DATA

Add HEVC/H.265 Scalable Monochrome image compression to Section 8.

8.2.X HEVC/H.265 SCALABLE MONOCHROME Image Compression

The HEVC standard defines 3 scalable profiles to process monochrome image data:

— The “Scalable Monochrome Profile” supports data with a maximum of 8 bits per component
— The “Scalable Monochrome 12 Profile” supports data with a maximum of 12 bits per component
— The “Scalable Monochrome 16 Profile” supports data with a maximum of 16 bits per component

DICOM allows the usage of any of the three profiles listed above at Level 5.1 and Main tier to encode and decode monochrome still pictures and video content with a resolution up to 4k with a bit depth ranging from 8 to 16 bits per component. DICOM provides a mechanism for supporting the use of HEVC/H.265 Image Compression through the Encapsulated Format (see PS 3.3). Annex A defines a Transfer Syntax that references the HEVC/H.265 Standard.

The use of the DICOM Encapsulated Format to support HEVC/H.265 compressed pixel data requires that the Data Elements that are related to the Pixel Data encoding (e.g., Photometric Interpretation, Samples per Pixel, Planar Configuration, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns, etc.) shall contain values that are consistent with the characteristics of the compressed data stream, with some specific exceptions noted here. The Pixel Data characteristics included in the HEVC/H.265 bit stream shall be used to decode the compressed data stream.

Notes: 1. These requirements are specified in terms of consistency with what is encapsulated, rather than in terms of the uncompressed pixel data from which the compressed data stream may have been derived.

2. When decompressing, should the characteristics explicitly specified in the compressed data stream be inconsistent with those specified in the DICOM Data Elements, those explicitly specified in the compressed data stream should be used to control the decompression. The DICOM data elements, if inconsistent, can be regarded as suggestions as to the form in which an uncompressed Data Set might be encoded.

The requirements are:

— Planar Configuration (0028,0006) shall be 0
— Samples per Pixel (0028,0002) shall be 1
— Photometric Interpretation (0028,0004) shall be MONOCHROME2
— Bits Allocated (0028,0100) shall be comprised between 8 and 16
— Bits Stored (0028,0101) shall be comprised between 8 and 16
— High Bit (0028,0102) shall be equal to Bits Allocated (0028,0100) minus 1
— Pixel Representation (0028,0103) shall be 0
— The value of HEVC/H.265 sample aspect_ratio_idc shall be 1 in the encapsulated HEVC/H.265 bit stream if aspect_ratio_info_present_flag is 1.
— Pixel Aspect Ratio (0028,0034) shall be absent. This corresponds to a 'Sampling Aspect Ratio' (SAR) of 1:1.
— The values for Rows (0028,0010), Columns (0028,0011), Cine Rate (0018,0040), and Frame Time (0018,1063) or Frame Time Vector (0018,1065) shall be compliant with the HEVC profile and level specified in the encapsulated bit stream and following the HEVC/H.265 standard ([ISO/IEC 23008-2:2016]), and restricted to a square pixel aspect ratio.
— Lossy Image Compression (0028,2110) shall be present
— The value of HEVC/H.265 vps_max_layers_minus1 shall be 1 for all VPS (Video Parameter Set) data present in the encapsulated HEVC/H.265 bit stream.

— The value of HEVC/H.265 cu_transquant_bypass_flag shall be 1 for all coding units associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.
— The value of HEVC/H.265 slice_type shall not be equal to 2 for all slices associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.
— The value of HEVC/H.265 pred_mode_type shall not be equal to MODE_INTRA for all coding units associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.
— The value of HEVC/H.265 inter_layer_pred_enable_flag shall be 1 for all slices associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.
— The HEVC/H.265 variables RefPicList0[ ] and RefPicList1[ ] derived as specified in the subclause F.8.3.4 of the HEVC/H.265 standard ([ISO/IEC 23008-2:2016]), shall contain only one inter-layer reference picture when associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.

Notes: 1. The value of Planar Configuration (0028,0006) is irrelevant since the manner of encoding components is specified in the HEVC/H.265 standard, hence it is set to 0.

2. The limitation on rows and columns are to maximize interoperability between software environments and commonly available hardware HEVC/H.265 encoder/decoder implementations. Source pictures that have a lower value should be re-formatted by scaling and/or pixel padding prior to HEVC/H.265 encoding.

3. The Frame Time (0018,1063) may be calculated from the frame rate of the acquiring camera. A frame rate of 29.97 frames per second corresponds to a frame time of 33.367 ms.

4. The value of chroma_format_idc for this profile and level is equal to 0, indicating the usage of 4:0:0 content.

5. The constraint over the value of cu_transquant_bypass_flag in the HEVC/H.265 bitstreams ensures that the HEVC compression is lossless and fully reversible at least for the highest temporal layer of the bitstream.

6. When Bits Allocated (0028,0100) or Bits Stored (0028,0101) is greater than 8, the encapsulated bit stream cannot be associated to the Scalable Monochrome Profile as it is only defined for up to 8 bits per component.

7. When Bits Allocated (0028,0100) or Bits Stored (0028,0101) is greater than 12, the encapsulated bit stream cannot be associated to the Scalable Monochrome Profile or the Scalable Monochrome 12 Profile as they are only defined for up to 8 and 12 bits per component respectively. 8. The constraints over vps_max_layers_minus1, slice_type, pred_mode_type and inter_layer_pred_enable_flag are added in order to reduce the complexity of the design for complying codecs.

One fragment shall contain either all the Access Units necessary to decode at least one frame and at most a single key frame, or the Access Unit associated with the decoding of a single frame of a non-base layer.

All the Access Units corresponding to the encoding of a temporal layer shall be contained in fragments located after those containing the Access Units corresponding to the encoding of a temporally lower layer.

Notes: 1. These last two requirements allow a simplified parsing of the DICOM data when performing a random access to a frame.

2. The fragments used for non-base layer hevc streams cannot be read without the parsing of their associated base-layer complementary fragments.

The Number of Frames (0028,0008) attribute shall be equal to the number of frames associated with nuh_layer_id equal to 0.

Notes: 1. When the Lossy Image Compression (0028,2110) attribute is equal to 00, indicating a lossless compression, there are twice as many frames in the encapsulated bit stream as indicated by the Number of Frames attribute.

2. The Number of Frames attribute is equal to the number of frame which the process can output.

3. When the Lossy Image Compression (0028,2110) attribute is equal to 00, there are two frames in the encapsulated bit stream per frame to output:

4. One frame associated with nuh_layer_id equal to 0, representing the lossy data the system can output

5. One frame associated with nuh_layer_id not equal to 0, representing the lossless complementary data the system can use to output the lossless version of the frame.

The Basic Offset Table item shall be associated to a value and shall contain indexes referring to all the frames present in the stream.
When the Lossy Image Compression (0028,2110) attribute is equal to 00, indicating a lossless compression, and when Basic Offset Table is associated to a value, there shall be one Basic Offset value from the Basic Offset Table per frame associated with a nuh_layer_id greater than 0.

Note: The frames associated with nuh_layer_id not equal to 0 are lossless complements of the others and correspond to the same pictures.

The data shall be the native HEVC/H.265 stream and shall not be comprised into a container format.

Note: This means that no audio data can be added into the stream.

Add HEVC/H.265 Scalable Main 4:4:4 Image Compression to Section 8.

8.2.X HEVC/H.265 SCALABLE MAIN 4:4:4 Image Compression

DICOM allows the usage of the HEVC/H.265 Scalable Main 4:4:4 Profile at Level 4.1 and Main tier to encode and decode RGB still pictures and video content with a resolution up to Full HD with a bit depth of 8 bits per component. DICOM provides a mechanism for supporting the use of HEVC/H.265 Image Compression through the Encapsulated Format (see PS 3.3). Annex A defines a Transfer Syntax that references the HEVC/H.265 Standard.

The use of the DICOM Encapsulated Format to support HEVC/H.265 compressed pixel data requires that the Data Elements that are related to the Pixel Data encoding (e.g., Photometric Interpretation, Samples per Pixel, Planar Configuration, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns, etc.) shall contain values that are consistent with the characteristics of the compressed data stream, with some specific exceptions noted here. The Pixel Data characteristics included in the HEVC/H.265 bit stream shall be used to decode the compressed data stream.

Notes: 1. These requirements are specified in terms of consistency with what is encapsulated, rather than in terms of the uncompressed pixel data from which the compressed data stream may have been derived.

2. When decompressing, should the characteristics explicitly specified in the compressed data stream be inconsistent with those specified in the DICOM Data Elements, those explicitly specified in the compressed data stream should be used to control the decompression. The DICOM data elements, if inconsistent, can be regarded as suggestions as to the form in which an uncompressed Data Set might be encoded.

The requirements are:

— Planar Configuration (0028,0006) shall be 0
— Samples per Pixel (0028,0002) shall be 3
— Photometric Interpretation (0028,0004) shall be RGB
— Bits Allocated (0028,0100) shall be 8
— Bits Stored (0028,0101) shall be 8
— High Bit (0028,0102) shall be 7
— Pixel Representation (0028,0103) shall be 0
— The value of HEVC/H.265 sample aspect_ratio_idc shall be 1 in the encapsulated HEVC/H.265 bit stream if aspect_ratio_info_present_flag is 1.
— Pixel Aspect Ratio (0028,0034) shall be absent. This corresponds to a 'Sampling Aspect Ratio' (SAR) of 1:1.
— The values for Rows (0028,0010), Columns (0028,0011), Cine Rate (0018,0040), and Frame Time (0018,1063) or Frame Time Vector (0018,1065) shall be compliant with the Scalable Main 4:4:4 Profile / Level 5.1 of the HEVC/H.265 standard ([ISO/IEC 23008-2:2016]) and restricted to a square pixel aspect ratio.
— Lossy Image Compression (0028,2110) shall be present
— The value of HEVC/H.265 vps_max_layers_minus1 shall be 1 for all VPS (Video Parameter Set) data present in the encapsulated HEVC/H.265 bit stream.
— The value of HEVC/H.265 cu_transquant_bypass_flag shall be 1 for all coding units associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.
— The value of HEVC/H.265 slice_type shall not be equal to 2 for all slices associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.

— The value of HEVC/H.265 pred_mode_type shall not be equal to MODE_INTRA for all coding units associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.

— The value of HEVC/H.265 inter_layer_pred_enable_flag shall be 1 for all slices associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.

— The HEVC/H.265 variables RefPicList0[ ] and RefPicList1[ ] derived as specified in the subclause F.8.3.4 of the HEVC/H.265 standard ([ISO/IEC 23008-2:2016]), shall contain only one inter-layer reference picture when associated to a picture with nuh_layer_id equal to the value of vps_max_layers_minus1 of its associated VPS in the encapsulated HEVC/H.265 bit stream.

Notes: 1. The value of Planar Configuration (0028,0006) is irrelevant since the manner of encoding components is specified in the HEVC/H.265 standard, hence it is set to 0.

2. The limitation on rows and columns are to maximize interoperability between software environments and commonly available hardware HEVC/H.265 encoder/decoder implementations. Source pictures that have a lower value should be re-formatted by scaling and/or pixel padding prior to HEVC/H.265 encoding.

3. The Frame Time (0018,1063) may be calculated from the frame rate of the acquiring camera. A frame rate of 29.97 frames per second corresponds to a frame time of 33.367 ms.

4. The value of chroma_format_idc for this profile and level is equal to 0, indicating the usage of 4:0:0 content.

5. The constraint over the value of cu_transquant_bypass_flag in the HEVC/H.265 bitstreams ensures that the HEVC compression is lossless and fully reversible at least for the highest temporal layer of the bitstream.

6. The constraints over vps_max_layers_minus1, slice_type, pred_mode_type and inter_layer_pred_enable_flag are added in order to reduce the complexity of the design for complying codecs.

One fragment shall contain either all the Access Units necessary to decode at least one frame and at most a single key frame, or the Access Unit associated with the decoding of a single frame of a non-base layer.

All the Access Units corresponding to the encoding of a temporal layer shall be contained in fragments located after those containing the Access Units corresponding to the encoding of a temporally lower layer.

Notes: 1. These last two requirements allow a simplified parsing of the DICOM data when performing a random access to a frame.

2. The fragments used for non-base layer hevc streams cannot be read without the parsing of their associated base-layer complementary fragments.

The Number of Frames (0028,0008) attribute shall be equal to the number of frames associated with nuh_layer_id equal to 0.

Notes: 1. When the Lossy Image Compression (0028,2110) attribute is equal to 00, indicating a lossless compression, there are twice as many frames in the encapsulated bit stream as indicated by the Number of Frames attribute.

2. The Number of Frames attribute is equal to the number of frame which the process can output.

3. When the Lossy Image Compression (0028,2110) attribute is equal to 00, there are two frames in the encapsulated bit stream per frame to output:

4. One frame associated with nuh_layer_id equal to 0, representing the lossy data the system can output

5. One frame associated with nuh_layer_id not equal to 0, representing the lossless complementary data the system can use to output the lossless version of the frame.

The Basic Offset Table item, shall be associated to a value, and shall contain indexes referring to all the frames present in the stream.
When the Lossy Image Compression (0028,2110) attribute is equal to 00, indicating a lossless compression, and when Basic Offset Table is associated to a value, there shall be one Basic Offset value from the Basic Offset Table per frame associated with a nuh_layer_id greater than 0.

Note: The frames associated with nuh_layer_id not equal to 0 are lossless complements of the others and correspond to the same pictures.

The data shall be the native HEVC/H.265 stream and shall not be comprised into a container format.

Note: This means that no audio data can be added into the stream.

10 TRANSFER SYNTAX

Add Transfer Syntax for HEVC/H.265 Scalable Monochrome Image Compression to Section 10.

10.X Transfer Syntax for HEVC/H.265 Scalable Monochrome Image Compression

One Transfer Syntax is specified for HEVC/H.265 Scalable Monochrome Image Compression using either:

- The ISO/IEC 23008-2:2016 HEVC Scalable Monochrome Profile at Level 5.1 and at Main tier.
- The ISO/IEC 23008-2:2016 HEVC Scalable Monochrome 12 Profile at Level 5.1 and at Main tier.
- The ISO/IEC 23008-2:2016 HEVC Scalable Monochrome 16 Profile at Level 5.1 and at Main tier.

Transfer Syntax HEVC/H.265 Scalable Monochrome corresponds to the ISO/IEC 23008-2:2016 HEVC standard's profile and level specifications of any of the above listed three profiles with additional constraints limiting the number of coded layers to 2 and limiting the usage of non-base temporal layers to the lossless encoding. The mentioned additional constraints are described in "8.2.X HEVC/H.265 SCALABLE MONOCHROME Image Compression"

Add Transfer Syntax for HEVC/H.265 Scalable Main 4:4:4 Profile / Level 4.1 Image Compression to Section 10.

10.X Transfer Syntax for Lossless HEVC/H.265 Scalable Main 4:4:4 Profile / Level 4.1 Image Compression

One Transfer Syntax is specified for Lossless HEVC/H.265 Scalable Main 4:4:4 Profile / Level 4.1 Image Compression. Transfer Syntax Lossless HEVC/H.265 Scalable Main 4:4:4 Profile corresponds to the ISO/IEC 23008-2:2016 HEVC standard's profile and level specifications of the HEVC/H.265 Scalable Main 4:4:4 Profile with the level 4.1 and with additional constraints limiting the number of coded layers to 2 and limiting the usage of non-base temporal layers to the lossless encoding. The mentioned additional constraints are described in "8.2.X HEVC/H.265 SCALABLE MAIN 4:4:4 Image Compression"

A TRANSFER SYNTAX SPECIFICATIONS (NORMATIVE)

Add HEVC/H.265 Scalable Monochrome requirements to Annex A.

A.4.X HEVC/H.265 SCALABLE MONOCHROME IMAGE COMPRESSION

The International Standards Organization ISO/IEC MPEG has developed an International Standard, [ISO/IEC 23008-2:2016] (HEVC), for the video compression of generic coding of moving pictures and associated audio information. This standard is jointly maintained and has identical technical content as the ISO/IEC 23008-2:2016 HEVC standard.

A DICOM Transfer Syntax for HEVC/H.265 Scalable Monochrome Image Compression shall be identified by a UID value of:

- 1.2.840.10008.1.2.4.10X corresponding to the HEVC/H.265 Scalable Monochrome Profile, the HEVC/H.265 Scalable Monochrome 12 Profile or the HEVC/H.265 Scalable Monochrome 16 Profile at Level 5.1 and at Main tier of the ISO/IEC 23008-2:2016 HEVC Video standard with additional constraints limiting the number of coded layers to 2 and limiting the usage of non-base temporal layers to the lossless. The mentioned additional constraints are described in “8.2.X HEVC/H.265 SCALABLE MONOCHROME Image Compression”.

Add HEVC/H.265 Scalable Main 4:4:4 requirements to Annex A.

A.4.X HEVC/H.265 SCALABLE MAIN 4:4:4 IMAGE COMPRESSION

The International Standards Organization ISO/IEC MPEG has developed an International Standard, [ISO/IEC 23008-2:2016] (HEVC), for the video compression of generic coding of moving pictures and associated audio information. This standard is jointly maintained and has identical technical content as the ISO/IEC 23008-2:2016 HEVC standard.

A DICOM Transfer Syntax for HEVC/H.265 Scalable Main 4:4:4 Profile / Level 4.1 Image Compression shall be identified by a UID value of:

- 1.2.840.10008.1.2.4.10X corresponding to the HEVC/H.265 Scalable Main 4:4:4 Profile / Level 4.1 of the ISO/IEC 23008-2:2016 HEVC Video standard with additional constraints limiting the number of coded layers to 2 and limiting the usage of non-base temporal layers to the lossless encoding. The mentioned additional constraints are described in “8.2.X HEVC/H.265 SCALABLE MAIN 4:4:4 Image Compression”.

Changes to NEMA Standards Publication PS 3.6
Digital Imaging and Communications in Medicine (DICOM)
Part 6: Data Dictionary

A REGISTRY OF DICOM UNIQUE IDENTIFIERS (UIDS) (NORMATIVE)

Add new UID to Annex A.

UID Value	UID Name	UID Type	Part
1.2.840.10008.1.2.4.10X	HEVC/H.265 Scalable Monochrome	Transfer Syntax	PS3.5
1.2.840.10008.1.2.4.10X	HEVC/H.265 Scalable Main 4:4:4	Transfer Syntax	PS3.5

Changes to NEMA Standards Publication PS 3.17
Digital Imaging and Communications in Medicine (DICOM)
Part 6: Explanatory Information

Add a section to explain lossy and lossless image retrieval in containers for HEVC Scalable streams

VVV. LOSSY AND LOSSLESS IMAGES RETRIEVAL PROCESS FOR HEVC SCALABLE STREAMS (INFORMATIVE)

This part discusses image retrieval in DICOM multi-frame objects containing HEVC scalable bit streams. The reader should be reminded that HEVC scalable bit streams are only used with monochrome and 4:4:4 image formats.

When a system is requested to output the lossy version of an image, it uses the image index and reads in the DICOM object header the memory position the image. The selected image fragment can then be re-encapsulated into a single single-frame container.

When a system is requested to output more than 1 lossy image, it similarly uses the index of each image and reads each of them as described before. The gathered images can then be re-encapsulated into a single multi-frame object or into several single-frame ones.

When a system is requested to output the lossless version of an image, it searches for both the lossy fragment and the lossless fragment related to the image index. The lossless fragment will be located at the index $i_{lossless} = i_{lossy} + N_{images}$, where i_{lossy} is the index of the lossy image and N_{images} is the number of lossy images contained in the multi-frame object. The two fragments are then re-encapsulated into a single multi-frame container with the lossy fragment indexed as first picture and the lossless fragment indexed as the second picture.

When a system is requested to output more than 1 lossless image, it similarly uses the index of the lossy and the lossless fragment of each image and reads each of them as described before. It can then re-encapsulate the fragments into different multi-frame containers or in a single one. However, in each new container, the lossy fragments shall be stored before the lossless fragments and the order of images among the lossy fragments shall be the same as among the lossless fragments.