Digital Imaging and Communications in Medicine (DICOM)

Supplement 253: Waveform Compression

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DICOM Standards Committee, Working Group 6

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Document History

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2026/03/14	Version 2		Updates during and after first part of First Read
2026/03/18	Version 3		WG-06-meeting
2026/03/19	Version 4		Updates during and after WG-32 meeting
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2026/08/30	Version 7		Updates during and after WG-32 meetings
2026/09/01	Version 8		WG-06 meetings
2026/09/18	Version 9		Public Comment

Open Issues

3.	Q: Is the scheme patent and license fee free? A: The IP and patent issue was discussed with ITU/VCEG. ITU has similar rules as DICOM: if companies work in context of ITU they have to declare their patent rights, if there are any. The companies currently contributing to T.261 (Dolby, Fraunhofer HHI, and Philips) filed no formal declarations about their patent rights yet. WG-06 will continue to check this with ITU at every milestone this supplement reaches in the DICOM standardization process.
12.	Q: According the current definition of Waveform IODs sample data are embedded in the metadata of the multiplex group (different to image instances, which usually have all metadata in front of pixel data, although not required by the standard). It could be appropriate to shift the encoded bitstream to a new attribute located after the metadata (and having sample data of different Multiplex Groups aligned, not separated by metadata) (Re-writing the object is necessary in any case, e.g. to update the length information). Would such an approach make it easier or faster to access the data? WG-06 is in favor of having a separate, new attribute.
21.	Q: The quality of T.261 lossy encoded data depends on the parameterization of the encoding process. The encoded bitstream contains these parameters and also quality indicators, if enabled by the encoder. DICOM Metadata as defined in this supplement only comprise Lossy Waveform Compression Ratio as a quality indicator. Shall additional encoding parameters, such as the optional quality indicators provided by T.261, be added to the DICOM Metadata of the encoded object to convey the quality of the data? Such parameters could for example be the quantization step size (QP), the maximum allowed quantization error (MAE) or the signal-to-noise ration (SNR).
22.	Q: DICOM Webservices allow to retrieve pixel data beyond the instance level by accessing individual frames. Should there be a similar mechanism to retrieve selected parts (“segments”) of an encoded waveform?
23.	Q: The Repository Query SOP Class allows to query for the Lossy Image Compression Ratios (0028,2112) which has been applied to an Image instance. A Waveform instance may consist of several multiplex groups each of them having different multi-valued Lossy Waveform Compression Ratios. Which would be the relevant information to be added to the list of additional query attributes (PS3.4 Table C.6.4.1-1.) of the Repository Query SOP Class considering that waveforms can only be queried and retrieved per instance and not per selected multiplex group.

Closed Issues

1.	Q: Does the proposed codec work for the use case (amount of compression achievable vs. other schemes (in the literature) in lossless and appropriate bit-rate lossy modes)? A: We expect T.261 to work for the clinical use cases. The Working Group evaluated standardized audio codecs, but these did not produce a sufficient result. There are no other standardized compression schemes for this kind of data.
2.	Q: Is there open source reference software for encoding and decoding that can be tested and re-used in commercial implementations? A: Yes, https://vcgit.hhi.fraunhofer.de/vceg-sw/bwc
4.	Q: The parameters used in the encoding process are fully stored in the encoded bitstream. It is not necessary to apply them in the decoding process. Should these parameters nevertheless also be available in the DICOM metadata of the encoded waveform? A: No, not necessarily. Most important aspect is the consistency of metadata. Existing DICOM metadata affected by the encoding / decoding process shall be updated accordingly. Other metadata used internally by the codec shall not be duplicated to the DICOM metadata.
5.	T.261 would allow to provide detailed timing information in the encoded bitstream. DICOM Waveforms do not support any timing information on samples (or parts of waveforms) besides Acquisition DateTime (up to µs precise) and the sampling frequency (Hz). There are attempts of some vendors to overcome physical hardware limitations resulting in subtle variations of the sampling frequency by providing detailed timing information on a per sample basis. Shall Transfer Syntaxes for Waveform compression make use of this feature even though this feature is not available in the uncompressed DICOM object at all? A: A way to provide more precise timing information over the time of a recording is introduced in this supplement document. This information will be available as DICOM metadata, independent of having a compressed or an uncompressed representation of the data.
6.	Q: T.261 allows to store auxiliary metadata encoded in the bitstream, which are redundant to metadata provided in the DICOM Waveform: e.g. waveform type (EEG, EMG, …). This information does not affect the encoding or decoding process but are useful for non-DICOM applications. Shall DICOM make use of this feature and store such metadata in the encoded bitstream keeping the information aligned to the DICOM metadata? A: In general: any metadata information should be separate from the compressed sample data – only clean sample data shall go to the encoded bitstream, nothing else.
7.	Q: T.261 allows to store information about waveform features in the encoded bitstream, indicating that a portion of the waveform data has special characteristics or is of special interest. This information does not affect the encoding or decoding process but are useful for non-DICOM applications. Shall this feature be used in a DICOM context? A: No – see #6
8.	Q: T.261 allows to store annotation in the encoded bitstream. This information does not affect the encoding or decoding process but are useful for non-DICOM applications. Shall this feature of T.261 be used in a DICOM context? A: No – see issue #6. In DICOM objects annotations are stored using DICOM mechanisms (i.e. in the waveform object itself, in a Waveform Annotation SR or in a Waveform Presentation State).
9.	T.261 supports security features: providing user identification information, providing user authentication information, and providing authentication signature information: This information does not affect the encoding or decoding process but are required for non-DICOM applications. Shall this feature be used in a DICOM context?

	A: No – keep that separate. See issue #6. DICOM provides proper mechanisms for security and data integrity.
10.	This supplement proposes a DICOM Transfer Syntax for lossless compression using T.261 codec using the default case “joint channels” – all channels of a Multiplex Group are considered as a single channel group. Shall there also be other Transfer Syntaxes like a second DICOM Transfer Syntax for lossless compression allowing “individual channels” – each channel of a Multiplex Group goes into a separate channel group. This could result in better compression result, if single channels in a Multiplex Group are know to have little quality / much distortion. A: Decision was to have a single lossless Transfer Syntax using the “joint channels” mode. The “individual channels” mode is expected to result in little compression ratio. For efficiency reasons this supplement also addresses a lossy Transfer Syntax. The basic mechanism of encapsulation works in the same way for both codecs. Considering both in this supplement ensures that encapsulation and compression/decompression works for both encodings. T.261 comprises a single profile, so the encoding process is the same for lossy and lossless encoding, except for the quality index.
11.	Q: There are two alternatives how the T.261 bitstream could be encapsulated in the DICOM object: one in analogy to compressed multiframe images with an offset table allowing to decompress individual “chunks”, the other in analogy to video Transfer Syntaxes without an offset table and just providing the whole bitstream. Does the encoded bitstream allow decoding a specific portion of the waveform without storing the byte offsets in an offset table in the DICOM object? A: Yes.
14.	Q: Shall support of streaming be considered in context of this supplement? A: Not in this supplement document. WG-35 was recently established to address all aspects of streaming of DICOM objects.
15.	Q: Which encapsulation mechanism would be appropriate: having an Offset Table in the Sequence of encoded chunks, having an Offset Table as an Attribute in the metadata or have no offset table at all and leave accessing defined parts of the encoded bitstream to the decoder? Having the Offset Table as an Attribute in the metadata, (7FE0,0001) Extended Offset Table) for images, has turned out to be sometimes problematic: metadata may become quite large if there are many pointers in the Offset Table and some application store the whole set of metadata e.g. in a database field. A proper VR has to be chosen in order to provide the content as Bulk Data instead of including it into the metadata resource as json or xml. Although 32 bit pointers would work for many clinical use cases there might be long running recordings with high resolutions, which would require 64 bit pointers. A: T.261 allows random access to parts of the encoded bit stream. ITU has specified T.261 integration of T.261 into the mpeg file format [ISO/IEC 14496-12]) as Annex E in the T.261 specification. This allows to either directly access the encoded data at a specific (sample-) position or read out the offset information via API. So no offset table in the DICOM metadata is required.
16.	Q: Shall support of encapsulated encoded waveform data be restricted to be only allowed for objects with a single Multiplex Group? What are the use cases (implementations) which make use of waveform objects with more than one Multiplex Group and are those such which would benefit from using the new Transfer Syntaxes? A: For the time being WG-32 is not aware of any use cases for EEG nor ECG which require more than one Multiplex Group. However, the new Transfer Syntaxes shall be applicable to ALL of the existing waveform

	SOP Classes. Otherwise this would result in invalid Transfer Syntax / SOP Class combinations, which should be avoided.
17.	Q: Has the working group considered FLAC (RFC 9639 Free Lossless Audio Codec (FLAC) https://www.rfc-editor.org/rfc/rfc9639.html, https://en.wikipedia.org/wiki/FLAC) as one of the codec options? FLAC is an open specification with public tooling with a number of the relevant features for (lossless, good compression, block based, selectable block size, multi-channel, etc). A: FLAC was not evaluated because it has some significant limitations: it only supports up to 8 channels and it does lossless compression only. It is also not clear if there is sufficient maintenance for the codec by Xiph.org. But even though Xiph.org is not an international standards organization, FLAC could be considered in future if the encapsulation mechanism introduced in this supplement works in principle.
18.	Q: There might be different types of Offset Tables (32-bit pointers, 64-bit pointers, 64-bit pointers with chunk-timestamp), each as first item in the sequence of items holding the encoded bitstream. How should this be distinguished: a different Transfer Syntax, a different Data Element for the encapsulated data? A: As described in issue #15 T.261 does not require an offset table.
19.	Q: When retrieving DICOM Waveforms via DICOMweb, which bulk data media type is appropriate for T.261 compressed waveform data? Using application/octet-stream would hamper content negotiation, so a specific media type is recommended. A: Mime type for the T.261 file format shall be application/mp4.
20.	Q: Part 11 of the DICOM Standard contains Media Storage Application Profiles (e.g. defines how to store MPEG4 data on a DVD). Is there a need to specify a specific media support for T.261 encoded Waveforms? Is it likely that Waveform data are shared via media? A: No such requirements are known yet. If a specific profile is needed, it shall not be done in this supplement, but separately.

Scope and Field of Application

This supplement proposes to

- add an encapsulation mechanism for DICOM waveforms to encapsulate compressed data
- in analogy to the existing image compression and encapsulation of compressed pixel data.
- A new Transfer Syntax for lossless compressed DICOM waveforms is added.
- A new Transfer Syntax for lossy compressed DICOM waveforms is added.

This supplement adds Transfer Syntaxes for compression of DICOM Waveforms based on ITU/VCEG codec T.261, which was created especially for encoding and decoding of biomedical waveform data. This implies the introduction of an encapsulation mechanism for waveform sample data.

T.261 specifies an interoperable format for efficient compression, transmission, and storage of waveform signals, including biomedical waveform signals such as electrocardiography (ECG), electroencephalography (EEG), electromyography (EMG), and photoplethysmogram (PPG) data, as well as other types of general waveform data. It supports various bit depths, a broad range of sampling rates, and large numbers of channels, as required by a range of biomedical and general signal processing applications. T.261 provides for lossy, near-lossless, and lossless compression, and includes features such as optimized data blocking, indexing for rapid access and independent channel decoding.

A draft version of the specification of T.261 is available here:

https://www.itu.int/wftp3/av-arch/video-site/2604_StE/VCEG-CA19-BWC-Specification-Draft6-v1.doc

Changes to NEMA Standards Publications PS3.2
Digital Imaging and Communications in Medicine (DICOM)
Part 2: Conformance

Add new Transfer Syntaxes to Section N.1.1. Content and Transfer Media by amending Table N.1-2 Supported Transfer Syntaxes

Table N.1-2 Supported Transfer Syntaxes

Transfer Syntax Set	Transfer Syntax Name	Transfer Syntax UID	DICOM Web Service Bulk Data Media Type
...			
Real-Time Video Transfer Syntax Set (RTV)	*MPEG2 Main Profile / Main Level*	*1.2.840.10008.1.2.4.100*	*video/mpeg2*
	...		
	MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	*1.2.840.10008.1.2.4.104*	*video/mp4*
Waveform Lossless Compressed Transfer Syntax Set (WLL)	***T.261 Transfer Syntax for Lossless Waveform Compression***	***UID_TS1_lossless***	***application/mp4***
Waveform lossy Compressed Transfer Syntax Set (WL)	***T.261 Transfer Syntax for Lossy Waveform Compression***	***UID_TS2_lossy***	***application/mp4***

Modify N.5.3.2 Studies Web Service

N.5.3.2 Studies Web Service

This section provides details regarding the Studies Web Service. For an overview of supported Transactions and resources see Table N.1-9 Study Service.

….

N.5.3.1.2 Supported Web Media Types

…

N.5.3.2.1.2 DICOM Bulk Data Media Type

…

Table N.5-70 lists the supported Media Types and Transfer Syntax UIDs for Compressed Bulk Data.

Table N.5-70. DICOM Compressed Bulk Data Media Types

Category	Media Type	Transfer Syntax UID	Transfer Syntax Name	User Agent	Origin Server
Single Frame Image	image/jpeg	…			
…					
Waveform	**application/mp4**	**UID_TS1_lossless**	**T.261 Transfer Syntax for Lossless Waveform Compression**		
	application/mp4	**UID_TS1_lossy**	**T.261 Transfer Syntax for Lossless Waveform Compression**		

Modify N.5.3.2.2 Retrieve Supported Transaction (WADO-RS) by amending Table N.5-74 and Table N.5-77

N.5.3.2.2 Retrieve ~~Supported~~ Transaction (WADO-RS)

The Studies Web Service Retrieve Transaction is also known as WADO-RS.

…

N.5.3.2.2.1 User Agent

The Retrieve Transaction user agent supports Header Fields listed in Table N.5-74.

Table N.5-74. Header Fields for Retrieve Transaction - User Agent

Header Field	Supported Values	Comments
Bulk Data and Pixel Data resource		
Accept	Uncompressed: <<multipart/related; type="application/octet-stream">> Compressed: <<multipart/related; type="{media-type}">> supported {media-type} being <<image/jpeg image/x-dicom-rle image/x-jls image/jp2 image/jphc image/jpx image/jxl video/mpeg2 video/mp4	See details in Section N.5.3.2.1.2.

	application/mp4>>	
Rendered resource		
...		

N.5.3.2.2.2 Origin Server

The Retrieve Transaction origin server receives GET requests to retrieve specific studies, series or instances.

…

The Retrieve Transaction origin server supports Header Fields listed in Table N.5-77.

Table N.5-77. Header Fields for Retrieve Transaction - Origin Server

Header Field	Supported Values	Comments
Bulk Data and Pixel Data resource		
Accept	Uncompressed: <<multipart/related; type="application/octet-stream">> Compressed: <<multipart/related; type="{media-type}">> supported {media-type} being <<image/jpeg image/x-dicom-rle image/x-jls image/jp2 image/jphc image/jpx image/jxl video/mpeg2 video/mp4 **application/mp4**>>	See details in Section N.5.3.2.1.2.
Rendered resource		
...		

Modify N.5.3.2.3 StoreTransaction (STOW-RS) by amending Table N.5-79 and Table N.5-81

N.5.3.2.3 Store Transaction (STOW-RS)

N.5.3.2.3.1 User Agent

…

155 The Store Transaction user agent supports Header Fields listed in Table N.5-79.

Table N.5-79. Header Fields for Store Transaction – User Agent

Header Field	Supported Values	Comments
Content-Type	...	
	Uncompressed: <<multipart/related; type="application/octet-stream">> Compressed: <<multipart/related; type="{media-type}">> supported {media-type} being <<image/jpeg image/x-dicom-rle image/x-jls image/jp2 image/jphc image/jpx image/jxl video/mpeg2 video/mp4 **application/mp4**>>	See details in Section N.5.3.2.1.2.
Content-Length	...	
Content-Encoding	...	

N.5.3.2.3.1 Origin Server

The Store Transaction origin server receives POST requests to store or append to an existing resource
160 on the server.

...

The Store Transaction origin server supports Header Fields listed in Table N.5-81.

Table N.5-81. Header Fields for Store Transaction - Origin Server

Header Field	Supported Values	Comments
Content-Type	...	
	Uncompressed: <<multipart/related; type="application/octet-	See details in Section N.5.3.2.1.2.

	stream">> Compressed: <<multipart/related; type="{media-type}">> supported {media-type} being <<image/jpeg image/x-dicom-rle image/x-jls image/jp2 image/jphc image/jpx image/jxl video/mpeg2 video/mp4 **application/mp4**>>	
Content-Length	...	
Content-Encoding	...	

Changes to NEMA Standards Publications PS3.3
Digital Imaging and Communications in Medicine (DICOM)
Part 3: Information Object Definitions

Modify C.10.9 Waveform Module as follows

C.10.9 Waveform Module

The table in this section contains Attributes that describe a time-based waveform. A waveform consists of one or more multiplex groups, each encoded into an Item in the Waveform Sequence. All channels within a multiplex group are synchronously digitized at a common sampling frequency.

Table C.10-9. Waveform Attributes

Attribute Name	Tag	Type	Attribute Description
Waveform Sequence	(5400,0100)	1	Sequence of Items, each representing one waveform multiplex group. One or more Items shall be included in this Sequence. Ordering of Items in this Sequence is significant for external reference to specific multiplex groups.
>Multiplex Group Time Offset	(0018,1068)	1C	Offset time in milliseconds from a reference time (see Section C.10.9.1.1). Required if Acquisition Time Synchronized (0018,1800) Value is Y; may be present otherwise. **Note: The Value Representation allows to have fractions of microseconds.**
>Multiplex Group Acquisition End DateTime	**(ggg2,eee1)**	**3**	**Absolute date and time when data acquisition ended for this multiplex group.** **Note:** **Acquisition DateTime (0008,002A) and Multiplex Group Acquisition End DateTime may have different offsets from UTC**
...			
>Multiplex Group Sample Times Sequence	**(ggg2,eee2)**	**3**	**Timing information for selected sample positions that is more precise than timing derived from Acquisition DateTime (0008,002A).** **Only a single Item is permitted in this Sequence.** **Note:** **Sample Times in this sequence allow encoding of variations in when**

			samples are acquired, which can sometimes vary subtly from the sampling frequency. **Synchronization with related objects like videos or annotations is based on Acquisition DateTime (0008,002A), not the times in this Sequence**
>>Referenced Sample Positions	**(0040,A132))**	**1**	**List of Samples within this multiplex group. Position of first sample is 1.**
>>Relative Sample Times	**(ggg2,eee4)**	**1**	**Times in microseconds relative to Acquisition DateTime (0008,002A) for the selected samples.**
...			
>Waveform Originality	(003A,0004)	1	See Section C.10.9.1.3. Enumerated Values: **ORIGINAL** **DERIVED**
...			
>Source Waveform Sequence	**(003A,020A)**	**3**	**Waveform from which this waveform was derived.** **See Section C.10.9.1.3**
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Referenced Multiplex Group Number	**(ggg1,eee4)**	**1C**	**Identifier of the referenced multiplex group which is the ordinal of the Item of Waveform Sequence (5400,0100) (i.e., the Multiplex Group Number),** **Shall be present if the referenced multiplex group in the source waveform does not contain a Waveform Multiplex Group UID (003A,0310).**
>>Referenced Multiplex Group UID	**(ggg1,eee5)**	**1C**	**Identifier of the referenced Multiplex Group.** **Shall be present if the referenced multiplex group in the source waveform contains a Waveform Multiplex Group UID (003A,0310).**
>Waveform Derivation Description	**(ggg1,eee0)**	**3**	**A text description of how the waveform multiplex group was derived.**
...			
>Lossy Waveform Compression	**(ggg1,eee1)**	**1C**	**Specifies whether a Waveform has undergone lossy compression (at a point in its lifetime).** **Enumerated Values:** **00 Waveform has not been subjected to lossy compression.**

			01 Waveform has been subjected to lossy compression. **Once this Attribute has been set to a Value of "01" it shall not be reset.** **See Section C.10.9.1.X2** **Required if it is known whether or not lossy compression has been performed on the Waveform.**
>Lossy Waveform Compression Method	**(ggg1,eee2)**	**1C**	**A label for the lossy compression method(s) that have been applied to the source waveform.** **Defined Terms** **T.261 T.261 Lossy Compression [ITU T.261]** **See Section C.10.9.1.X2.1** **Required if Lossy Waveform Compression (ggg1,eee1) is present and has a value of "01"**
>Lossy Waveform Compression Ratio	**(ggg1,eee3)**	**1C**	**Describes the approximate lossy compression ratio(s) that have been applied to this waveform.** **See Section C.10.9.1.X2.2** **Required if Lossy Waveform Compression (ggg1,eee1) is present and has a value of "01"**
...			

C.10.9.1.3 Waveform Originality and Waveform Derivation Description

Waveform Originality (003A,0004) shall have the Value ORIGINAL if the Waveform Data samples are the original or source data, and shall have the Value DERIVED if the Waveform Data samples have been derived in some manner from the sample data of other waveforms.

Note

1. Waveform Originality (003A,0004) is comparable to Image Type (0008,0008) Value 1 (see Section C.7.6.1.1.2). Within a single Multiplex Group, all channels shall have the same Originality value.
2. Waveform data that has been transcoded from a non-DICOM format may have Waveform Originality Value ORIGINAL if the samples are unchanged from the originally acquired waveform samples.

Reference to the DICOM Waveform from which the data was derived can be provided for all channels of a single multiplex group or per individual channel within the multiplex group referring to selected channels in the source waveform. In the first case Waveform Derivation Description

(ggg1,eee0) describes the way in which the waveform was derived. In the second case Channel Derivation Description (003A,020C) allows to describe the derivation per individual channel.

C.10.9.1.X2 Lossy Waveform Compression

The Attribute Lossy Waveform Compression (ggg1,eee1) conveys that the Waveform has undergone lossy compression. It provides a means to record that the Waveform has been compressed (at a point in its lifetime) with a lossy algorithm and changes have been introduced into the Waveform Data (5400,1010). Once this Attribute has been set to a Value of "01" it shall not be reset.

Note

1. If a Waveform is compressed with a lossy algorithm, the Attribute Lossy Waveform Compression (ggg1,eee1) is set to "01". Subsequently, if the Waveform is decompressed and transferred in uncompressed format, this Attribute Value remains "01".

If a Waveform is originally obtained as a lossy compressed waveform from the sensor, then Lossy Waveform Compression (ggg1,eee1) is set to "01" and the Attribute Waveform Originality (003A,0004) shall be set to ORIGINAL.

If a Waveform is a lossy compressed version of another waveform, Lossy Waveform Compression (ggg1,eee1) is set to "01", the Attribute Waveform Originality (003A,0004) shall be set to DERIVED, and if the predecessor was a DICOM Waveform, then the Waveform shall receive a new SOP Instance UID.

C.10.9.1.X2.1 Lossy Waveform Compression Method

Lossy Waveform Compression Method (ggg1,eee2) may be multi-valued if successive lossy compression steps have been applied; the order of the Values shall correspond to the Values of Lossy Waveform Compression Ratio (ggg1,eee3), if present.

Defined Terms for Lossy Waveform Compression Method:

T.261	T.261 Lossy Compression [ITU T.261]

C.10.9.1.X2.2 Lossy Waveform Compression Ratio

The value of the "compression ratio" is encoded as a numeric value that represents the numerator of an implicit ratio in which the denominator is always one, consistent with the traditional representation in the literature.

Note

For example, a compression ratio of 30:1 would be described with a Value of 30.

The value may be an estimate (e.g., the nominal value that is supplied to the compressor), or it may be a measured value (e.g., computed by dividing the uncompressed waveform data size by the size of the compressed bit stream).

Lossy Waveform Compression Ratio (ggg1,eee3) may be multi-valued if successive lossy compression steps have been applied; if so, the order of the Values shall correspond to the multiple Values of Lossy Waveform Compression Method (ggge1,eee2), if present.

Changes to NEMA Standards Publications PS3.4
Digital Imaging and Communications in Medicine (DICOM)
Part 4: Service Class Specifications

Modify C.6.1.1.5.1 as follows

C.6.1.1 Patient Root Query Retrieve Information Model

…

C.6.1.1.5.1 Alternate Representation Sequence

The Alternate Representation Sequence (0008,3001) encodes a reference to an alternate encoding of the composite image **or waveform** identified in the query response item. This alternate encoding may utilize a different SOP Class or have different ~~**image**~~ quality characteristics, but it shall be the same image **or waveform**.

Note

The Alternate Representation Sequence (0008,3001) allows the query response about an original ~~**image**~~ **instance** to reference a lossy compressed version, and vice versa.

An ~~**image**~~ **instance** may be lossy compressed, e.g., for long-term archive purposes, and its SOP Instance UID changed. An application processing a SOP Instance that references the original ~~**image**~~ **instance** UID, e.g., a Structured Report, may query the C-FIND SCP for the ~~**image**~~ **instance**. The SCP returns a reference to an accessible version of the ~~**image**~~ **instance** even if the original SOP Instance is no longer available.

The Alternate Representation Sequence (0008,3001), if present in a query request Identifier, shall be zero-length, or shall contain a single zero-length Item. That is, only Universal Matching is defined for this Attribute.

The Alternate Representation Sequence (0008,3001), if present in the query response Identifier, may include zero or more Items.

Each Alternate Representation Sequence Item in the query response Identifier shall include

- the Series Instance UID (0020,000E) if the alternately encoded ~~**image**~~ **instance** is in a different Series.
- the SOP Class UID (0008,0016) and SOP Instance UID (0008,0018) of the alternately encoded ~~**image**~~ **instance**.
- the Purpose of Reference Code Sequence (0040,A170), which shall describe the nature of the alternate encoding of the ~~**image**~~ **instance**.
- The Purpose of Reference Code Sequence (0040,A170) shall include only one Item. The Baseline Context Group for this Code Sequence is CID 7205.

Modify C.6.4 Repository Query SOP Class

C.6.4 Repository Query SOP Class

The Repository Query SOP Class uses the C-FIND Service and the Study Root Query Retrieve Information Model. …

C.6.4.1 Additional Query Information Model Attributes

The Repository Query SOP Class uses the Study Root Query**/Retrieve** Information **M**~~m~~odel specified in Section C.6.2.1, but ...

Table C.6.4.1-1. Additional Keys for Repository Query

Attribute Name	Tag	Type	Attribute Description
...			
File Access Sequence	(0008,041A)	O	Description of non-DICOM protocol access to a stored SOP Instance. This Attribute is defined only at the Composite Instance level. This Attribute is supported only with Universal Matching, i.e., if present in the Request Identifier it is zero-length or has only a zero-length Item. See Section C.6.4.1.3. See Section C.6.4.5.5 for additional SCP requirements. Zero or more Items may be included in this Sequence in a Response Identifier.
...			
>Lossy Image Compression Ratio	**(0028,2112)**	**-**	**Describes the approximate lossy compression ratio(s) that has been applied to this image.**
>Lossy Waveform Compression Ratio	**(ggg1,eee3)**	**-**	**Describes the approximate lossy compression ratio(s) that has been applied to this waveform.** **See Open Issue 23.**
...			

Modify S.3.2.1 Create a Media Creation Request as follows

S Media Creation Management Service Class

S.1 Overview

S.1.1 Scope

The Media Creation Management Service Class defines a mechanism …

Note

1 …

2 It is the responsibility of the SCU to negotiate and store instances with an appropriate Transfer Syntax should a specific Transfer Syntax be required by a requested profile. The SCP is not required to support compression or decompression of stored instances in order to convert stored instances into a form suitable for a requested profile. It may do so, if so requested, but the level of lossy compression would be at the discretion of the SCP. If the degree of compression is important to the application, then the SCU may compress the **instances** ~~**images**~~ before sending them to the SCP.

The request controls ….

S.3.2.1 Create a Media Creation Request

...

Table S.3.2.1.1-1. Media Creation Management – N-CREATE Attributes

Attribute Name	Tag	Usage (SCU/SCP)
...		
Allow Media Splitting	(2200,0007)	3/1C See Section S.3.2.1.1.6
Allow Lossy Compression	(2200,000F)	3/1C See Section S.3.2.1.1.9
...		

S.3.2.1.1.6 Allow Media Splitting

The SCP may or may not have the capability to split a request over more than one piece of media (e.g., if it doesn't fit on one). If it does, then the following SCP behavior shall apply and the specified Attributes are required to be supported by the SCP.

The Allow Media Splitting (2200,0007) Attribute shall be used by the SCP to determine if it is permitted to split this request over more than one piece of media.

Note

1. If the file-set size exceeds the media storage capacity, and this flag has been set to NO, the SCP shall refuse to process the request.
2. If the requested Media Storage Application Profile allows for lossless compression, and images **or waveforms** are not already compressed, such compression may be applied by the SCP in order to fit all instances on a single piece of media. This also applies to lossy compression if it has not been allowed by the value of Allow Lossy Compression (2200,000F).

Modify S.3.2.1.1.9 Allow Lossy Compression as follows

S.3.2.1.1.9 Allow Lossy Compression

If Allow Lossy Compression (2200,000F) has a value of YES, the SCP is allowed to perform lossy compression under the following circumstances:

- if it receives uncompressed or lossless compressed ~~**images**~~ **instances** yet is requested to use a profile that requires lossy compression, or
- if Allow Media Splitting (2200,0007) is NO, and the request would otherwise need to be split across media.

If Allow Lossy Compression (2200,000F) has a value of YES but the requested profile does not permit lossy compression, lossy compression shall not be performed.

The level of compression is at the SCP's discretion.

The SCP shall not decompress and recompress already lossy compressed ~~**images**~~ **instances**, but may use ~~**images**~~ **instances** that have already been lossy compressed.

The SCP is never required to perform lossy compression.If Allow Lossy Compression (2200,000F) has a value of NO, the SCP is not allowed to perform lossy compression. If Allow Lossy Compression (2200,000F) has a value of NO and the requested profile requires lossy compression, an error shall be returned.

Changes to NEMA Standards Publications PS3.5
Digital Imaging and Communications in Medicine (DICOM)
Part 5: Data Structure and Semantics

Update Section 2 Normative References as follows

….

[ITU T.261] ITU. 2026. *H.BWC (planned T.261) Draft 6 Specification Text* https://www.itu.int/wftp3/av-arch/video-site/2604_StE/VCEG-CA19-BWC-Specification-Draft6-v1.doc

…

Update Section 3 Definitions as follows:

…

3.10 DICOM Data Structures and Encoding Definitions

…

...

Encapsulated Format The Pixel Data Stream is encoded in a form wherein Fragments are contained within Item Tags within the Pixel Data (7FE0,0010) Data Element, usually used for compressed data.

...

Fragment One part of all of a Pixel Data Stream encoded within Encapsulated Pixel Data

Fragmentable Encapsulated Transfer Syntax A Transfer Syntax that allows the Encapsulated Format Pixel Data Stream to be split into one or more Fragments.

...

Native Format The Pixel Data Stream is encoded in an uncompressed form and occupies the entire Value of the Pixel Data (7FE0,0010) Data Element.

Non-Fragmentable Encapsulated Transfer Syntax A Transfer Syntax that requires the entire Encapsulated Format Pixel Data Stream be encoded in a single Fragment.

…

Pixel Data Stream The compressed or uncompressed octet-stream that constitutes the Pixel Data itself, without any DICOM-specific encapsulation structures.

Pixel Sample Value A value associated with an individual pixel. An individual pixel consists of one or more Pixel Sample Values (e.g., color images).

...

Waveform Data Digitized sensor data sampled at constant time intervals encoded in the Waveform Data (5400.1010) Data Element.

Waveform Data Stream The compressed or uncompressed octet-stream that constitutes the Waveform Data itself, without any DICOM-specific encapsulation structures.

Waveform Encapsulated Format The Waveform Data Stream as a whole or split into parts thereof is encoded in a form wherein Waveform Chunks areis contained within Item Tags within the Waveform Data (5400,1010) Data Element, usually used for compressed data.

Waveform Native Format The Waveform Data Stream is encoded in an uncompressed form and occupies the entire Value of the Waveform Data (5400,1010).

…

Modify Section 8.2 heading

8.2 Native or Encapsulated Format Pixel Data Encoding

Modify Section 8.3 Waveform Data and Related Data Elements heading and content

8.3 ~~Waveform Data and related Data Elements~~ Native or Encapsulated Waveform Data Encoding

The DICOM protocol provides for the exchange of encoded time-based signals, or waveforms, encoded in ~~the~~ Waveform Data (5400,1010).

Note:

~~1. Per Section 7.6, an IOD supporting multiple sets of Waveform Data will encapsulate Waveform Data (5400,1010) with a Sequence.~~

Multiple sets of Waveform Data originating from separate groups of channels are organized in Waveform Sequence (5400,0100), each representing a waveform multiplex group.

Waveform Data is conveyed in Waveform Data (5400,1010) and may be sent either in the Waveform Native Format (uncompressed) or in a Waveform Encapsulated Format (compressed).

In Waveform Native Format ~~E~~encoded Waveform Data of various bit depths is accommodated through the Waveform Bits Allocated (5400,1004) Data Element. This Data Element defines the size of each waveform data sample within the Waveform Data (5400,1010). Allowed Values are 8, 16, 32 and 64 bits.

In Waveform Native Format ~~T~~the Value Representation of the Waveform Data (5400,1010) shall be OW; OB shall be used in cases where Waveform Bits Allocated has a Value of 8, but only with Transfer Syntaxes where the Value Representation is explicitly conveyed.

Note:

1. Under the Default Transfer Syntax, OB and OW VRs have the identical byte transfer order.
2. Conversion of a SOP Instance from the Default Transfer Syntax to an Explicit VR Transfer Syntax (uncompressed) requires the interpretation of the Waveform Bits Allocated (5400,1004) Data Element, to determine the proper VR of the Waveform Data.

In Waveform Native Format ~~T~~the following Data Elements related to Waveform Data shall be encoded with the same VR as Waveform Data: Channel Minimum Value (5400,0110), Channel Maximum Value (5400,0112) and Waveform Padding Value (5400,100A).

In Waveform Encapsulated Format (i.e., other than the Waveform Native Format), the Value Representation of the Waveform Data shall be OB. The Waveform Data Sample Values are encoded according to the encoding process defined by one of the negotiated Transfer Syntaxes (see Annex A.X) resulting in a set of encoded byte streams.

The Waveform Data comprising the encapsulated stream consists of a Sequence of Items.

Each of the Items in the Sequence in the Waveform Data conveys its own explicit even length (see Section A.X).

The first Item in the Sequence shall be an offset table, which may be empty.

There may be one or more Items into which the encapsulated stream is split.

Note: In image Pixel Data these are referred to as Fragments, which is not used here to not interfere with the meaning of Fragment in the ITU specification.

The Sequence is of undefined length and is terminated by a Sequence Delimitation Item, thus allowing the support of encoding processes where the resulting length of the entire stream is not known until it is entirely encoded.

Waveform Encapsulated Format supports one ore more Multiplex Groups containing Waveform Data. Within each Waveform Data element there shall be at least one Item containing a part or all of the encoded byte stream.

Add a new Section 8.3.1 T.261 Waveform Compression

8.3.1 T.261 Waveform Compression

DICOM provides a mechanism for supporting the T.261 Waveform Compression through the Waveform Encapsulated Format. Annex A.X defines the Transfer Syntaxes that reference the T.261 Standard which provide a lossless (bit preserving) and a lossy compression scheme.

Note

The context where the usage of lossy compression of medical waveform data is clinically acceptable is beyond the scope of the DICOM Standard. The policies associated with the selection of appropriate compression parameters (e.g., compression ratio) for T.261 lossy compression is also beyond the scope of this Standard.

Using the Waveform Encapsulated Format to support T.261 compressed Waveform Data requires that the Data Elements that are related to Waveform Data encoding (e.g. Sampling Frequency, Waveform Sample Interpretation, Waveform Bits Allocated, Waveform Bits Stored) shall contain values that are consistent with the characteristics of the compressed data stream.

The requirements when using a Standard Waveform Sample Interpretation (i.e., a Defined Term from Section C.10.9 in PS3.3) are specified in Table 8.3.1-1. No other Standard Waveform Sample Interpretations shall be used.

Table 8.3.1-1 Valid Values of Waveform Data Related Attributes for T.261 Compression

Waveform Sample Interpretation	Waveform Sample Interpretation Meaning	Waveform Bits Allocated	Waveform Bits Stored	Number of Channels
SB	signed 8 bit linear	8	1-8	1024
SS	signed 16 bit linear	16	1-16	1024
SL	signed 32 bit linear	32	1-24	1024

Modify Section 10 Transfer Syntaxes by amending the waiving of TS-Negotiation in Section 10.1

10 Transfer Syntaxes

A Transfer Syntax is a set of encoding rules able to unambiguously represent one or more Abstract Syntaxes. …

10.1 DICOM Default Transfer Syntax

DICOM defines a Default Transfer Syntax …

…

Both of these requirements, (a) and (b), are waived when an Application sending ~~the~~ Pixel Data has only access to the Pixel Data in a lossy compressed form or the Pixel Data in a lossless compressed or encapsulated uncompressed form that is of such length that it cannot be encoded in the Default Transfer Syntax, and a Transfer Syntax that uses a Pixel Data reference is not offered.

Both of these requirements, (a) and (b) are also waived when an Application sending Waveform Data has only access to the Waveform Data in a lossy compressed form or the Waveform Data in a lossless compressed form that is of such length that it cannot be encoded in the Default Transfer Syntax.

Requirement (b) to accept the Default Transfer Syntax is waived if a Transfer Syntax that uses a Pixel Data reference is offered.

Note

In other In other words, every sending AE is required to be able to convert any Data Set it is going to transmit into the Default Transfer Syntax, regardless of the form in which it originally received or stored the Data Set, except in the cases of when the decompressed or unencapsulated Pixel Data **or Waveform Data** is too large to encode in the Default Transfer Syntax or is received in a lossy compressed form. In the case of lossy compressed Pixel Data **or Waveform Data**, the sending AE is permitted to propose only the lossy compressed Transfer Syntax appropriate to the lossy form that was received. In the case of lossless compressed or encapsulated uncompressed Pixel Data **or Waveform Data** that is too large to encode in the Default Transfer Syntax, the sending AE is permitted to propose any appropriate lossless compression Transfer Syntax or encapsulated uncompressed Transfer Syntax, not necessarily that in which the image was received, as an alternative to the Default Transfer Syntax.

This waiver does not apply to Data Sets received in a lossless compressed or encapsulated uncompressed form if the decompressed or unencapsulated Pixel Data **or Waveform Data** is small enough to encode in the Default Transfer Syntax, which means that any AE receiving a Data Set in a lossless compressed Transfer Syntax or encapsulated uncompressed Transfer Syntax that needs to re-send the Data Set is required to be able to decompress or unencapsulate it in order to support (at least) the Default Transfer Syntax.

Modify Section 10 Transfer Syntaxes by adding a section for T.261 Waveform Compression Transfer Syntaxes

10.x Transfer Syntaxes for T.261 Waveform Compression

Two Transfer Syntaxes are specified for T.261 Waveform Compression.

Modify Section A.4 Transfer Syntaxes for Encapsulation of Encoded Pixel Data

A.4 Transfer Syntaxes for Encapsulation of Encoded Pixel Data

These Transfer Syntaxes apply to the encoding of the entire DICOM Data Set, even though the image Pixel Data (7FE0,0010) portion of the DICOM Data Set is the only portion that is encoded by an encapsulated format. These Transfer Syntaxes shall only be used when Pixel Data (7FE0,0010) is present in the top level Data Set, and hence shall not be used when Float Pixel Data (7FE0,0008) or Double Float Pixel Data (7FE0,0009) are present. This implies that when a DICOM Message is being

encoded according to an encapsulation Transfer Syntax **for encoded Pixel Data** the following requirements shall be met:

...

- Overlay Data (60xx,3000)
  - shall have the Value Representation OB or OW and …
- ~~**Waveform Data (5400,1010) has the Value Representation specified in its Explicit VR Field. The component points shall be encoded in Little Endian.**~~
- Red Palette Color Lookup Table Data (0028,1201) …

Add a new section to Annex A Transfer Syntax Specifications (Normative)

A.X Transfer Syntaxes for Encapsulation of Encoded Waveform Data

These Transfer Syntaxes apply to the encoding of the entire DICOM Data Set, even though the Waveform Data (5400,1010) portion of the DICOM Data Set is the only portion that is encoded by an encapsulated format. These Transfer Syntaxes shall only be used when Waveform Data (5400,0010) is present in the top level Data Set. This implies that when a DICOM Message is being encoded according to an encapsulation Transfer Syntax for encoded Waveform Data the following requirements shall be met:

1. The Data Elements contained in the Data Set structure shall be encoded with Explicit VR (with a VR Field) as specified in Section 7.1.2.

2. The encoding of the overall Data Set structure (Data Element Tags, Value Length, etc.) shall be in Little Endian as specified in Section 7.3.

3. The encoding of the Data Elements of the Data Set shall be as follows according to their Value Representations:

- For all Value Representations defined in this Part of the Standard, except for the Value Representations OB and OW, the encoding shall be in Little Endian as specified in Section 7.3.
- For the Value Representations OB and OW, the encoding shall meet the following specification depending on the Data Element Tag:
  - Waveform Data (5400,1010) shall be in Waveform Encapsulated Format
    In Waveform Encapsulated Format, it has the Value Representation OB and is an octet-stream resulting from one of the encoding processes. It contains the encoded Waveform Data Stream fragmented into one or more Item(s). This Waveform Data Stream represents the Waveform Data of a single Multiplex Group.
    - The Length of the Data Element (5400,0010) shall be set to the Value of Undefined Length (FFFFFFFFH).
    - Each Data Stream fragment encoded according to the specific encoding process shall be encapsulated as a DICOM Item with a specific Data Element Tag of Value (FFFE,E000). The Item Tag is followed by a 4 byte Value (Item) Length Field encoding the explicit number of bytes of the Item.

- All items containing a Data Stream fragment shall be of an even number of bytes greater or equal to two and may be padded, if necessary, to meet the Sequence Item Format requirements of the DICOM Standard. …
- The first Item in the Sequence of Items before the encoded Waveform Data Stream shall be a Basic Offset Table item. The Basic Offset Table Item Value, however, is not required to be present:
  - When the Item Value is not present, the Item Length shall be zero (00000000H).
  - When the Item Value is present, the Basic Offset Table Item Value shall contain concatenated 32-bit unsigned integer values that are byte offsets to the first byte of the Item Tag of each fragment in the Sequence of Items. These offsets are measured from the first byte of the first Item Tag following the Basic Offset Table item.

A.X.1 T.261 Waveform Compression

The International Standards Organization ISO/IEC JTC1/SC 29 has developed an International Standard, [ITU T.261], for compression of biomedical waveform signals.

A DICOM Transfer Syntax for T.261 Waveform Compression shall be identified by a UID, appropriate to the selected T.261 coding mode.

Two Transfer Syntaxes are specified for T.261:

1. A Transfer Syntax with a UID of “UID_TS2_lossy”, which specifies the use of the lossy (irreversible) mode of T.261; i.e., the use of a block-based prediction followed by an invertible integer discrete cosine transformation (DCT), and quantization using optionally either least mean square (LMS) prediction, or linear predictive coding (LPC) in the time domain, followed by context based adaptive binary arithmetic coding.
2. A Transfer Syntax with a UID of “UID_TS1_lossless”, which specifies the use of the lossless (reversible) mode of T.261 using the same coding process as the lossy mode, but without quantization.

For these two Transfer Syntaxes only such stream packets defined in [ITU T.261] shall be present in the encoded data stream, which are necessary for encoding and decoding of the waveform data. Additional features and extensions that are contained in other stream packets shall not be included in the compressed bit stream unless they can be decoded or ignored without loss of fidelity by [ITU T.261] compliant implementations.

Note:

Stream packets 1 (WSP_SPT Waveform set parameters), 2 (CGP_SPT Channel Group parameters),4 (IF_SPT Independent frame), 5 (DF_SPT dependent frame) and 6 (SEGMENT_SPT segment payload) are required in order to allow decoding the compressed bitstream. Other stream packets are optional and may contain information which is sensible in terms of de-identification of the waveform data.

If the object contains more than one Multiplex Group, then each Multiplex Group shall be encoded separately.

Changes to NEMA Standards Publications PS3.6 Digital Imaging and Communications in Medicine (DICOM) Part 6: Data Dictionary

Amend Table 6-1. Registry of DICOM Data Elements

Table 6-1. Registry of DICOM Data Elements

Tag	Name	Keyword	VR	VM	
…					
(ggg1,eee0)	**Waveform Derivation Description**	**WaveformDerivationDescription**	**LO**	**1**	
(ggg1,eee1)	**Lossy Waveform Compression**	**LossyWaveformCompression**	**CS**	**1**	
(ggg1,eee2)	**Lossy Waveform Compression Method**	**LossyWaveformCompressionMethod**	**CS**	**1-n**	
(ggg1,eee3)	**Lossy Waveform Compression Ratio**	**LossyWaveformCompressionRatio**	**DS**	**1-n**	
(ggg1,eee4)	**Referenced Multiplex Group Number**	**ReferencedMultiplexGroupNumber**	**IS**	**1**	
(ggg1,eee5)	**Referenced Multiplex Group UID**	**ReferencedMultiplexGroupUID**	**UI**	**1**	
(ggg2,eee1)	**Multiplex Group Acquisition End DateTime**	**MultiplexGroupAcquisitionEndDateTime**	**DT**	**1**	
(ggg2,eee2)	**Multiplex Group Sample Times Sequence**	**MultiplexGroupSampleTimes Sequence**	**SQ**	**1**	
(ggg2,eee4)	**Relative Sample Times**	**RelativeSampleTimes**	**UL**	**1-n**	
…					

Amend .Annex A / Table A-1. UID Values

Table A-1. UID Values

UID Value	UID Name	UID Keyword	UID Type	Part
…				
UID_TS1_lossless	**T.261 Transfer Syntax for Lossless Waveform**	**T.261Lossless**	**Transfer Syntax**	**PS3.5**

	Compression			
UID_TS2_lossy	**T.261 Transfer Syntax for Lossy Waveform Compression**	**T.261Lossy**	**Transfer Syntax**	**PS3.5**
…				

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Changes to NEMA Standards Publications PS3.18
Digital Imaging and Communications in Medicine (DICOM)
Part 18: Web Services

Modify Section 3.6 Data Structures and Encoding

This Part of the Standard makes use of the following terms defined in PS3.5:

…

Waveform Data See Waveform Data in PS3.5

Waveform Encapsulated Format
See Waveform Encapsulated Format in PS3.5

Modify 3.9 Web Service Definitions

Bulk Data An object that contains an octet-stream containing one or more Value Fields (typically containing large data, such as Pixel Data) extracted from a DICOM Data Set. See Metadata.

Note:

1. The octet-stream does not include the Attribute Tag, Value Representation, or Attribute Length.
2. For the value of a Frame of a Pixel Data Attribute encoded in an Encapsulated Transfer Syntax, it does not include the Basic Offset Table and Pixel Data Stream Fragment Item Tags and lengths.
3. **For Waveform Data encoded in a Waveform Encapsulated Format it does not include the Basic Offset Table and Waveform Data Stream Item Tags and lengths.**

...

Metadata A DICOM Data Set where zero or more elements (typically containing large data, such as Pixel Data **or Waveform Data**) have been replaced with Bulk Data URIs.

Note:

Metadata does not include the Group 0002 File Meta Information Data Elements, which describe but are not part of a Data Set, per Section 7.1 in PS3.10.

Modify Section 8.7.2 and therein Table 8.7.2-1 Resource Categories as follows

8.7 Media Types

...

8.7.2 DICOM Resource Categories

Table 8.7.2-1 defines Resource Categories that correspond to different SOP Classes. The following sections map each Resource Category to appropriate DICOM and Rendered Media Types.

Table 8.7.2-1. Resource Categories

Resource Category	Definition
...	
Video	...

Waveform	**This category includes all resources that are Instances of a Waveform storage SOP Class.**
Text	...
Other	This category includes all resources that are not included above, for example ~~**waveforms**~~ **segmentation objects**.

Modify 8.7.3 DICOM Media Type Sets as follows

8.7.3 DICOM Media Type Sets

This section defines the Media Types used to represent DICOM Instances, Metadata and Bulk Data. It describes:

…

If a Transfer Syntax parameter for a DICOM Media Type is not specified in a request or response, the Transfer Syntax in the response shall be the Transfer Syntax specified as the default for the Resource Category and Media Type combination in Table 8.7.3-2, Table 8.7.3-4 or Table 8.7.3-5, unless the origin server has only access to the pixel **or waveform** data in lossy compressed form or the pixel **or waveform** data in a lossless compressed or encapsulated uncompressed form that is of such length that it cannot be encoded in the Explicit VR Little Endian Transfer Syntax.

…

Table 8.7.3-2, Table 8.7.3-3, Table 8.7.3-4, and Table 8.7.3-5 specify the Media Types used to encode different representations of DICOM Instances. These Media Types apply to all Resource Categories and have default encodings for images**, waveforms** and video data elements contained in the Instances.

Modify Section 8.7.3.1 Table 8.7.3-2 Transfer Syntax UIDs for application/dicom Media Types

8.7.3.1 Instance Media Types

The application/dicom Media Type specifies a representation of Instances encoded in the DICOM File Format specified in Section 7 “DICOM File Format” in PS3.10.

….

Table 8.7.3-2. Transfer Syntax UIDs for application/dicom Media Types

Category	Transfer Syntax UID	Transfer Syntax Name	Optionality
...			
Video	...		
	1.2.840.10008.1.2.4.107	HEVC/H.265 Main Profile / Level 5.1	O
	1.2.840.10008.1.2.4.108	HEVC/H.265 Main 10 Profile / Level 5.1	O

Waveform	**1.2.840.10008.1.2.1**	**Explicit VR Little Endian**	**D**
	UID_TS1_lossless	**T.261 Transfer Syntax for Lossless Waveform Compression**	**O**
	UID_TS2_lossy	**T.261 Transfer Syntay for Lossy Waveform Compression**	**O**
Text	1.2.840.10008.1.2.1	Explicit VR Little Endian	D
Other	1.2.840.10008.1.2.1	Explicit VR Little Endian	D

Note

The Transfer Syntaxes used in a DICOM-RTV Metadata Flow are not included, since they are not used to produce a representation of an Instance encoded in the DICOM File Format

Modify Section 8.7.3.3 Bulk Data MediaTypes as follows

8.7.3.3 Bulk Data Media Types

Bulk Data representations are only supported by RESTful services. There are two categories of Bulk Data: uncompressed and compressed

….

The Selected Media Type will be the default Media Type for the Resource Category when the origin server supports none of the Acceptable Media Types, as described in Section 8.7.8, unless the origin server has only access to the pixel **or waveform** data in lossy compressed form or the pixel **or waveform** data in a lossless compressed or encapsulated uncompressed form **~~that~~** is of such length that it cannot be encoded in the Explicit VR Little Endian Transfer Syntax.

The Origin Server may support additional Transfer Syntaxes.

If no Media Type Transfer Syntax parameter is specified, then the Explicit VR Little Endian Transfer Syntax "1.2.840.10008.1.2.1" shall be used, unless the origin server has only access to the pixel **or waveform** data in lossy compressed form or the pixel **or waveform** data in a lossless compressed or encapsulated uncompressed form **~~that~~** is of such length that it cannot be encoded in the Explicit VR Little Endian Transfer Syntax.

…

Depending on the Selected Media Type, the pixel data of a resource in the Video Category is encoded in:

- one Video compressed Bulk Data representation, or
- one Video uncompressed Bulk Data representation.

Depending on the Selected Media Type, the Waveform Data of a resource in the Waveform Resource Category is encoded in:

- **one Waveform compressed Bulk Data representation, or**
- **one Waveform uncompressed Bulk Data representation.**

8.7.3.3.1 Uncompressed Bulk Data Media Types

Table 8.7.3-4 specifies the default Media Type and Transfer Syntax UIDs, by Resource Category (see Table 8.7.2-1) …

Note

1.

…

Table 8.7.3-4. Transfer Syntax UIDs for Uncompressed Bulk Data

Category	Media Type	Transfer Syntax UID	Transfer Syntax Name	RESTful
...				
Video	application/octet-stream	1.2.840.10008.1.2.1	Explicit VR Little Endian	D
		1.2.840.10008.1.2.1.98	Encapsulated Uncompressed Explicit VR Little Endian	O
Waveform	**application/octet-stream**	**1.2.840.10008.1.2.1**	**Explicit VR Little Endian**	**D**
Text	application/octet-stream	1.2.840.10008.1.2.1	Explicit VR Little Endian	D
Other	application/octet-stream	1.2.840.10008.1.2.1	Explicit VR Little Endian	D

…

8.7.3.3.2 Compressed Bulk Data Media Types

Compressed Bulk Data contains only the compressed octet stream without the fragment delimiters.

…

These Media Types can be used to retrieve Bulk Data, such as images, video, **or waveform,** encoded in a specific Transfer Syntax.

…

Table 8.7.3-4. Media Types and Transfer Syntax UIDs for Compressed Bulk Data

Category	Media Type	Transfer Syntax UID	Transfer Syntax Name	RESTful
...				
Video	video/mpeg	1.2.840.10008.1.2.100	MPEG2 Main Profile / Main Level	O
		1.2.840.10008.1.2.100.1	Fragmentable MPEG2 Main Profile / Main Level	O
		1.2.840.10008.1.2.101	MPEG2 Main Profile / High Level	D
		1.2.840.10008.1.2.101.1	Fragmentable MPEG2 Main Profile / High Level	O

	video/mp4	...		
	application/x-deflate	1.2.840.10008.1.2.8.1	Deflate Image Frame Compression	O
Waveform	**application/mp4**	**UID_TS1_lossless**	**T.261 Transfer Syntax for Lossless Waveform Compression**	**D**
	application/mp4	**UID_TS2_lossy**	**T.261 Transfer Syntax for Lossy Waveform Compression**	**O**
Text		N/A (no defined compression transfer syntax for Text)		
Other		N/A (no defined compression transfer syntax for Other)		

The origin server may support additional Transfer Syntaxes.

…

Video pixel data is encoded as a single video representation. E.g., all Frames of an MPEG-4 video will be encoded as a single video/mp4 ([RFC4337]) representation.

Waveform Data is encoded as a single waveform representation. All channels of a multiplex group will be encoded as a single application/mp4 (RFC4337) representation.

…

Modify Section 8.7.3.4 Transfer Syntax follows

8.7.3.4 Transfer Syntax

The Default Transfer Syntax for DICOM Objects contained in a payload shall be Explicit VR Little Endian Uncompressed "1.2.840.10008.1.2.1". If the Transfer Syntax is not specified in a message, then the Default Transfer Syntax shall be used, unless the origin server has only access to the pixel data **or waveform data** in lossy compressed form or the pixel data **or waveform data** in a lossless compressed or encapsulated uncompressed form that is of such length that it cannot be encoded in the Explicit VR Little Endian Transfer Syntax.

Note:

1. …
2. Every origin server is required to be able to convert any Data Set it is going to return into the Explicit VR Little Endian Transfer Syntax, regardless of the form in which it originally received or stored the Data Set, except in the cases of when the decompressed Pixel Data **or Waveform Data** is too large to encode in the Explicit VR Little Endian Transfer Syntax or is received in a lossy compressed form. In the case of lossy compressed Pixel Data **or Waveform Data**, the origin server is permitted to return the lossy compressed Transfer Syntax appropriate to the lossy form that was received. In the case of lossless compressed or encapsulated uncompressed Pixel Data **or Waveform Data** that is too large to encode in the Explicit VR Little Endian Transfer Syntax, the origin server is permitted to return any appropriate lossless compression or encapsulated uncompressed Transfer Syntax, not necessarily that in which the image was received, as an alternative to the Explicit VR Little Endian Transfer Syntax.

3. ...

Modify Section 8.7.3.5.2 Transfer Syntax Parameter as follows

8.7.3.5.2 Transfer Syntax Parameter

For a given DICOM Media Type, a single Transfer Syntax parameter value may be specified, but its usage may be constrained by the service for which they are used.

….

The wildcard value "*" indicates that the user agent will accept any Transfer Syntax. This allows, for example, the origin server to respond without needing to transcode an existing representation to a new Transfer Syntax, or to respond with the Explicit VR Little Endian Transfer Syntax regardless of the Transfer Syntax stored, unless the origin server has only access to the pixel data **or waveform data** in lossy compressed form or the pixel data **or waveform data** in a lossless compressed form that is of such length that it cannot be encoded in the Explicit VR Little Endian Transfer Syntax.

Modify Section 8.7.8.1 Selected Media Type as follows

8.7.8.1 Selected Media Type

The Selected Media Type is the Media Type selected by the origin server for the representation in the response payload.

…

5.Otherwise, return a 406 (Not Acceptable).

Note

1.If the Selected Media Type is the Explicit VR Little Endian and the pixel data **or waveform data** is compressed and when uncompressed is of such length that it cannot contained in a Value Field, then the origin server will respond with a 406 (Not Acceptable), and the user agent may try again with a different set of Acceptable Media Types.

Modify Section 10.5 Store Transaction and therein Section 10.5.1.5 Request Payload

10.5 Store Transaction

…

10.5.1.5 Request Payload

The request payload shall be present and shall contain one or more representations consistent with the Content-Type Header Field.

…

• Compressed pixel data for a Video shall be encoded as one compressed Bulk Data representation.

• **Compressed Waveform Data shall be encoded as one compressed Bulk Data representation.**

• The Encapsulated Document (0042,0011) Bulk Data element …

Modify Section 10.5.2 Behavior

10.5.2 Behavior

The origin server stores Instances from the representations contained in the request payload.

…

The origin server shall encapsulate or convert any compressed pixel data **or waveform data** received as Bulk Data into an appropriate DICOM Transfer Syntax, as defined in Table 10.5.2-1.

If the request message contains compressed Bulk Data with a Content Type that is one of the Media Types specified in Table 10.5.2-1 **for Single Frame Image or Multi-frame Image or Video Resource Categories**, the request may omit the Image Pixel Description Macro Attributes and the origin server will derive them from the compressed octet stream.Some Media Types do not directly correspond to a DICOM Transfer Syntax and the origin server will transform the received bit stream into an uncompressed or lossless (reversibly) compressed Transfer Syntax.

Note

1. This allows a user agent to use consumer Media Types to encode the pixel data even though it may not have:
   - the pixel data in a form that directly corresponds to a lossless (reversible) DICOM Transfer Syntax, or
   - an API to access the information required to populate the Image Pixel Description Macro.
2. If the supplied compressed bit stream is in a lossless (reversible) format, the intent is to allow full fidelity retrieval of the decompressed pixels, not the format in which it happened to be submitted.

~~**The origin server shall encapsulate or convert any compressed pixel data received as Bulk Data into an appropriate DICOM Transfer Syntax, as defined in Table 10.5.2-1.**~~

If the supplied compressed octet stream is in a lossy (irreversible) format, there will be a corresponding DICOM Transfer Syntax, and the origin server is not expected to re-compress it causing further loss. **For Single Frame Image or Multi-frame Image or Video Resource Categories** Table 10.5.2-1 contains a list of Media Types containing compressed pixel data from which an origin server shall be able to derive the Image Pixel Data Description Macro Attribute values.

Requirements are specified in Table 10.5.2-1 as follows:

Transform No DICOM Transfer Syntax exists; shall be transformed by the origin server into an uncompressed or lossless compressed Transfer Syntax (the choice of which is at the discretion of the origin server).

Unchanged Shall be encapsulated in the corresponding DICOM Transfer Syntax without further lossy compression.

Table 10.5.2-1. Media Type Information to Transfer Syntaxes

Resource Category	Media Type	Requirement
Single Frame Image or Multi-frame Image	image/gif	Transform
	...	
	image/png	Transform
Video	video/mp4	Unchanged
	video/mpeg	Unchanged

	video/H265	Unchanged
Waveform	**application/mp4**	**Unchanged**

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