

1	Status	Final Text
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7	Submission Date	2023/07/26

8	Correction Number CP-2331	
9	Log Summary: Clarify Segment scan order for TILED_FULL	
10	Name of Standard	
11	PS3.3 2024a	
12	Rationale for Correction:	
13	CP 1984 extended the standard with attributes in the Segmentation IOD with the intention of supporting TILED_FULL in addition to	
14	the TILED_SPARSE support that had been enabled by CP 1830.	
15	However, it failed to specify the necessary implicit ordering of Segments, when more than one Segment is present.	
16	In this proposal, to be consistent with the precedent set for the optical path, the order of the segments is specified in terms of Segment	
17	Number (0062,0004) as defined in the Segment Sequence (0062,0002) rather than Referenced Segment Number (0062,000B) as	
18	defined in the Segment Identification Sequence (0062,000A) as would be used in the (omitted) Per-Frame Functional Group Sequence	
19	Items, except that the order is specified by numeric value since each Sequence Item is so numbered, whereas the optical paths are	
20	not defined numerically but by a textual identifier.	
21	CP 1830 also failed to relax the mandatory requirement for the Segmentation Macro (Segment Identification Sequence) to be present	
22	in the functional groups, which describes which segment a frame represents. Relax this constraint conditioned on being TILED_FULL.	
23	The Frame Content Macro, which in most IODs is required to be in the Per-Frame Functional Groups is in the Segmentation IOD	
24	not so constrained in the IOD definition (despite the general comment in the Macro definition itself), is made consistent, and conditions	
25	on being TILED_FULL are added to its content so that it may be rendered empty and thence omitted as in other IODs in which its	
26	contents are constrained by SOP Class.	
27	Add the note that typically accompanies those IODs in which the Per-Frame Functional Groups Sequence can be omitted.	
28	Correction Wording:	

Amend DICOM PS3.3 as follows (changes to existing text are bold and underlined for additions and ~~struckthrough~~ for removals):

## A.51.5 Segmentation Functional Groups

Table A.51-2. Segmentation Functional Group Macros

Functional Group Macro	Section	Usage
...		
Plane Position (Slide)	???	C - Required if Derivation Image Functional Group (???) is not present and the Frame of Reference is defined in the Slide Coordinate System and Dimension Organization Type (0020,9311) is not TILED_FULL. May be present otherwise if the Frame of Reference is defined in the Slide Coordinate System. See Section A.51.5.1.
...		
Frame Content	C.7.6.16.2.2	<b><u>MC - Required if not empty. Shall not be used as a Shared Functional Group</u></b>
Segmentation	???	<b><u>MC - Required if Dimension Organization Type (0020,9311) is not TILED_FULL</u></b>

### Note

**The Plane Position (Slide), Frame Content and Segmentation Macros are Type C, which allows the Per-Frame Functional Group Sequence (5200,9230) to be entirely omitted in those cases in which there are no other Per-Frame Functional Group Macros with content (i.e., the Frame Content Macro is empty or absent).**

### A.51.5.1 Segmentation Functional Groups Description

When a Frame of Reference UID is present the segment shall be specified within that coordinate system, using the Pixel Measures and either the Plane Position (Patient) and Plane Orientation (Patient), or the Plane Position (Slide) Functional Groups. Since this defines the spatial relationship of the segment, the size of the segmentation frames need not be the same size, or resolution, as the image data used to generate the segment data. The Derivation Image Functional Group may also be present, to specify on which images the segmentation was actually performed (since there may be others in the same Frame of Reference that are spatially co-located, but were not used to perform the segmentation).

If the Frame of Reference UID is not present, each pixel of the segmentation shall correspond to a pixel in a referenced image, using the Derivation Image Functional Group. Hence, the rows and columns of each referenced image will match the segmentation image. If both the Frame of Reference UID and the Derivation Image Functional Group are present, the segmentation and referenced image pixels need not correspond.

The value of Purpose of Reference Code Sequence (0040,A170) in the ??? shall be (121322, DCM, "Source Image for Image Processing Operation"). The value of Derivation Code Sequence (0008,9215) shall be (113076, DCM, "Segmentation").

### Note

Non-image source Instances used during segmentation, such as Real World Value maps, can be described in the top level Data Set in the Source Instance Sequence (0042,0013) of the ??? and are implied to have been used for the derivation of all frames. I.e., there is no mechanism for selectively specifying on a per-frame basis which non-Image Instances were used. Real World Value Map Instances already contain a means of selectively applying different scale factors to different frames.

## C.7.6.17 Multi-frame Dimension Module

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Table C.7.6.17-1. Multi-frame Dimension Module Attributes

Attribute Name	Tag	Type	Attribute Description
...			

Attribute Name	Tag	Type	Attribute Description
Dimension Organization Type	(0020,9311)	3	Dimension organization of the Instance.  <b>Defined Terms:</b>  <b>3D</b> Spatial Multi-frame image of equally spaced parallel planes (3D volume set) <b>3D_TEMPORAL</b> Temporal loop of equally spaced parallel-plane 3D volume sets. <b>TILED_FULL</b> Tiled image in which each frame represents a single tile and the <del>spatial</del> positions of the tiles are implicitly defined as per Section C.7.6.17.3. <b>TILED_SPARSE</b> Tiled image in which each frame represents a single tile and the <del>spatial</del> positions of tiles are explicitly defined by per-frame Functional Group Macro entries.
...			

### C.7.6.17.3 Spatial Location and, Optical Path, and Segment of Tiled Images

If Dimension Organization Type (0020,9311) is present with a value of TILED\_FULL, then the Per-Frame Functional Group Macros that would otherwise describe the spatial location of each tile explicitly (e.g., the X, Y and Z offsets from the origin in the Slide Coordinate System Plane Position (Slide)), and the optical path or segment, may be omitted.

A value of TILED\_FULL indicates that the frames across all Instances of a Concatenation, or a single Instance in the absence of a Concatenation, comprise a non-sparse non-overlapping representation of an entire rectangular region, and are sequentially encoded as successive frames in Pixel Data (7FE0,0010) in an implicit order varying:

- first along the row direction from left to right, where the row direction is defined in the Slide Coordinate System by the first three values of Image Orientation (Slide) (0048,0102),
- then along the column direction from top to bottom, where the column direction is defined in the Slide Coordinate System by the second three values of Image Orientation (Slide) (0048,0102),
- then along the depth direction from the glass slide towards the coverslip, where the depth direction is defined in the Slide Coordinate System from zero to positive,
- then along optical paths, if applicable, where the direction is defined by successive Items of the Optical Path Sequence (0048,0105) in the order in which they are listed in that Sequence,
- then along the segments, if applicable, where the direction is defined by ascending numeric values of Segment Number (0062,0004) as defined in the Segment Sequence (0062,0002).

If Dimension Organization Type (0020,9311) is absent or has a value of TILED\_SPARSE, then the ~~spatial~~ location of each tile is explicitly encoded using information in the Per-Frame Functional Group Sequence, and the recipient shall not make any assumption about the spatial position or optical path or segment or order of the encoded frames, but shall rely on the values of the relevant Per-Frame Functional Group Macro.

### C.7.6.16.2.2 Frame Content Macro

Table C.7.6.16-3 specifies the Attributes of the Frame Content Macro, which is used as a Functional Group Macro.

This Functional Group Macro may only be part of the Per-frame Functional Groups Sequence (5200,9230) Attribute.

**Table C.7.6.16-3. Frame Content Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Frame Content Sequence	(0020,9111)	1	Identifies general characteristics of this frame. Only a single Item shall be included in this Sequence.
>Frame Acquisition Number	(0020,9156)	3	A number identifying the single continuous gathering of data over a period of time that resulted in this frame.
>Frame Reference DateTime	(0018,9151)	1C	<p>The point in time that is most representative of when data was acquired for this frame. See ??? and ??? for further explanation.</p> <p><b>Note</b></p> <p>The synchronization of this time with an external clock is specified in the ??? in Acquisition Time Synchronized (0018,1800).</p> <p>Required if Frame Type (0008,9007) Value 1 of this frame is ORIGINAL, <b>and Dimension Organization Type (0020,9311) is not TILED_FULL</b>, and the SOP Class UID is not:</p> <ul style="list-style-type: none"> <li>• "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted Enhanced CT Image Storage)", or</li> <li>• "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted Enhanced MR Image Storage), or</li> <li>• "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted Enhanced PET Image Storage), or</li> <li>• "1.2.840.10008.5.1.4.1.1.77.1.6" (VL Whole Slide Microscopy Image Storage)</li> </ul> <p>May be present otherwise.</p>
>Frame Acquisition DateTime	(0018,9074)	1C	<p>The date and time that the acquisition of data that resulted in this frame started. See ??? for further explanation.</p> <p>Required if</p> <ul style="list-style-type: none"> <li>• Frame Type (0008,9007) Value 1 of this frame is ORIGINAL, <b>and Dimension Organization Type (0020,9311) is not TILED_FULL</b>, and the SOP Class UID is not:</li> <li>• "1.2.840.10008.5.1.4.1.1.2.2" (Legacy Converted Enhanced CT Image Storage), or</li> <li>• "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted Enhanced MR Image Storage), or</li> <li>• "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted Enhanced PET Image Storage), or</li> <li>• "1.2.840.10008.5.1.4.1.1.77.1.6" (VL Whole Slide Microscopy Image Storage)</li> <li>• or SOP Class UID (0008,0016) is "1.2.840.10008.5.1.4.1.1.6.3" (Photoacoustic Image Storage).</li> </ul> <p>May be present otherwise.</p>

Attribute Name	Tag	Type	Attribute Description
>Frame Acquisition Duration	(0018,9220)	1C	<p>The actual amount of time [in milliseconds] that was used to acquire data for this frame. See ??? and ??? for further explanation.</p> <p>Required if Frame Type (0008,9007) Value 1 of this frame is ORIGINAL, <b>and Dimension Organization Type (0020,9311) is not TILED_FULL</b>, and the SOP Class UID is not:</p> <ul style="list-style-type: none"> <li>• "1.2.840.10008.5.1.4.1.1.2.2 (Legacy Converted Enhanced CT Image Storage)", or</li> <li>• "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted Enhanced MR Image Storage), or</li> <li>• "1.2.840.10008.5.1.4.1.1.128.1" (Legacy Converted Enhanced PET Image Storage), or</li> <li>• "1.2.840.10008.5.1.4.1.1.77.1.6" (VL Whole Slide Microscopy Image Storage)</li> </ul> <p>May be present otherwise.</p>
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