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2	Date of Last Update	2019/01/24
3	Person Assigned	David Clunie
4		mailto:dclunie@dclunie.com
5	Submitter Name	David Clunie
6		mailto:dclunie@dclunie.com
7	Submission Date	2018/04/19

8	Correction Number CP-1822	
9	Log Summary: Remove Dimension Index Sequence requirement for WSI when Dimensions implicitly defined by TILED_FULL	
10	Name of Standard	
11	PS3.3 2018e	
12	Rationale for Correction:	
13	It is not necessary to explicitly specify Dimensions by Attribute using the Dimension Index Sequence when the TILED_FULL value	
14	of Dimension Organization Type implicitly defines them.	
15	Further, having Dimension Index Sequence results in a conditional requirement to include Dimension Index Values in Frame Content	
16	Sequence on a per frame basis, if Frame Content Sequence is present (though CP 1713 changed the requirement for Frame Content	
17	Sequence from mandatory to optional, so this does not prevent omission of the entire Per-Frame Functional Group Sequence, if	
18	there is no other need for it).	
19	It is proposed that Dimension Index Sequence be made conditional, required if Dimension Organization Type (0020,9311) is absent	
20	or not TILED_FULL.	
21	It is not considered necessary to provide a canonical explicit description of the dimensions that TILED_FULL implies (i.e., Image	
22	Orientation (Slide) and Optical Path Sequence), nor indeed would it be sufficient since the X, Y and Z order specified in C.7.6.17.3	
23	can not be explicitly described as there is no mechanism at present for specifying a selected value of a multi-valued attribute as a	
24	single dimension).	
25	Correction Wording:	

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

## A.32.8.4 VL Whole Slide Microscopy Image Functional Group Macros

**Table A.32.8-2. VL Whole Slide Microscopy Image Functional Group Macros**

Functional Group Macro	Section	Usage
Pixel Measures	???	M - Shall be used as a Shared Functional Group.
Frame Content	C.7.6.16.2.2	U - Shall not be used as a Shared Functional Group.
...		

**Note**

The Plane Position (Slide) and Optical Path Identification 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).

## C.7.6.17 Multi-frame Dimension Module

Table C.7.6.17-1 specifies the Attributes of the Multi-frame Dimension Module.

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

Attribute Name	Tag	Type	Attribute Description
Dimension Organization Sequence	(0020,9221)	1	Sequence that lists the Dimension Organization UIDs referenced by the containing SOP Instance. See Section C.7.6.17.2 for further explanation.  One or more Items shall be included in this Sequence.
>Dimension Organization UID	(0020,9164)	1	Uniquely identifies a set of dimensions referenced within the containing SOP Instance. See Section C.7.6.17.2 for further explanation.
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 spatial 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 spatial positions of tiles are explicitly defined by per-frame Functional Group Macro entries.

Attribute Name	Tag	Type	Attribute Description
Dimension Index Sequence	(0020,9222)	1C	Identifies the Sequence containing the indices used to specify the dimension of the multi-frame object.  One or more Items shall be included in this Sequence.  <b><u>Required if Dimension Organization Type (0020,9311) is absent or not TILED_FULL. May be present otherwise.</u></b>
>Dimension Index Pointer	(0020,9165)	1	Contains the Data Element Tag that is used to identify the Attribute connected with the index. See Section C.7.6.17.1 for further explanation.
>Dimension Index Private Creator	(0020,9213)	1C	Identification of the creator of a group of Private Data Elements.  Required if the Dimension Index Pointer (0020,9165) value is the Data Element Tag of a Private Attribute.
>Functional Group Pointer	(0020,9167)	1C	Contains the Data Element Tag of the Functional Group Sequence that contains the Attribute that is referenced by the Dimension Index Pointer (0020,9165).  See Section C.7.6.17.1 for further explanation.  Required if the value of Dimension Index Pointer (0020,9165) is the Data Element Tag of an Attribute that is contained within a Functional Group Sequence.
>Functional Group Private Creator	(0020,9238)	1C	Identification of the creator of a group of Private Data Elements.  Required if the Functional Group Pointer 0020,9167) value is the Data Element Tag of a Private Attribute.
>Dimension Organization UID	(0020,9164)	1	Uniquely identifies a set of dimensions referenced within the containing SOP Instance. In particular the dimension described by this Sequence Item is associated with this Dimension Organization UID. See Section C.7.6.17.2 for further explanation.
>Dimension Description Label	(0020,9421)	3	Free text description that explains the meaning of the dimension.

### C.7.6.17.1 Dimension Indices

With the Dimension Index Sequence (0020,9222), Data Element Tags are specified that identify the indices used for a particular SOP Instance.

The actual index values for each frame in a multi-frame header are stored in a single Dimension Index Values Attribute (0020,9157) defined in the Frame Content Functional Group. For each SOP Instance this Attribute has a Value Multiplicity equal to the number of Items in the Sequence. The ordering of the Items in the Sequence defines the ordering in the Dimension Index Values Attribute: Item 1 of the Sequence relates to Value 1, Item 2 to Value 2, etc.

The Dimension Index Pointer (0020,9165) references a single Attribute that describes the actual values that define the dimension. Each Attribute referenced in the Dimension Index Sequence (0020,9222) will have an index stored in the Dimension Index Values (0020,9157) for each frame. Each index value is an ordinal number starting from 1 and monotonically increasing by 1 within the scope of a Dimension Organization UID (0020,9164). These values are independent of the actual values of the Attribute referenced by the Dimension Index Pointer (0020,9165), i.e., the index values are logical indices, rather than actual indices. Frames assigned the same index shall contain nominally the same value for the referenced Attribute. If the referenced Attribute is not present for some frames, or is present but has no value, then a single index shall be assigned to indicate the lack of the value (i.e., all such frames shall have the same index value, which is different from other index values). It is at the discretion of the SOP Instance creator whether the Attribute values are equivalent, and therefore appropriate for assignment to the same index value.

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### C.7.6.17.2 Dimension Organization UID

The Dimension Organization UID (0020,9164) value identifies a set of dimensions to which an Item of the Dimension Index Sequence (0020,9222) belongs.

When different SOP Instances share the same Dimension Organization UID (0020,9164) for a particular Item of the Dimension Index Sequence (0020,9222), equivalent indices from the corresponding Dimension Index Values (0020,9157) shall have the same meaning across the SOP Instances.

This mechanism allows an image creator to explicitly specify that indices are intended to convey identical information across SOP Instances.

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### C.7.6.17.3 Spatial Location and Optical Path 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, may be omitted.

A value of TILED\_FULL indicates that the frames across all Instances of a Concatentation, or a single Instance in the absence of a Concatentation, 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, 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.

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 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 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.
...	...	...	...

Attribute Name	Tag	Type	Attribute Description
>Dimension Index Values	(0020,9157)	1C	<p>Contains the values of the indices defined in the Dimension Index Sequence (0020,9222) for this multi-frame header frame. The number of values is equal to the number of Items of the Dimension Index Sequence and shall be applied in the same order.</p> <p>See Section C.7.6.17.1 for a description.</p> <p><b>Note</b></p> <p>In Section C.7.6.17.1, the index values are defined to start from 1 and monotonically increase by 1, within the scope of the Dimension Organization UID (0020,9164).</p> <p>Required if the value of Dimension Index Sequence (0020,9222) exists.</p> <p><b>Note</b></p> <p><b><u>For some IODs, such as the VL Whole Slide Microscopy Image IOD, the entire Frame Content Sequence (0020,9111) may be omitted, but if it is present and Dimensions are explicitly defined, then the index values need to be supplied here.</u></b></p>
...	...	...	...