Status	Letter Ballot
Date of Last Update	2024/11/11
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Submission Date	2024/04/03

Correction Number CP-2411
Log Summary: Clarify Point Coordinates origin in Microscopy Bulk Simple Annotations
Name of Standard PS3.3
Rationale for Correction: The origin and sub-pixel addressing characteristics of the coordinates used in Microscopy Bulk Simple Annotations are intended to be interpreted in the same manner as for Graphic Data, as is used in SR and Presentation States, but this is not explicit. The existing reference to the Displayed Area Selection Module is potentially confusing and not necessary, so it is removed; it was probably intended to be a reference to the Graphic Annotation Module anyway, so a note (particularly with reference to the illustrations in the latter) is added. Also further clarify the peculiar use of VOLUME (rather than MATRIX) for Pixel Origin Interpretation (which it is unfortunately too late to change).
Correction Wording:

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

C.37.1.2 Microscopy Bulk Simple Annotations Module

Table C.37.1-2. Microscopy Bulk Simple Annotations Module Attributes

Attribute Name	Tag	Type	Attribute Description
...			
Annotation Coordinate Type	(006A,0001)	1	Whether coordinates are image-relative (2D) or volume-relative (3D). **Enumerated Values:** **2D** relative to individual frame or total image matrix **3D** relative to a Cartesian coordinate system defined by a Frame of Reference
Pixel Origin Interpretation	(0048,0301)	1C	For image-relative coordinates, specifies whether coordinates are to be interpreted relative to the individual frame pixel origins, or relative to the Total Pixel Matrix origin (see Section C.8.12.4.1.4). Required if Annotation Coordinate Type (006A,0001) is 2D. **Enumerated Values:** **FRAME** relative to individual frame **VOLUME** relative to Total Pixel Matrix **Note** The use of the term "VOLUME" to refer to the Total Pixel Matrix is historical and inherited from **Pixel Origin Interpretation (0048,0301) use in** Presentation States **and Structured Reports**, **and is equivalent to "MATRIX" for Bounding Box Annotation Units (0070,0003),** and does not refer to 3D coordinates.
Referenced Image Sequence	(0008,1140)	1C	The image to which this Annotation object applies. Only a single Item shall be included in this Sequence. Required if Annotation Coordinate Type (006A,0001) is 2D. May be present otherwise.
>Include ???			
Annotation Group Sequence	(006A,0002)	1	Groups of Annotations sharing common characteristics, such as graphic type, properties or measurements. One or more Items shall be included in this Sequence.
...			

Attribute Name	Tag	Type	Attribute Description
>Common Z Coordinate Value	(006A,0010)	1C	The Z coordinate(s) common to all points in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022), in mm in the Slide Coordinate System (Section C.8.12.2.1.1) associated with the Frame of Reference. More than one value may be present if the Annotations apply to more than one (but not all) Z planes. Required if Annotation Coordinate Type (006A,0001) is 3D, and all points in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) are in the same Z plane(s). **Note** This requirement means that it is mandatory to factor out the commonality, i.e., it is not permitted to send Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) with (X, Y, Z) triplets where all the Z values are the same. For Annotations of images that only have a single Z plane, or where all the points in an Annotation Group are coplanar and in the same Z plane, this condition will always be satisfied. Annotations in different Z planes can be separated into separate Annotation Groups in order to allow this condition to be satisfied, but using separate Annotation Groups is not required. See Section C.37.1.2.1.1.
>Point Coordinates Data	(0066,0016)	1C	The coordinates of one or more points that define the Annotations (whether single points or polygons), encoded in (X, Y) or (X, Y, Z) order. Required if Double Point Coordinates Data (0066,0022) is not present. For each point, two coordinates (X, Y) shall be encoded if Common Z Coordinate Value (006A,0010) is present, otherwise three coordinates (X, Y, Z) shall be encoded. See Section C.37.1.2.1.1.
>Double Point Coordinates Data	(0066,0022)	1C	The coordinates of one or more points that define the Annotations (whether single points or polygons), encoded in (X, Y) or (X, Y, Z) order. Required if Point Coordinates Data (0066,0016) is not present. For each point, two coordinates (X, Y) shall be encoded if Common Z Coordinate Value (006A,0010) is present, otherwise three coordinates (X, Y, Z) shall be encoded. See Section C.37.1.2.1.1.
>Long Primitive Point Index List	(0066,0040)	1C	A list of point indices. See Section C.37.1.2.1.1. Required if Graphic Type (0070,0023) is POLYLINE or POLYGON.
...			

C.37.1.2.1 Microscopy Bulk Simple Annotations Module Attribute Descriptions

C.37.1.2.1.1 Type, Points, Polygons, Parameterized and Rotated Shapes and Indices

All the Annotations in a single Item of Annotation Group Sequence (006A,0002) share the same value for Graphic Type (0070,0023).

If Annotation Coordinate Type (006A,0001) is 2D, then the coordinates are interpreted as image-relative, either relative to an individual frame or the Total Pixel Matrix, with units of pixels**~~, as defined in Section C.10.4 Displayed Area Module~~**. If Pixel Origin Interpretation (0048,0301) is FRAME, then a single frame of a single image shall be specified in Referenced Image Sequence (0008,1140). If Pixel Origin Interpretation (0048,0301) is VOLUME, then a single image shall be specified in Referenced Image Sequence (0008,1140) without a subset of frames designated, and the coordinates are relative to the Total Pixel Matrix of that image. The referenced image

shall not be an instance of a Concatenation; i.e., in the case of Concatenations, references shall be relative to the SOP Instance UID of Concatenation Source (0020,0242).

The 2D coordinates are an ordered set of (column,row) pairs that denote positions in an image specified with sub-pixel resolution such that:

- **The coordinates of the TLHC pixel**
  - **for the origin at the TLHC of the TLHC pixel are (0.0, 0.0), and**
  - **for the BRHC of the TLHC pixel are (1.0, 1.0).**
- **The coordinates of the BRHC pixel depend on the value of Pixel Origin Interpretation (0048, 0301):**
  - **If FRAME, then the BRHC of the BRHC pixel has coordinates (Columns (0028,0011), Rows (0028,0010)).**
  - **If VOLUME, then the BRHC of the BRHC pixel has coordinates (Total Pixel Matrix Columns (0048,0006), Total Pixel Matrix Rows (0048,0007)).**

Note

1. The referenced image need not be any particular resolution layer of a WSI pyramid. I.e., it may or may not be the highest resolution layer. The user may annotate images that are not at the highest resolution, but such Annotations may be projected onto any resolution layer that is available (or computed). If the referenced image is no longer stored or accessible, the ability to project the Annotations onto other layers may be lost.

2. A reference to a single frame means that all Annotations in this instance are on that frame; no mechanism is provided to span frames, or to specify more than one frame.

3. **2D sub-pixel addressing for the similar application of Graphic Data (0070,0022) used in Presentation States and Structured Reports is illustrated in Section C.10.5.1.2 Graphic Data and Graphic Type.**

If Annotation Coordinate Type (006A,0001) is 3D, then the X, Y and Z coordinates are interpreted as volume relative, with units of mm, in the Cartesian space defined by the Frame of Reference UID.

Note

1. A single referenced image may be specified even if Annotation Coordinate Type (006A,0001) is 3D. It need not be any particular resolution layer of a WSI pyramid, but may be interpreted as a suitable layer on which to render, select from or otherwise apply the Annotation. In particular, it may not be the highest resolution layer. Regardless, the Annotations are applicable to any image in the same Frame of Reference.

2. The use of millimeters as the unit for the Z coordinates is inconsistent with the use of microns for the Z Offset in Slide Coordinate System (0040,074A) in the Section C.8.12.2 Slide Coordinates Module.

...

For referenced unchanged DICOM PS3.3:

C.18.6 Spatial Coordinates Macro

Table C.18.6-1 specifies the Attributes of the Spatial Coordinates Macro, which convey Spatial Coordinates in an SCOORD Content Item. An SCOORD Content Item shall always be the Source Content Item of one or more SELECTED FROM Relationships with IMAGE Target Content Items. Each IMAGE Target Content Item shall contain a reference to one single-frame or multi-frame Image.

Note

The same set of spatial coordinates may be selected from more than one single-frame image, or more than one frame of a multi-frame image when the purpose of reference is applicable to multiple images. For example, the spatial coordinates may specify the outline of a sampling region at the same spatial location on multiple images acquired over time.

Table C.18.6-1. Spatial Coordinates Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Graphic Data	(0070,0022)	1	An ordered set of (column,row) pairs that denote positions in an image specified with sub-pixel resolution such that the origin at the TLHC of the TLHC pixel is 0.0\0.0, the BRHC of the TLHC pixel is 1.0\1.0, and the BRHC of the BRHC pixel is Columns\Rows. The values must be within the range 0\0 to Columns\Rows. The maximum values are those contained in the referenced image in Attributes Columns (0028,0011) and Rows (0028,0010), or in the case of spatial coordinates with Pixel Origin Interpretation (0048,0301) value VOLUME, in Attributes Total Pixel Matrix Columns (0048,0006) and Total Pixel Matrix Rows (0048,0007). See ??? for further explanation.
Graphic Type	(0070,0023)	1	See ??? for Enumerated Values.
Pixel Origin Interpretation	(0048,0301)	1C	For a referenced multi-frame image, specifies whether the Graphic Data (0070,0022) values are to be interpreted relative to the individual frame pixel origins, or relative to the Total Pixel Matrix origin (see Section C.8.12.4.1.4). Required if the instance referenced by Referenced Image Sequence (0008,1140) is tiled (i.e., contains Total Pixel Matrix Columns (0048,0006) and Total Pixel Matrix Rows (0048,0007)). May be present otherwise. **Enumerated Values:** **FRAME** relative to individual frame **VOLUME** relative to Total Pixel Matrix If not present, Graphic Data values are defined relative to the frame pixel origin.
Fiducial UID	(0070,031A)	3	The globally unique identifier for this fiducial Item. **Note** The fiducial UID can be used to associate this set of graphics with other Content Items.

C.8.12.2 Slide Coordinates Module

C.8.12.2.1 Slide Coordinates Module Attribute Descriptions

C.8.12.2.1.1 Image Center Point Coordinates Sequence

This Section defines the Slide Coordinate System and specifies the Attributes that shall be used to describe the location of the center point of the Image pixel plane (as captured through a microscope) in the Slide Coordinate System Frame of Reference.

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C.8.12.4.1.3 Total Pixel Matrix Columns, Rows, Focal Planes

See Section C.8.12.14.1.1.

C.8.12.4.1.4 Total Pixel Matrix Origin Sequence and Image Orientation (Slide)

See Section C.8.12.14.1.2.

C.8.12.14.1 Microscope Slide Layer Tile Organization Module Attribute Descriptions

C.8.12.14.1.1 Total Pixel Matrix Columns, Rows, Focal Planes

Total Pixel Matrix Columns (0048,0006), Total Pixel Matrix Rows (0048,0007) and Total Pixel Matrix Focal Planes (0048,0303) describe the size of the entire imaged volume as a single extent across all frames (tiles).

The extent would be as described in these Attributes if the whole volume would be imaged and encoded as a non-sparse pixel matrix with the pixel spacing as specified in Pixel Spacing (0028,0030) of the Pixel Measures Functional Group (see ???), such as when Dimension Organization Type (0020,9311) is present with a value of TILED_FULL.

C.8.12.14.1.2 Total Pixel Matrix Origin Sequence and Image Orientation (Slide)

Total Pixel Matrix Origin Sequence (0048,0008) specifies the location of the top leftmost pixel of the pixel matrix, and Image Orientation (Slide) (0048,0102) specifies the direction cosines of the first row and the first column of the pixel matrix, both with respect to the Slide Coordinate System Frame of Reference (see Section C.8.12.2). Although the image acquisition may vary the true row and column orientation at the pixel scale to account for local variation in the physical specimen, this Attribute describes the orientation as if the Pixel Matrix were flat.

Note

Typically, Image Orientation (Slide) will describe only a planar rotation, as the image plane is usually nominally parallel to the slide surface.

C.10.4 Displayed Area Module

This Module describes Attributes required to define a Specified Displayed Area space.

The Specified Displayed Area is that portion of the image displayed on the device.

...

Table C.10-4. Displayed Area Module Attributes

Attribute Name	Tag	Type	Attribute Description
Displayed Area Selection Sequence	(0070,005A)	1	A Sequence of Items each of which describes the displayed area selection for a group of images or frames. Sufficient Items shall be present to describe every image and frame listed in the ???. One or more Items shall be included in this Sequence.
>Referenced Image Sequence	(0008,1140)	1C	The subset of images and frames listed in the ???, to which this displayed area selection applies. One or more Items shall be included in this Sequence. Required if the displayed area selection in this Item does not apply to all the images and frames listed in the ???.
>>Include ???			

Attribute Name	Tag	Type	Attribute Description
>Pixel Origin Interpretation	(0048,0301)	1C	For a referenced multi-frame image, specifies whether the Displayed Area Top Left Hand Corner (0070,0052) and Displayed Area Bottom Right Hand Corner (0070,0053) are to be interpreted relative to the individual frame pixel origins, or relative to the Total Pixel Matrix origin (see Section C.8.12.4.1.4). Required if the instance referenced by Referenced Image Sequence (0008,1140) is tiled (i.e., contains Total Pixel Matrix Columns (0048,0006) and Total Pixel Matrix Rows (0048,0007)). May be present otherwise. **Enumerated Values:** **FRAME** relative to individual frame **VOLUME** relative to Total Pixel Matrix If not present, TLHC and BRHC are defined relative to the frame pixel origins.
>Displayed Area Top Left Hand Corner	(0070,0052)	1	The top left (after spatial transformation) pixel in the referenced image to be displayed, given as column\row. Column is the horizontal (before spatial transformation) offset (X) and row is the vertical (before spatial transformation) offset (Y) relative to the origin of the pixel data before spatial transformation, which is 1\1. See ???.
>Displayed Area Bottom Right Hand Corner	(0070,0053)	1	The bottom right (after spatial transformation) pixel in the referenced image to be displayed, given as column\row. Column is the horizontal (before spatial transformation) offset (X) and row is the vertical (before spatial transformation) offset (Y) relative to the origin of the pixel data before spatial transformation, which is 1\1. See ???.
>Presentation Size Mode	(0070,0100)	1	Manner of selection of display size. **Enumerated Values:** **SCALE TO FIT** **TRUE SIZE** **MAGNIFY** See Section C.10.4 for further explanation.
...			...

C.10.5 Graphic Annotation Module

This Module defines Attributes of vector graphics and text annotation that shall be made available by a display device to be applied to an image. The graphics and text are defined in position and size relative to the image pixel coordinates or the Specified Displayed Area space (defined in Section C.10.4); in the context of a Volumetric Presentation State IOD, the annotation is relative to the Volumetric Presentation View (e.g., the MPR view defined in ???). A Graphic Annotation shall be related to an Image.

Note

See ??? for constraints on Attributes in this Module when used in the Planar MPR Volumetric Presentation State IOD.

Table C.10-5. Graphic Annotation Module Attributes

Attribute Name	Tag	Type	Attribute Description
Graphic Annotation Sequence	(0070,0001)	1	A Sequence of Items each of which represents a group of annotations composed of graphics or text or both. One or more Items shall be included in this Sequence.

Attribute Name	Tag	Type	Attribute Description
>Referenced Image Sequence	(0008,1140)	1C	The subset of images and frames listed in the ???, to which this graphic annotation applies. One or more Items shall be included in this Sequence. Required if graphic annotations in this Item do not apply to all the images and frames listed in the ???.
>>Include ???			
...			
>Text Object Sequence	(0070,0008)	1C	Sequence that describes a text annotation. One or more Items shall be included in this Sequence. Either one or both of Text Object Sequence (0070,0008) or Graphic Object Sequence (0070,0009) are required.
>>Bounding Box Annotation Units	(0070,0003)	1C	Units of measure for the axes of the text bounding box. Defines whether or not the annotation is Image or Displayed Area relative. Both dimensions shall have the same units. **Enumerated Values:** **PIXEL** Image relative position specified with sub-pixel resolution such that the origin, which is at the Top Left Hand Corner (TLHC) of the TLHC pixel is 0.0\0.0, the Bottom Right Hand Corner (BRHC) of the TLHC pixel is 1.0\1.0, and the BRHC of the BRHC pixel is Columns\Rows (see Figure C.10.5-1). The values must be within the range 0\0 to Columns\Rows. **DISPLAY** Fraction of Specified Displayed Area where 0.0\0.0 is the TLHC and 1.0\1.0 is the BRHC. The values must be within the range 0.0 to 1.0. **MATRIX** Image relative position specified with sub-pixel resolution such that the origin, which is at the Top Left Hand Corner (TLHC) of the TLHC pixel of the Total Pixel Matrix, is 0.0\0.0, the Bottom Right Hand Corner (BRHC) of the TLHC pixel is 1.0\1.0, and the BRHC of the BRHC pixel of the Total Pixel Matrix is Total Pixel Matrix Columns\Total Pixel Matrix Rows (see Section C.8.12.4.1.3 and Figure C.10.5-1b). The values must be within the range 0.0\0.0 to Total Pixel Matrix Columns\Total Pixel Matrix Rows. MATRIX may be used only if the instance referenced by Referenced Image Sequence (0008,1140) is tiled (i.e., contains Total Pixel Matrix Columns (0048,0006) and Total Pixel Matrix Rows (0048,0007)). Required if Bounding Box Top Left Hand Corner (0070,0010) or Bounding Box Bottom Right Hand Corner (0070,0011) is present.
...			
>Graphic Object Sequence	(0070,0009)	1C	Sequence that describes a graphic annotation. One or more Items shall be included in this Sequence. Either one or both of Text Object Sequence (0070,0008) or Graphic Object Sequence (0070,0009) are required.
>>Graphic Annotation Units	(0070,0005)	1	Units of measure for the axes of the graphic annotation. Enumerated Values for Graphic Annotation Units (0070,0005) are the same as for Bounding Box Annotation Units (0070,0003).

Attribute Name	Tag	Type	Attribute Description
>>Graphic Dimensions	(0070,0020)	1	**Enumerated Values:** **2**
>>Number of Graphic Points	(0070,0021)	1	Number of data points in this graphic.
>>Graphic Data	(0070,0022)	1	Coordinates that specify this graphic annotation. See Section C.10.5.1.2 for further explanation.
>>Graphic Type	(0070,0023)	1	The shape of graphic that is to be drawn. See Section C.10.5.1.2. **Enumerated Values:** **POINT** **POLYLINE** **INTERPOLATED** **CIRCLE** **ELLIPSE**

C.10.5.1 Graphic Annotation Module Attribute Descriptions

C.10.5.1.2 Graphic Data and Graphic Type

Graphic Data (0070,0022) contains the points in the graphic annotation, each dimension for the first point, followed by dimensions for second point, etc. For a two dimensional curve: X1, Y1, X2, Y2, etc. The first (X) dimension corresponds to the image or Specified Displayed Area column (horizontal offset), and the second (Y) dimension corresponds to the image or Specified Displayed Area row (vertical offset). The Value Representation of all components of the N-tuple shall be the same. The image or Specified Displayed Area relative drawing space is defined in Graphic Annotation Units (0070,0005).

...

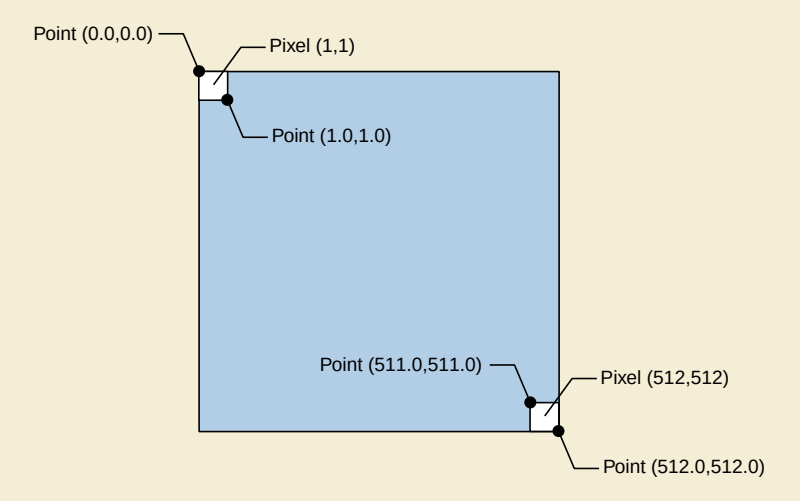

Figure C.10.5-1. Sub-pixel Addressing Units in PIXEL Space

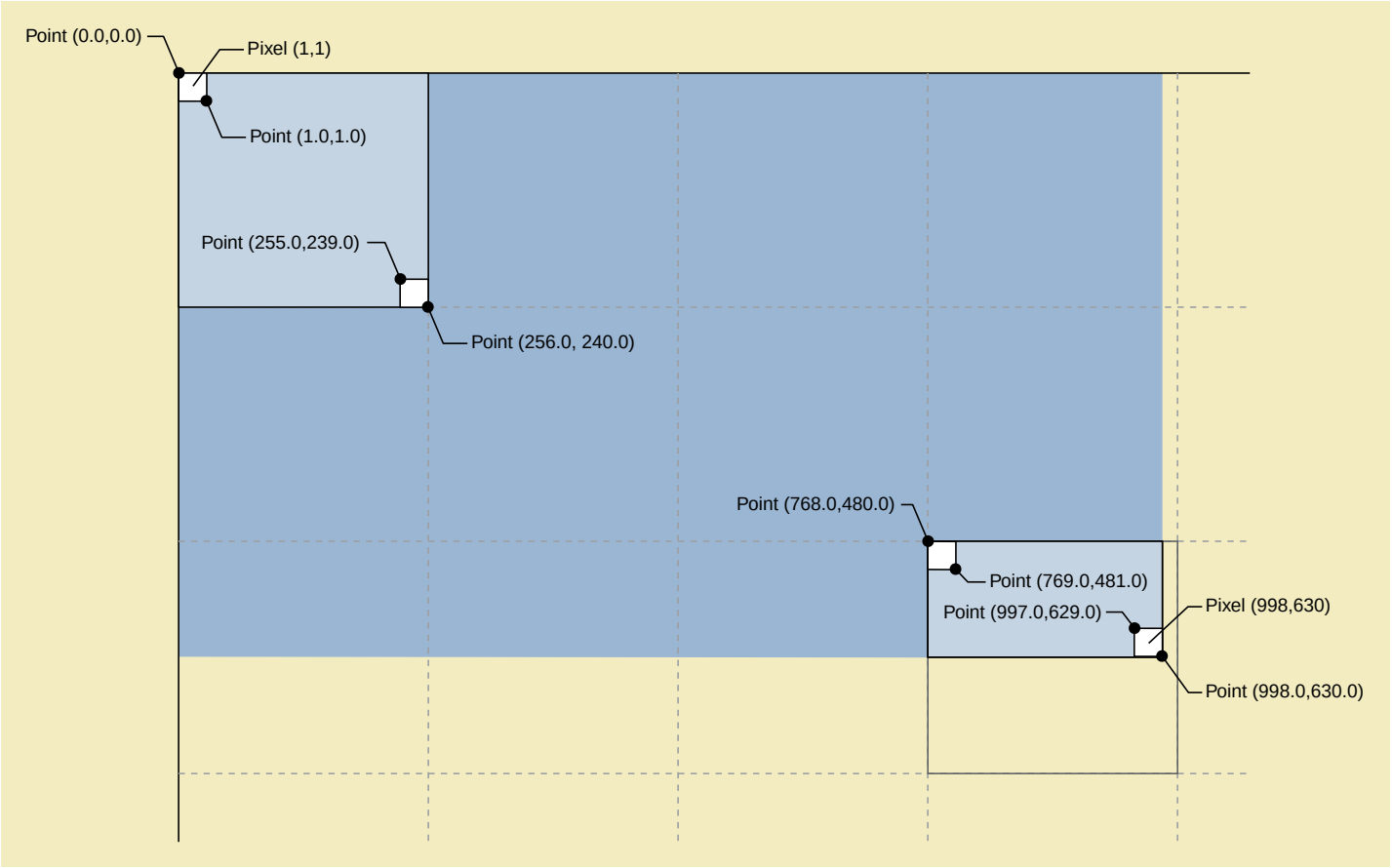

Figure C.10.5-1b. Sub-pixel Addressing Units in MATRIX Space