Digital Imaging and Communications in Medicine (DICOM)

Supplement 47: Visible Light Video

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Foreword

The American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) formed a joint committee to develop a standard for Digital Imaging and Communications in Medicine (DICOM). This DICOM Standard and the corresponding Supplements to the DICOM Standard were developed according to the NEMA procedures.

This Supplement defines Visible Light Video Information Objects Definitions (IOD) and related SOP Classes.

Scope and Field of Application

DICOM Visible Light Video SOP Classes are needed to support new applications that require video.

This supplement introduces three new Information Objects Definitions (IOD) and related SOP Classes for Endoscopy, Microscopy and Photography Video.

LIMITATIONS OF CURRENT STANDARD.

The four existing Visible Light SOP Classes only support single-frame images.

Adding new video (time-based multi-frame) SOP Classes will enable applications such as the following:

- Acquiring digital video, replacing the analogue video tape recorders. Such video acquisitions are large enough to justify use of lossy compression transfer syntaxes using interpolation between frames, as MPEG2.
- Managing the audio channel(s) multiplexed with the video.
- Selecting significant clips and distributing them on a removable medium such as DVD.

FORM OF THIS SUPPLEMENT

Since this document proposes changes to existing Parts of DICOM, the reader should have a working understanding of the Standard. This proposed Supplement includes a number of Addenda to existing Parts of DICOM:

- PS 3.3 Addendum: Information Object Definitions
- PS 3.4 Addendum: Service Class Specifications
- PS 3.16 Addendum: Content Mapping Resource

PS 3.3: Add VL VS IODs in Table A.1-1 (all cells not included here are empty)

Table A.1-1
COMPOSITE INFORMATION OBJECT MODULES OVERVIEW - IMAGES

IODs Modules	…	Video VL EN	Video VL MC	Video VL PH
Patient		M	M	M
Specimen Identification			M	C
Clinical Trial Subject		U	U	U
General Study		M	M	M
Patient Study		U	U	U
Clinical Trial Study		U	U	U
General Series		M	M	M
Clinical Trial Series		U	U	U
General Equipment		M	M	M
General Image		M	M	M
Image Pixel		M	M	M
Cine		M	M	M
Multi-frame		M	M	M
VL Image		M	M	M
Acquisition Context		M	M	M
SOP Common		M	M	M

PS 3.3: Add explanatory material for the VL Image IOD:

A.32 VISIBLE LIGHT IMAGE INFORMATION OBJECT DEFINITIONS

The Visible Light (VL) Image Information Object Definition (IOD) specifies images that are acquired by means of a camera or other sensors that are sensitive to visible or near-visible light.

Examples of types of equipment that create Visible Light Images include:

a. Rigid and flexible endoscopy equipment
b. Operation microscopes / colposcopes
c. Ophthalmology equipment
d. Digital or Video Cameras
e. Analysis microscopes

Separate IODs have been defined for specialized applications. Some support only single frame images, some support both single frame and multi-frame video images.

PS 3.3: Add new VL object IODs:

A.32.X Video Endoscopic Image Information Object Definition

A.32.X.1 Video Endoscopic Image IOD Description

The Video Endoscopic Image IOD specifies the Attributes of Multi-frame Video Endoscopic Images.

A.32.X.2 Video Endoscopic Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 of this Part depicts those components of the DICOM Information Model that directly reference the Video Endoscopic Image IOD, with exception of the Curve, VOI LUT, and Modality LUT entities, which are not used. Table A.32.X-1 specifies the Modules of the Video Endoscopic Image IOD.

Notes: 1. An endoscopic procedure might include multiple series of video Endoscopic images as well as one or more additional series of: single frame VL Endoscopic images, Key Object Selection documents (for selecting clips from the video) and/or of related diagnostic images. The procedure might involve multiple Performed Procedure Steps, multiple endoscopes, and multiple anatomic regions and might be supervised, performed, and/or interpreted by one or more individuals.

2. Several distinct diagnostic or therapeutic processes might occur during an endoscopic procedure. For example: Endoscopic examination of duodenal mucosa, biopsy, lavage, or biliary stone removal.

3. The video may include audio channel(s) for acquiring patient voice or physiological sounds, healthcare professionals' commentary, or environmental sounds.

4. The Frame Pointers Module has not been included because the selection of relevant sub-sequence(s) is usually made in a second workflow step and stored into separate Key Object Selection Documents.

Table A.32.X-1
VIDEO ENDOSCOPIC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Cine	C.7.6.5	M
	Multi-frame	C.7.6.6	M
	Image Pixel	C.7.6.3	M
	Acquisition Context	C.7.6.14	M
	VL Image	C.8.12.1	M
	SOP Common	C.12.1	M

A.32.X.3 Video Endoscopic Image IOD Content Constraints

A.32.X.3.1 Modality

The value of Modality (0008,0060) shall be ES.

Note: The use of a single value for Modality recognizes the fact that the same acquisition equipment is often used for different purposes (e.g. laparoscopy and colonoscopy). This means that Modality is not useful to distinguish one type of endoscopy from another when browsing a collection of studies. Therefore, the use of Procedure Code Sequence (0008,1032) and Anatomic Region Sequence (0008,2218) in the image instances and in the query response is recommended, though gathering sufficient information to populate these attributes in an unscheduled workflow environment (i.e., in the absence of Modality Worklist) may require operator intervention.

A.32.X.3.2 Image Related Data Encoding

The Modality LUT, VOI LUT, Graphic Annotation, Overlay and Curve Modules shall not be present.

A.32.X.3.3 Anatomic Region Sequence

The Defined Context Group for Anatomic Region Sequence (0008,2218) shall be CID 4040.

A.32.Y Video Microscopic Image Information Object Definition

A.32.Y.1 Video Microscopic Image IOD Description

The Video Microscopic Image IOD specifies the Attributes of Video Microscopic Images. Slide Coordinates shall not be encoded with this IOD.

A.32.Y.2 Video Microscopic Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 of this Part depicts those components of the DICOM Information Model that directly reference the Video Microscopic Image IOD, with exception of the Curve, VOI LUT, and Modality LUT entities, which are not used. Table A.32.Y-2 specifies the Modules of the Video Microscopic Image IOD.

Notes: 1. A microscopy procedure might include multiple series of video Microscopic images as well as one or more additional series of: single frame VL Microscopic images, Key Object Selection documents (for selecting clips from the video) and/or of related diagnostic images. The procedure might involve multiple Performed Procedure Steps, multiple microscopes, and multiple anatomic regions and might be supervised, performed, and/or interpreted by one or more individuals.

2. Several distinct diagnostic or therapeutic processes might occur during a single procedure. For example: Histologic staining of the same section with multiple special stains.

3. The video may include audio channel for acquiring patient voice or physiological sounds, healthcare professionals comment, or environment sounds.

4. The Frame Pointers Module has not been included because the selection of relevant sub-sequence(s) is usually made in a second step and stored into separate Key Object Selection Documents.

Table A.32.Y-2
VIDEO MICROSCOPIC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Specimen Identification	C.7.1.2	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U

Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Cine	C.7.6.5	M
	Multi-frame	C.7.6.6	M
	Image Pixel	C.7.6.3	M
	Acquisition Context	C.7.6.14	M
	VL Image	C.8.12.1	M
	SOP Common	C.12.1	M

A.32.Y.3 Video Microscopic Image IOD Content Constraints

A.32.Y.3.1 Modality

The value of Modality (0008,0060) shall be GM.

A.32.Y.3.2 Image Related Data Encoding

The Modality LUT, VOI LUT, Graphic Annotation, Overlay and Curve Modules shall not be present.

A.32.Z Video Photographic Image Information Object Definition

A.32.Z.1 Video Photographic Image IOD Description

The Video Photographic Image IOD specifies the attributes of VL Multi-frame photographic Images.

A.32.Z.2 Video Photographic Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 of this Part depicts those components of the DICOM Information Model that directly reference the Video Photographic Image IOD, with exception of the Curve, VOI LUT and Modality LUT entities, which are not used. Table A.32.Z-1 specifies the Modules of the Video Photographic Image IOD.

Notes: 1. A VL photographic imaging procedure might include multiple series of video Photographic images as well as one or more additional series of: single frame VL Photographic images, Key Object Selection documents (for selecting clips from the video) and/or of related diagnostic images. The procedure might involve multiple Performed Procedure Steps, multiple cameras, and multiple anatomic regions and might be supervised, performed, and/or interpreted by one or more individuals.

2. Several distinct diagnostic or therapeutic processes might occur during a single procedure.

3. The video may include audio channel for acquiring patient voice or physiological sounds, healthcare professionals comment, or environment sounds.

4. The Frame Pointers Module has not been included because the selection of relevant sub-sequence(s) is usually made in a second step and stored into separate Key Object Selection Documents.

Table A.32.Z-1
VL PHOTOGRAPHIC IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Specimen Identification	C.7.1.2	C - Required if the Imaging Subject is a Specimen
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M

	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Cine	C.7.6.5	M
	Multi-frame	C.7.6.6	M
	Image Pixel	C.7.6.3	M
	Acquisition Context	C.7.6.14	M
	VL Image	C.8.12.1	M
	SOP Common	C.12.1	M

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195 **A.32.Z.3 Video Photographic Image IOD Content Constraints**

196 **A.32.Z.3.1 Modality**

197 The value of Modality (0008,0060) shall be XC.

198 **A.32.Z.3.2 Image Related Data Encoding**

199 The Modality LUT, VOI LUT, Graphic Annotation, Overlay and Curve Modules shall not be present.

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201 *PS 3.3: Modify VL Image Module:*

202 **C.8.12.1 VL Image Module**

203 **VL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
…	…	…	…
>Window Center	**(0028,1050)**	**3**	**Window Center for display. See C.11.2.1.2 for further explanation.** **Meaningful only if Photometric Interpretation (0028,0004) is MONOCHROME2.**
>Window Width	**(0028,1051)**	**1C**	**Window Width for display. See C.11.2.1.2 for further explanation.** **Required if Window Center (0028, 1050) is present.**
…	…	…	…

Anatomic Region Sequence	**(0008,2218)**	**1C**	**Sequence that identifies the anatomic region of interest in this image (i.e. external anatomy, surface anatomy, or general region of the body).** **Only a single Item shall be permitted in this sequence.** **Required if Number of Frames (0028,0008) is present and Specimen Accession Number (0040,050A) is absent. May be present otherwise.**
>Include 'Code Sequence Macro' Table 8.8-1		***DCID 4040 is defined for the Video Endoscopic IOD.*** ***For other IODs, no Baseline Context ID is defined.***	
>Anatomic Region Modifier Sequence	**(0008,2220)**	**3**	**Sequence of Items that modifies the anatomic region of interest of this image** **One or more Items may be included in this Sequence.**
>>Include 'Code Sequence Macro' Table 8.8-1		***Baseline Context ID is 2 .***	
Primary Anatomic Structure Sequence	**(0008,2228)**	**3**	**Sequence of Items that identifies the primary anatomic structure(s) of interest in this image.** **One or more Items may be included in this Sequence.**
>Include 'Code Sequence Macro' Table 8.8-1		***No Baseline Context ID is defined***	
>Primary Anatomic Structure Modifier Sequence	**(0008,2230)**	**3**	**Sequence of Items that modifies the primary anatomic structure of interest in this image.** **One or more Items may be included in this Sequence.**
>>Include 'Code Sequence Macro' Table 8.8-1		***Baseline Context ID is 2 .***	

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206 **C.8.12.1.1 VL Image Module Attribute Descriptions**

207 …

208 **C.8.12.1.1.1 Photometric Interpretation**

209 The Enumerated Values of Photometric Interpretation (0028,0004) shall be:

210 – MONOCHROME2

211 – RGB

212 – YBR_FULL_422

- **YBR_FULL_420**
- YBR_RCT
- YBR_ICT

Note: There is no formal color space defined, hence "false" color applications that encode near-visible light images may be encoded, for example, as RGB.

…

C.8.12.1.1.4 Samples per Pixel

The Enumerated Values of Samples per Pixel (0028,0002) shall be as follows: If the value of Photometric Interpretation (0028,0004) is MONOCHROME2, then the Enumerated Value of Samples per Pixel (0028,0002) shall be one (1). If the value of Photometric Interpretation (0028,0004) is RGB or YBR_FULL_422 or **YBR_FULL_420 or** YBR_RCT or YBR_ICT, then the Enumerated Value of Samples per Pixel (0028,0002) shall be three (3).

PS 3.4: Add three new Storage SOP Classes to Annex B:

Table B.5-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Video Endoscopic Image
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Video Microscopic Image
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Video Photographic Image

PS 3.4: Add new Media Storage SOP Classes to Annex I:

Table I.4-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Video Endoscopic Image
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Video Microscopic Image
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Video Photographic Image

PS 3.16: Add new Context Group:

CID 4040 Endoscopy Anatomic Regions

Context ID 4040
Endoscopy Anatomic Regions
Type: Extensible Version: 20040326

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	Example of the type of endoscopy for which this region is applicable (informative)
SRT	T-D4000	Abdomen	Laparoscopy
SRT	T-59490	Anus, rectum and sigmoid colon	Rectosigmoidoscopy
SRT	T-60610	Bile duct	
SRT	T-74000	Bladder	Cystoscopy
SRT	T-DD123	Bladder and urethra	Panendoscopy (urethrocystoscopy)
SRT	T-26000	Bronchus	Bronchoscopy
SRT	T-83200	Cervix	Colposcopy
SRT	T-D3000	Chest	Thoracoscopy
SRT	T-DD163	Esophagus, stomach and duodenum	Upper gastrointestinal endoscopy
SRT	T-AB200	External auditory canal	Otoscopy
SRT	T-63000	Gall bladder	Laparoscopic cholecystectomy
SRT	T-D7000	Inguinal region	Endoscopic inguinal hernia repair
SRT	T-15001	Joint	Arthroscopy
SRT	T-71000	Kidney	Percutaneous renal endoscopy
SRT	T-D9200	Knee	Arthroscopy of knee
SRT	T-59000	Large intestine	Colonoscopy
SRT	T-24100	Larynx	Laryngoscopy
SRT	T-40230	Lumen of blood vessel	Endoluminal (intravascular) endoscopy
SRT	T-D3300	Mediastinum	Mediastinoscopy
SRT	T-2300C	Naso pharynx	Naso pharyngoscopy
SRT	T-22000	Paranasal sinus	Endoscopic sinus surgery
SRT	T-55002	Pharynx	Pharyngoscopy
SRT	T-20101	Pharynx and larynx	Laryngopharyngoscopy

SRT	T-59600	Rectum	Proctoscopy
SRT	T-D2220	Shoulder	Arthroscopy of shoulder
SRT	T-59470	Sigmoid colon	Sigmoidoscopy
SRT	T-11500	Spine	Spinal endoscopy
SRT	T-DD006	Trachea and bronchus	Tracheobronchoscopy
SRT	T-70010	Upper urinary tract	Percutaneous or retrograde ureteric and renal endoscopy
SRT	T-73800	Ureter	Percutaneous or retrograde ureteric endoscopy
SRT	T-88920	Uterus and fallopian tubes	Culdoscopy

Editorial note: make a separate informative annex to explain relationship of type of endoscopy (procedure name) to anatomic regions.