



# **Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities**

## **Annex A Dental Digital Acquisition Modality Specializations**

**Version 2.0**

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## SIGNATURE PAGE

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## PREFACE

The purpose of this Requirements Document is to specify how dental modalities shall provide the Digital Imaging and Communications in Medicine (DICOM) functionality needed by the Department of Veterans Affairs (VA) and Department of Defense (DoD). This document contains the minimal requirements for VA and DoD dental digital acquisition modality purchases. Individual VA/DoD organizations may elect to mandate requirements which are listed as optional or are not present within this document.

The Veterans Health Administration (VHA) Patient Care Services and the DoD Military Health System (MHS), representing all clinical care programs that use imaging equipment, consider these requirements essential for interoperability between imaging equipment and government hospital information systems (HIS). Other agencies are encouraged to adopt these requirements as the basis for DICOM conformance.

This document is available online at [www.va.gov/imaging](http://www.va.gov/imaging).

Please refer to this website for directions regarding submission of comments, inquiries, and suggestions

## REVISION HISTORY

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## 1. INTRODUCTION

### 1.1. Executive Summary

The goal of this Annex is to provide dental imaging interoperability, using DICOM requirements, for dental grayscale (radiographic) digital images and dental visible light (photographic) digital images. This interoperability includes the ability to order, acquire, store, retrieve, and share DICOM images, as well as the ability to attach these images to an electronic patient record or other digital assembly of patient information. Interoperability will be functional among various digital acquisition devices and DICOM conformant storage devices both stand alone and integrated with an electronic patient record.

Specifically, this document discusses DICOM requirements for the following:

1. Storage to a CD, with a viewer on the CD

The ability to store DICOM images to a CD. This CD includes a viewer that provides basic display capabilities plus a print functionality.

2. Read the DICOM CD using diagnostic quality viewer for that system to display multi vendor DICOM images.

The ability to import images may be a future requirement<sup>1</sup>.

3. Network storage

The ability to store images from an acquisition device to a network storage device. The images also can be printed using the viewer of the computer.

4. Modality Worklist

The ability of an acquisition device to receive orders for images from another system is included. Associated patient information will accompany the order and will eliminate manual entry of this data. The DICOM information concerning the images can also be passed back to the ordering device and be associated with the patient record.

5. Integrate Imaging Modality with PACS

This feature provides the ability for PACS systems to integrate with the image acquisition modality systems. It includes many features such as synchronizing the state of the acquisition process, storing images, and taking ownership of the images (and any other type of data, called "Evidence").

The modality has the ability to synchronize the state of the acquisition process. It supports statuses such as, "in progress", "completed", or "discontinued". It also conveys the identification of the imaging device that performed the procedure and the list of images and/or evidence created. This information is used by PACS systems to prepare for the receipt of data and for managing the reporting and image management processes on PACS workstations.

Also included is the ability for the modality to transmit the images/evidence to the PACS and then to request the PACS take long-term ownership of data. This facilitates the application of automatically deleting images from the modality system.

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<sup>1</sup> The importation of images from CDs may be a future requirement. Specifications for this capability are currently being developed as part of IHE.

6. Query/Retrieve

The ability to share images among various storage and acquisition systems is included. Associated patient information will accompany the images in each direction.

7. Print

DICOM print is specified as an optional feature but will not be the only possibility for printing an image. The images will also be printed using the OS of the viewing computer. In addition, query/retrieve will allow recovery of an image from storage to the acquisition device, which has a methodology for printing an image.

8. Presentation State

The ability to save a manipulation of the original image (such as overlays, measurements, etc.), as an addendum to the original image will be included. The original image and the presentation state will both be viewable.

9. Sorting Information

This information will allow the sorting of images which determines the display of both individual images and of studies, such as full mouth series.

## 1.2. Audience

The intended audience of this document is:

- Government Contracting Specialists who need to include this document in every purchase order for dental imaging modalities to ensure that the equipment provides the necessary capabilities to interoperate properly with the Department of Veterans Affairs (VA) and the Department of Defense (DoD) systems.
- Vendor technical staff planning to interface dental imaging modalities with the Veterans Health Information System Technology and Architecture (VistA) Imaging and the Composite Health Care System II (CHCS II). This document is intended to clarify the differences to implementers who are well versed in the Digital Imaging and Communications in Medicine (DICOM) standard and the Integrating the Healthcare Enterprise (IHE) Technical Framework. Example equipment includes:
  - Digital intra-oral radiology systems
  - Digital panoramic systems
  - Digital intra-oral camera systems
  - Digital Cephalometric systems
  - Extra-oral digital photographic systems
  - Microscopic imaging systems for Oral Pathology
- VA and DoD technical and functional personnel who want to familiarize themselves with the IHE concepts in context of the VistA Imaging and CHCS II environments.

## 1.3. Reference Documents

1. Digital Imaging and Communications in Medicine (DICOM)
2. Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities
3. IHE Technical Framework rev 5.5, 2003
4. Media Application Profile for Digital Radiographic Images in Dentistry (Supplement 92)

**1.4. Symbols and Abbreviations**

CD	Compact Disc
CD-R	Compact Disc – Read Only
CDT	Current Dental Terminology
CHCS II	Composite Health Care System II
COTS	Commercial off the Shelf
CPI	Consistent Presentation of Images
DEN	Dental
DICOM	Digital Imaging and Communications in Medicine
DoD	Department Of Defense
DX	Digital Radiography (Non-panoramic Extra-oral digital radiographs. e.g. cephalometric, etc.)
ES	Endoscopic
FSC	File Set Creator
FSR	File Set Reader
GEN	General
HIMSS	Healthcare Information and Management Systems Society
IHE	Integrating the Healthcare Enterprise
IO	Intra-Oral Digital Radiograph
MHS	Military Health System
MPPS	Modality Performed Procedure Step
MWL	Modality Worklist
OS	Operating System
PC	Personal Computer
PX	Panoramic X-ray
RFC	Request For Comments
RIS	Radiology Information System
RSNA	Radiological Society of North America
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
UID	Unique Identifier
VA	Department of Veterans Affairs

VHA	Veterans Health Administration
VistA	Veterans Health Information System Technology and Architecture
VL	Visible Light (e.g. extra-oral Color photography)

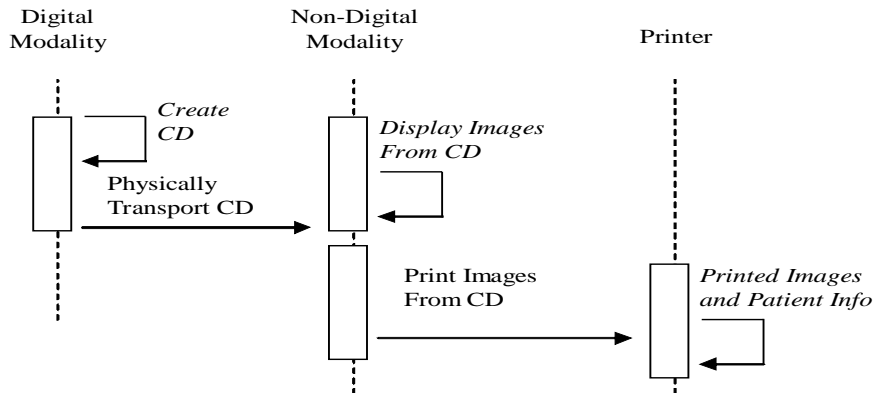
## 2. USE CASES

The following use cases are typical examples of how DICOM services may be used for dental applications within the VA/DoD. The purpose of these use cases is to identify the DICOM requirements on systems used in various clinical settings in the VA/DoD. Note that an institution could implement a combination and/or mix/match any of these scenarios.

### 2.1. Solo Practice, non-digital

A dentist does not have a digital data acquisition system.

**Figure 1 Solo Practice, non-digital**



1. A new patient arrives, with a CD containing images from the previous dentist. The images are in DICOM format and a basic DICOM viewer is included on the disk.
2. The Basic DICOM viewer on the CD is Microsoft compatible and at least contains basic functionality such as zoom, pan, window/level, display of patient demographics, etc. From now on, the Basic DICOM viewer will just be called a viewer.
3. Using his/her office PC, the dentist starts the viewer and is able to display and manipulate the images.
4. The dentist needs the ability to print the images from the CD for reasons such as the patient record, insurance purposes, etc. This print capability does not require diagnostic quality print and could be accomplished by a plain paper printer. The CD viewer is required to support the ability to print the images with patient demographic information included.
5. The dentist takes his/her own x-ray images before treating the patient.
6. The dentist may make a copy of the patient's CD to include in the patient's record.

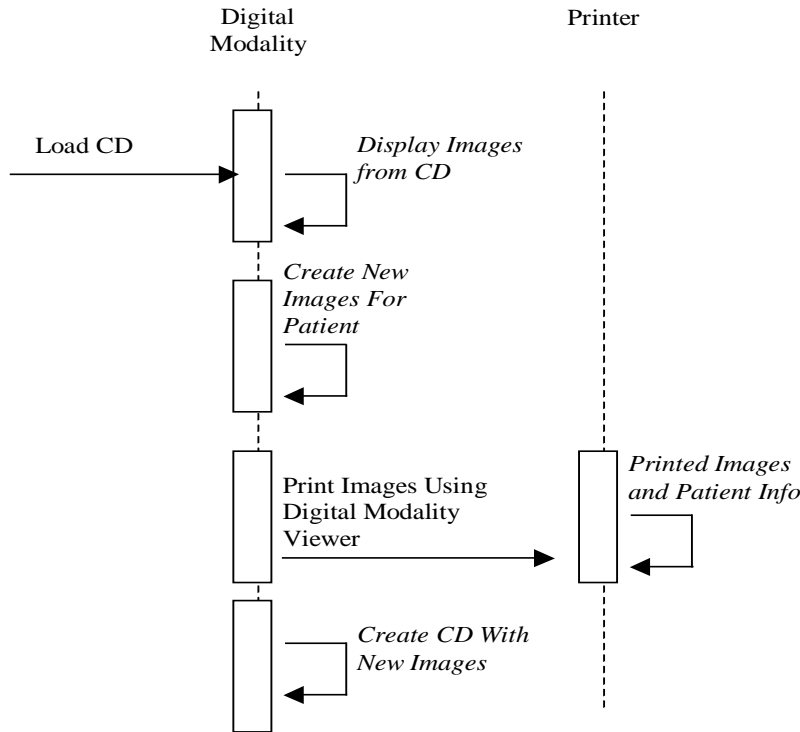
VA/DoD Requirements:

Since the data acquisition system in Step 5 above is not DICOM compatible, there are no requirements for this system. However to support systems such as this, requirements are being placed upon dental products that are DICOM enabled (see further use cases).

## 2.2. Solo Practice, stand-alone digital

A dentist's office has a stand-alone digital system with PC based DICOM workstation capabilities, image viewing, a local database, and a high quality printer.

**Figure 2 Solo Practice, stand-alone digital**



1. A new patient arrives with a CD containing DICOM images that were obtained using a digital system from the same or a different vendor. The dentist views the images using the CD viewer to see which images have been obtained and to potentially schedule x-ray images to complement them. There are several intra-oral (IO) images as well as a panoramic radiograph image (PX).
2. The dentist decides to obtain two additional views on his/her digital system.
3. The dentist compares the previous images with the newly acquired images and archives the new images on his/her local database/archive<sup>2</sup>.
4. Using the print capabilities of his/her digital system, the dentist may print images using a high quality printer for the patient to take to a specialist, for the patient record, for insurance reasons, etc.
5. A new DICOM CD with the new images is generated. This newly generated CD has a basic viewer on it.

Note: The ability to import images may be a future requirement, see footnote 1 in section 1.1.

Additional VA/DoD Requirements:

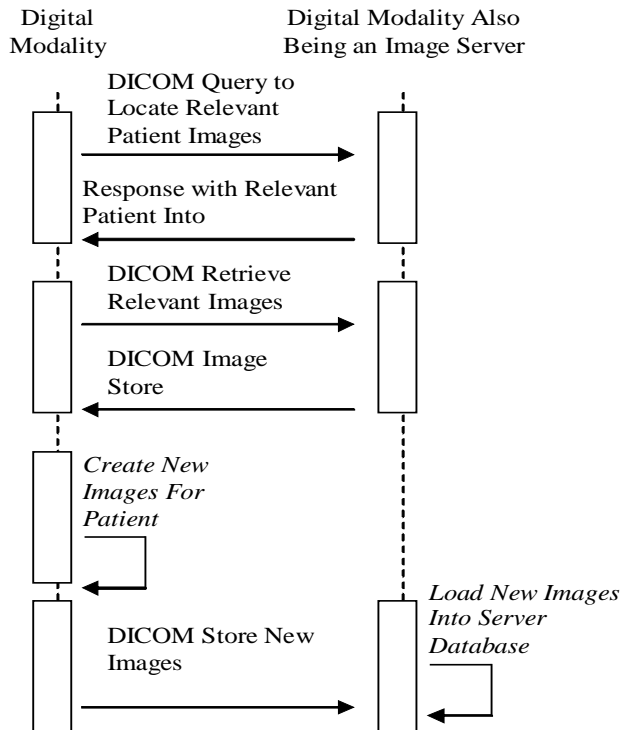
<sup>2</sup> The actual implementation of the local database/archive is up to the vendor. It could be anything from files on the local hard-drive to removable media or even a jukebox.

1. Support the Media Application Profile for Digital Radiographic Images in Dentistry (Supplement 92) as a File Set Creator (FSC). Support for DX (PX and Ceph) and IO objects is required.
2. VA/DoD Requirements support the Media Application Profile for Digital Radiographic Images in Dentistry (Supplement 92) as a File Set Reader (FSR).
3. Incorporated on the CD is a Basic DICOM viewer that is Microsoft compatible. This viewer is required to at least support basic DICOM functionality such as zoom, pan, window/level, display of patient demographics data, etc. The viewer shall have the ability to print the images with patient demographic information included.

### 2.3. Solo Practice, multi-vendor shared digital systems

A dental practice has multiple digital systems with one system serving as the “archive” or server. These systems are not from the same vendor, but they all have DICOM workstation capability. Although the exchange of image information via a CD is possible (such as seen in use case 2.2), this use case utilizes DICOM networking services for its workflow.

**Figure 3 Solo Practice, multi-vendor shared digital systems**



1. During installation the service engineer has configured the systems to communicate with each other and checks this using the DICOM verification service.
2. A patient arrives who has been seen before at this location/facility. The dentist does a DICOM Query (FIND SCU) to locate the appropriate images from the other digital device functioning as a server.
3. The dentist then uses DICOM Retrieve (MOVE SCU; STORE SCP) at his/her digital system and views selected images using the built-in DICOM viewing applications. The other system, which functions as the “server”, supports DICOM Query SCP and Move SCP.
4. Additional panoramic (PX) and intra-oral (IO) images are taken.
5. The new images are stored from the digital system to the local server (STORE SCU).

Note: If there were no system that supports the server role on the network, a “poor-man” solution for this use case would be for the dentist to rely on someone “pushing” the images using a DICOM Store from the other system, not requiring Query-Retrieve support but rather the Storage SCP.

Note: The contents of this use case also apply to the dental practice where all equipment and software are provided by the same vendor.

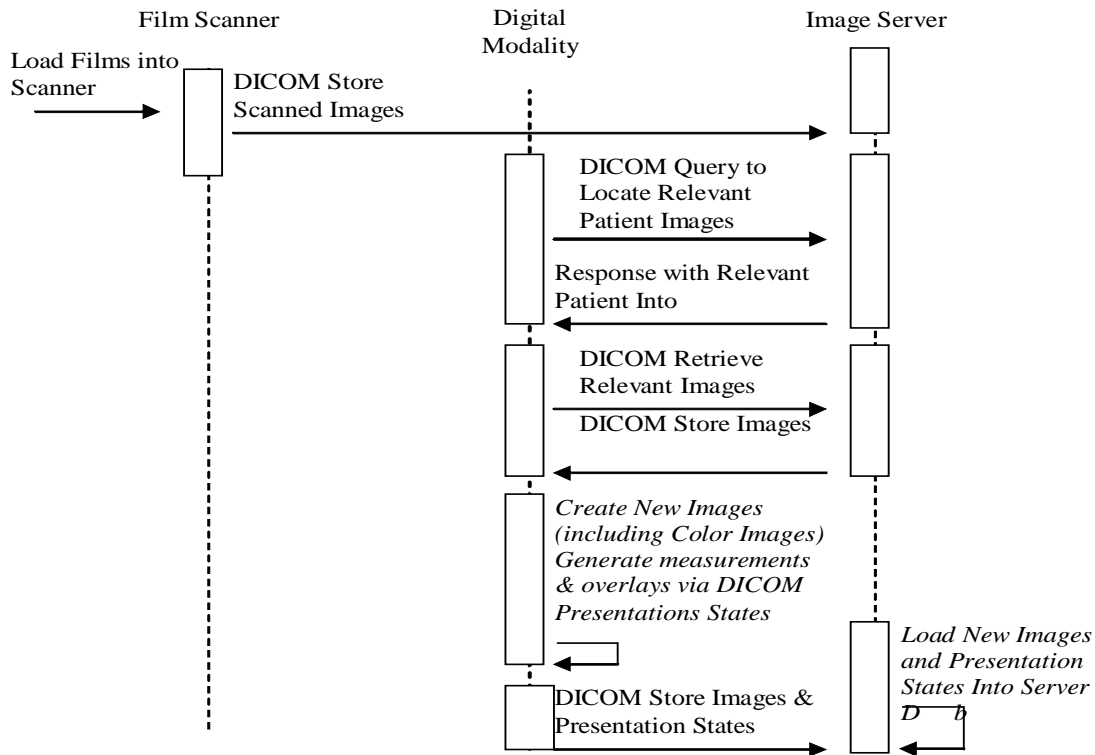
Additional VA/DoD Requirements:

1. Support for the Verification SOP Class as both an SCU and SCP.
2. Support for the DICOM Query “Study Root” SOP Class as an SCU.
3. Support for the DICOM Retrieve “Study Root” SOP Class as an SCU.
4. Support for the DICOM Storage SOP Class as an SCU and SCP for DX, IO (For Presentation SOP Classes only).
5. Optionally, if a product wishes to implement a server capability, it shall support:
  - a. DICOM Query “Study Root” SOP Class as an SCP
  - b. DICOM Retrieve “Study Root” SOP Class as an SCP

**2.4. Dental Practice, multi-vendor digital systems sharing a server**

A dental practice (solo or a group at one or more locations) has a digital system in each operatory. Each system can generate panoramic (PX), intra-oral (IO), and color photography (VL) images and has local viewing capabilities. At least one system at each location has a film scanner. The shared server has a database/archive and could possibly be another dental system. Each of the systems is made by a different vendor.

**Figure 4 Dental Practice, multi-vendor digital systems sharing a server**



1. A new patient arrives with conventional film panoramic and intra-oral x-rays. The receptionist scans these films with a DICOM film scanner. The scanned images are stored in the patient folder in the archive.

2. The dentist, using the office's digital system, does a DICOM Query (FIND SCU) and retrieves the appropriate images from the local server using DICOM Retrieve (MOVE SCU; STORE SCP).
3. Additional panoramic (PX) and intra-oral (IO) images are taken.
4. The dentist views the images on his/her device and generates several measurements that are shown as overlays on his/her monitor and stored as DICOM Presentation States. In addition, non-linear image processing (e.g. image filtering) might be applied on some of the images. These images will be stored as additional images and as a part of the same study.
5. Some Visible Light (color) images are taken with a camera for insurance purposes to show several cavities. These images are also stored at the local server (STORE SCU).
6. The receptionist creates a CD with a copy of the patient's complete set of images for the patient to take to a specialist or for other reasons. This CD has the same capabilities discussed in other use cases. The images stored on this CD may be generated from more than one application profile (i.e. Supplement 92) and the General Purpose CD Application Profile. Only one disk needs to be created.

Note: The contents of this use case also apply to the dental practice where all equipment and software are provided by the same vendor.

**Note: The VA/DoD will support and utilize DICOM Dental Acquisition Context Group Specifications when available.**

Additional VA/DoD Requirements:

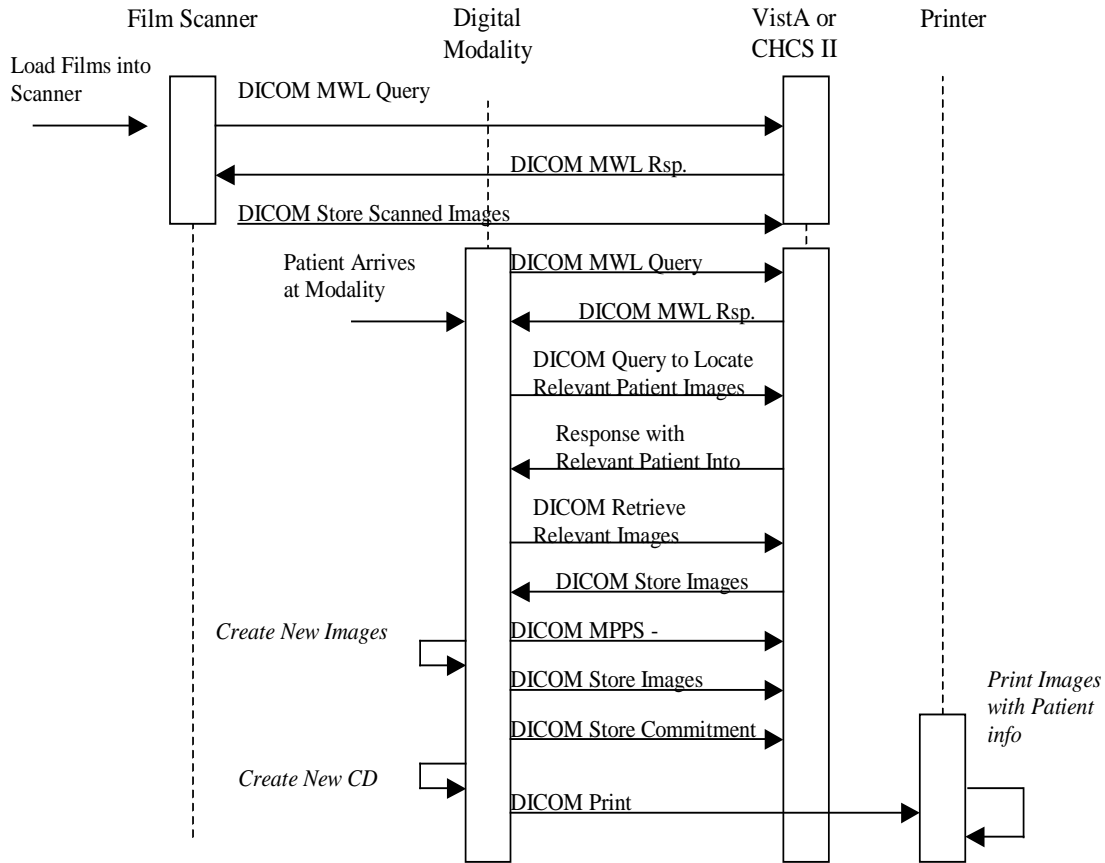
1. Support DICOM Secondary Capture SOP Class as an SCU and SCP.
2. Support DICOM Softcopy Presentation State SOP Class as an SCU and SCP.
3. Support Visible Light Photographic SOP Class as an SCU and SCP.
4. Support the General Purpose CD Application Profile as an FSR and FSC for the Secondary Capture, Visible Light and Softcopy Presentation State SOP Classes.

## **2.5. Dental Practice, multi-vendor digital systems integrated with electronic patient record**

A digital system is integrated with either the VA's VistA system or the DoD's CHCS II system. High levels of DICOM services are supported for image workflow, image management, and DICOM print.



**Figure 5 Dental Practice, multi-vendor digital systems integrated with electronic patient record**



1. A patient has been scheduled for an appointment. Upon arrival, the patient's demographic and procedure information, such as views and procedure details, is retrieved using DICOM Modality Worklist from the institution's information system (e.g. VistA or CHCS II system).
2. A new patient arrives with previous conventional film panoramic and intra-oral x-rays. The dentist, using the office's digital system, does a DICOM Query (FIND SCU) and he/she retrieves the appropriate images from the local server using DICOM Retrieve (MOVE SCU; STORE SCP).
3. Additional panoramic (PX) and intra-oral (IO) images are taken. The new images are stored at the local server (STORE SCU).
4. The acquisition devices support DICOM Storage Commitment, allowing the exchange of status information between the acquisition devices and server. By doing this, the server takes over the responsibility for these images and they can safely be deleted from the local acquisition storage.
5. In addition, the DICOM Modality Performed Procedure Step (MPPS) service is implemented to allow for the acquisition devices to report on the examination status, number of images acquired, and any changes to the scheduled procedure.
6. The images are printed on a DICOM printer for the patient to take to the specialist.
7. In addition the images are written to a CD equipped with a viewer.

**Additional VA/DoD Requirements**

1. Support DICOM Modality Worklist Management as an SCU.
2. DICOM Storage Commitment as an SCU.
3. DICOM Modality Performed Procedure Step as an SCU.
4. Optionally support DICOM Grayscale Print Management Meta SOP Class as an SCU.
5. Optionally support DICOM Color Print Management Meta SOP Class as an SCU.

## 2.6. Sorting Presentation Constructs

The dentist generally uses pre-defined clinical templates (radiograph mounts) for sorting, arranging and storing individual dental images and groups of images in a study. Digital images can be displayed side by side based on a currently used FMS template used for the film FMS for clinically relevant digital presentation constructs.

For IO, the dentist requests one such user preferred arrangement, based on a patient's 18 (or 20) image full mouth film series. The series viewer presentation sequence starts with the Upper Right Molar, progresses across the maxilla to the Upper Left Molar, then proceeds to the Lower Left Molar and across the mandible to the Lower Right Molar. The sequence then continues to the Right Posterior BW and proceeds to the Left Posterior BW, followed by any other IO in order of exposure time. Presentation state or derived images would appear after the original image, sorted by date and time, in the ordered list above. Partial FMS or individual PAs or BW would be presented in the same order as the FMS, in effect skipping the images missing from the FMS presentation order. The full mouth series is one example of where IO images are identified and displayed based on familiar clinically relevant templates irregardless of the modality vendor. This series is outputted to a "proof of completion" workstation at a billing center for claim processing.

DX (ceph) and PX would be sorted by date and time of exposure for those studies.

In a second user preferred digital presentation construct, the dentist sorts and arranges IO, PX, and DX images by study time and then by the time of each image in a study. This series is outputted to the patient for their record.

Note: The ability to use and save either a DICOM Presentation State or a DICOM Derived Image is assumed, as is the presence of DICOM Query-Retrieve. The IO attributes in Table 10 in the VA/DoD Annex A DICOM requirements documents are also assumed for this use case.

Note: It is assumed that particular treatment facilities will have customized presentation requirements and will have customized software able to create individual user preference presentation constructs.

Note: Standardized Dental Viewset templates will be developed by DICOM WG 22 within the next year for encoding and exchanging presentation layouts and displays. The DOD/VA will require additional DICOM templates in the future consistent with developed DICOM standards.

## 2.7. Visible Light (VL) Photographic Images (XC and ES)

Visible Light (color) images are taken either with a camera located extraorally (XC) or with a camera located intraorally (ES). XC images are acquired with a camera outside the mouth and can be of the head and neck or of the intraoral area, but the orientation of the acquisition device to the patient is always "outside to inside", as is the x-ray beam for IO. ES images are acquired with the camera inside the mouth and the orientation of the camera with respect to the patient can be either "outside to inside" (e.g. buccal view of teeth) or "inside to outside" (e.g. lingual view of teeth). Before saving an image, the dentist may use the DICOM "Image Comments" to annotate text. Such text comments stored in the DICOM "Image Comments" section are captured in DICOM and saved with the image.

Note: In the short term, for images acquired with the use of a mirror, the end user will need to be trained to adjust the mirrored image to a direct image view. However, mirrored to direct may become a required automated adjustment in the future.

Several consultants (within and outside of the institutions) could receive the images on referral and read the accompanying annotations provided by the DICOM "Image Comments". Image Presentation Integrity is assured in that the visible light images look the same independent of the method used to present the images. After placing the images in the proper acquisition context, the consultants could either

independently and/or collaboratively comment on the initial treatment recommended by the referring dentist.

Note: The ability to use and save either a DICOM Presentation State or a DICOM Derived Image is assumed, as is the presence of DICOM Query-Retrieve. The IO C-Store Attributes in Table 10 in the VA/DoD Annex A DICOM requirements documents are also needed for XC images and are assumed for this use case.

Note: It is assumed that other graphics or text notes may be available to supplement the image comments in the dental viewer software. Separate graphics may be referenced within the image comments or stored as a presentation state or a secondary capture image.

Note: The DICOM Dental Acquisition Context Group will be developed within the next year first for XC, then for ES. The DOD/VA will require additional DICOM XC and ES descriptors in the future consistent with developed DICOM standards.

### 3. RELATIONSHIP TO IHE PROFILES

#### 3.1. Scheduled Workflow Integration Profile (Mandatory)

The VA VistA and DoD CHCS II systems provide patient demographic and procedure information via DICOM Modality Worklist. This enables the modality to explicitly link newly created images to the orders for the patients. SWF also includes the ability of imaging modalities to integrate with PACS. It includes many features such as synchronizing the state of the acquisition process, storing images, therefore, a modality shall support all of the transactions as defined by Integrating the Healthcare Enterprise (IHE)<sup>3</sup> as part of the Scheduled Workflow Integration Profile. For the specific VA/DoD requirements see section 2 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities*. This section describes the minimal required IHE profiles. Individual VA/DoD organizations may elect to mandate requirements which are listed as optional or are not present within this document.

##### 3.1.1. Additional Requirements to the Scheduled Workflow Integration Profile

**Table 1 Scheduled Workflow Integration Profile - Actor and Transactions**

Actors			
Acquisition Modality	See section 2 of <i>Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities</i> for initial requirements		
	Modality Presentation State Stored	Mandatory	4.9

#### 3.2. Consistent Presentation of Images (CPI) (Mandatory)

The digital acquisition modality and the workstation are typically directly connected in the dental operator setting. Therefore, the need to use digital acquisition devices to display relevant patient information and images is essential. Because of this need, digital acquisition devices are required to support the role of a workstation (called the Image Display Actor) for the consistent presentation of images. Use cases 2.3, 2.4, and 2.5 illustrate clinical situations in the VA and DoD in which this connectivity exists.

<sup>3</sup> The appropriate sections of the IHE Technical Framework rev 5.5, 2003. HIMSS/RSNA Integrating the Healthcare Enterprise Technical Framework, available at [www.RSNA.org/IHE](http://www.RSNA.org/IHE) web site.

In many VA/DoD dental environments an image storage server will be in use supporting the IHE role of an Image Archive (i.e. the VA's VistA or the DoD's CHCS II). However in certain situations they are not available and digital acquisition devices may choose to play the role of an Image Archive. This capability is an optional feature.

A modality shall support the Consistent Presentation of Images (CPI) Integration Profile as shown in table 2.

**Table 2 Consistent Presentation of Images - Actor and Transactions**

Actors	Transactions	Requirement	IHE Section
Image Display	Query Images	Mandatory	4.14
	Retrieve Images	Mandatory	4.16
	Query Presentation States	Mandatory	4.15
	Retrieve Presentation States	Mandatory	4.17
Image Archive	Query Images	Optional	4.14
	Retrieve Images	Optional	4.16
	Query Presentation States	Optional	4.15
	Retrieve Presentation States	Optional	4.17

**3.3. Print Composer (Optional)**

No specializations for grayscale printing are stipulated in this Annex, therefore see section 2.2 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**3.3.1. Additional Requirements to Support Color Print**

The IHE Print Composer profile supports the ability to print Grayscale DICOM images. For dental systems that support color (Visible Light) and support the optional DICOM print feature, they shall support the following DICOM Meta SOP Class:

**Table 3 Optional DICOM Support for Color Printing**

SOP CLASS NAME	SOP CLASS UID	Role
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	SCU

**4. DETAILED REQUIREMENTS FOR SOP CLASSES AND APPLICATION PROFILES**

**4.1. SOP Class Support to Implement IHE Profiles**

To comply with the mandatory IHE profiles specified and any VA/DoD extensions, an acquisition modality is required to support the following SOP Classes, with their specified role Service Class User (SCU)/Service Class Provider (SCP):

**Table 4 Mandatory SOP Classes**

SOP CLASS NAME	SOP CLASS UID	USAGE
Verification SOP Class	1.2.840.10008.1.1	SCU/SCP
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	SCU/SCP

SOP CLASS NAME	SOP CLASS UID	USAGE
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	SCU/SCP
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.1.7	SCU/SCP
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	SCU/SCP
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	SCU/SCP
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	SCU/SCP
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCU
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCU
Modality Worklist Information Model Find	1.2.840.10008.5.1.4.31	SCU
Modality Performed Procedure Step SOP class	1.2.840.10008.3.1.2.3.3	SCU
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	SCU

**Table 5 Mandatory Media Profiles**

APPLICATION PROFILE	IDENTIFIER	USAGE
Dental CD-R Interchange (Based upon the acceptance of DICOM Supplement 92)	STD-DEN-CD	FSC/FSR
General Purpose CD-R Interchange	STD-GEN-CD	FSC/FSR

This section also specifies DICOM functionality that is not currently required but may be useful now or required in the future.

**Table 6 Optional SOP Classes**

SOP CLASS NAME	SOP CLASS UID	USAGE
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	(not used)
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	(not used)
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCP
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	SCU
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	SCU

If acquisition systems do support these optional DICOM services, it should do so in a fashion satisfying the requirements in this Annex.

#### 4.2. Association Behavior

No specializations are stipulated in this Annex, therefore see section 3.2 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**4.3. Specification of Individual SOP Classes and Application Profiles**

The following additions and/or specializations are described for dental modalities.

**4.3.1. Creation of DICOM CD**

There are many different workflows that benefit from the exchange of CDs storing dental images. One example is a new patient arrives with a CD containing images from a previous dentist. In order to best determine what new images to create, the old images on the CD need to be viewed. Therefore, the VA/DoD requires support to exchange CD media.

Digital Dental modalities shall support the Dental CD-R Interchange Application Profile as defined by DICOM Supplement 92 in the roles of an FSC and FSR. Added to the CD is a Basic DICOM Viewer . This viewer permits the media content to be displayed on another system (by another practitioner, insurance provider, or a patient at home) using generally available PC resources.

Note: Support of the Application Profile is based upon the assumption that DICOM Supplement 92 will successfully become a DICOM Standard.

**4.3.1.1. VA/DoD Extensions to the Dental CD Interchange Application Profile Role as a FSC**

A FSC shall incorporate a Basic DICOM Viewer on the CD. The Basic DICOM viewer shall at a minimum:

- 1) Be compatible with Microsoft Windows 2000 or Windows XP operating systems.
- 2) Support the ability to access the media DICOM directory information and enable the user to select images for display.
- 3) Support basic DICOM image display functionality such as zoom, pan, brightness, contrast, display of patient demographics, etc.
- 4) Support the ability to render/display any Grayscale Softcopy Presentation State SOP Instances associated with the images on the CD.
- 5) Support the ability to print any selected image(s) with patient demographic information included on the print. This print capability shall be Microsoft OS compatible.

The VA/DoD requires support for information beyond the definition of the application profile, such as Visible Light (VL) Photographic Images (i.e. XC and ES color photographic image support as described in Table 10), DICOM Secondary Capture (i.e. scanned film), and DICOM Presentation States (i.e. measurement and overlay data). Therefore, a FSC shall support the General CD-R Purpose Application Profile for the following SOP Classes:

**Table 7 Additional Mandatory DICOM SOP Class Support - FSC**

SOP CLASS NAME	SOP CLASS UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.1.7
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1

**4.3.1.2. VA/DoD Extensions to the Dental CD-R Interchange Application Profile Role as a FSR**

A FSR shall support the General CD-R Purpose Application Profile for the following SOP Classes:

**Table 8 Additional Mandatory DICOM SOP Class Support - FSR**

SOP CLASS NAME	SOP CLASS UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.1.7
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1

**4.3.2. Verification (Mandatory)**

No specializations are stipulated in this Annex, therefore see section 4.7 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**4.3.3. Image Storage (Mandatory)**

Digital Dental modalities are required to support the DICOM Image Storage SOP Classes as defined in section 4.4 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities*. The specific image SOP Classes required for dental are:

**Table 9 Mandatory Image Storage DICOM SOP Classes**

SOP CLASS NAME	SOP CLASS UID	USAGE
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	SCU/SCP
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	SCU/SCP
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.1.7	SCU/SCP
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	SCU/SCP
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	SCU/SCP

**4.3.3.1. Additional C-STORE Attribute Requirements**

The *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* defines many attribute requirements related to image workflow and display; see table 11 of that document for requirements.

This section addresses additional attribute requirements to facilitate the hanging protocols needed for the dental user. Specific hanging protocols are not stipulated. Instead, the attributes needed to allow for the sorting of images that determines the display of individual images and of studies of images, such as a full mouth series, are specified.

- Panoramic images shall be conveyed with the modality PX.

The following attributes are required to be included and contain a valid value for SOP Instances of the Digital X-Ray Image Storage and Digital Intra-oral X-Ray Image Storage SOP Classes:

**Table 10 Mandatory Additional C-Store Attributes for Image Sorting**

Modality	Tag	Attribute Name	Description
	(0008,0020)	Study Date	Permits sorting by date and time at the study level
	(0008,0030)	Study Time	
	(0008,0023)	Content Date	Permits sorting by date and time at the image level within the study
	(0008,0033)	Content Time	
	(0008,0060)	Modality	Type of equipment that originally acquired the data used to create the images in this series (in example, IO, PX, DX)
IO - Intra Oral	(0008,2218)	Anatomic Region Sequence	DICOM Standard Part 16 CID 4016 defines the code designation and meaning for either Maxilla, Mandible or both regions for IO. Only a single Item shall be permitted in this Sequence.
	(0008,2220)	Anatomic Region Modifier Sequence	DICOM Standard Part 16 CID 4017 defines the code designation and meaning for Anterior, Premolar, Molar, and Occlusal regions, Required if Primary Anatomic Structure Sequence is not sent. Only a single Item shall be permitted in this Sequence.
	(0008,2228)	Primary Anatomic Structure Sequence	DICOM Standard Part 16 CID 4018 defines the code designation, value and meaning for the exact quadrant and tooth number Required if Anatomic Region Modifier Sequence is not sent.
	(0020,0062)	Image Laterality	Enumerated Values: R = Right, L = Left, B = Midline (both left and right)
PX - Panoramic	(0020,0020)	Patient Orientation	Enumerated Values: A = Anterior, P = Posterior, R = Right, L = Left, H = Head, F = Foot



Modality	Tag	Attribute Name	Description
DX - Cephalometric	(0008,2218)	Anatomic Region Sequence	Recommend utilizing Part 16 CID 4016 designation of IO for the DX modality. CID 4016 defines the code designation and meaning for either Maxilla, Mandible or both regions. Only a single Item shall be permitted in this Sequence.
	(0020,0062)	Image Laterality	Enumerated Values: R = Right, L = Left, (R and L are the only choices for cephalometric radiograph, (B = Midline (both left and right), and U = Unpaired do not apply).
XC – Visible Light Photographic	(0020,4000)	Image Comments	User-Defined Comments about the image to describe the acquisition context formatted to include descriptors on the subject's state, the perspective of the camera to the subject, image perspective, the anatomic region sequence and the anatomic region sequence modifier or primary anatomic structure sequence, laterality. The length of the image comments field shall be no less than 100 characters.
	(0008,2218)	Anatomic Region Sequence	Recommend utilizing Part 16 CID 4016 designation of IO for the DX modality. CID 4016 defines the code designation and meaning for either Maxilla, Mandible or both regions. Only a single Item shall be permitted in this Sequence.
	(0008,2220)	> Anatomic Region Modifier Sequence	Using DICOM Standard Part 16 CID 4017 that defines the code designation and meaning for Anterior, Premolar, Molar, and Occlusal regions, Required if Primary Anatomic Structure Sequence is not sent. Only a single Item shall be permitted in this Sequence.
	(0008,2228)	Primary Anatomic Structure Sequence	DICOM Standard Part 16 CID 4018 defines the code designation, value and meaning for the exact quadrant and tooth number. Required if Anatomic Region Modifier Sequence is not sent.

Modality	Tag	Attribute Name	Description
	(0020,0062)	Image Laterality	Enumerated Values: R = Right, L = Left, B = Midline (both left and right), U = Unpaired
ES – Visible Light Endoscopic	(0020,4000)	Image Comments	User-Defined Comments about the image to describe the acquisition context formatted to include descriptors on the subject's state, the perspective of the camera to the subject, image perspective, the anatomic region sequence and the anatomic region sequence modifier or primary anatomic structure sequence, laterality. The length of the image comments field shall be no less than 100 characters.

\*Note: This table specifies attributes already required by DICOM, which are included for emphasis.

#### 4.3.3.2. Additional Detector and Equipment Attribute Requirements

The VA and DOD require DICOM DX Detector and General Equipment Module Attributes for identification to support the auditing of quality issues with manufacturers. This requirement builds upon the recent Supplement 92 work of the ADA and the DICOM Committees supported by the VA and DOD.

**Table 11 Mandatory Additional Detector and Equipment Attributes**

Tag	Attribute Name	Attribute Description
(0018, 7004)	Detector Type	The type of detector used to acquire this image. Defined Terms: DIRECT = X-Ray photoconductor SCINTILLATOR = Phosphor used STORAGE = Storage phosphor FILM = Scanned film/screen
(0018, 700A)	Detector ID	The ID or serial number of the detector used to acquire this image.
(0018, 702A)	Detector manufacturer name	The name of the manufacturer of the detector component of the acquisition system.
(0018, 702B)	Detector manufacturer's model name	The model name of the detector component of the acquisition system.

\*Note: The DOD/VA may require additional attributes in the future consistent with developed DICOM standards.

**4.3.4. Modality Presentation State Stored (Mandatory)**

Digital Dental modalities are required to generate Grayscale Softcopy Presentations States for the purpose of capturing measurements, overlays and annotation, data that can be applied to the dental images. The VA and the DoD do not wish to store duplicate images (i.e. copies with the measurements, annotations, etc. burned into the pixel data) to capture this information.

Digital Dental modalities shall be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.9 as the role of the Acquisition Modality. This requires support for the following SOP Class:

**Table 12 Mandatory Presentation State SOP Class**

SOP CLASS NAME	SOP CLASS UID	ROLE
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	SCU/SCP

The only VA/DoD specialization to IHE is that the modality is not required to support the Performed Procedure Step; this is an optional feature only.

**4.3.5. Modality Worklist Provided (Mandatory)**

No specializations are stipulated in this Annex, therefore see section 4.1 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**4.3.6. Modality Procedure Step - In Progress (Mandatory)**

No specializations are stipulated in this Annex, therefore see section 4.2 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**4.3.7. Modality Procedure Step - Completed (Mandatory)**

No specializations are stipulated in this Annex, therefore see section 4.3 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**4.3.8. Storage Commitment (Mandatory)**

No specializations are stipulated in this Annex, therefore see section 4.6 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**4.3.9. Query Images SCU (Mandatory)**

Digital Dental modalities are required to be able to query (perform a C-FIND request) remote servers for images. This enables the ability to view relevant patient information on the modality and to determine images that may need to be retrieved for display.

Digital Dental modalities shall be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.14 as the role of the Image Display. This requires support for the following SOP Class:

**Table 13 Mandatory Query SOP Class - SCU**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCU

This Annex stipulates no specializations beyond IHE.

#### 4.3.10. Query Images SCP (Optional)

Digital Dental modalities may optionally support the IHE Profile in the role of the Image Archive. This enables the modalities to function as a server in the network.

Digital Dental modalities may optionally be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.14 as the role of the Image Archive. This requires support for the following SOP Class:

**Table 14 Optional Query SOP Class – SCP**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP

This Annex stipulates no specializations beyond IHE.

#### 4.3.11. Query Presentation States SCU (Mandatory)

Digital Dental modalities are required to be able to query (perform a C-FIND request) remote servers for Grayscale Softcopy Presentations State SOP Instances.

Digital Dental modalities shall be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.15 as the role of the Image Display. This requires support for the following SOP Class:

**Table 15 Mandatory Presentation State Query – SCU**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCU

This Annex stipulates no specializations beyond IHE.

#### 4.3.12. Query Presentation States SCP (Optional)

Digital Dental modalities may optionally support the IHE Profile in the role of the Image Archive. This enables the modalities to function as a server in the network.

Digital Dental modalities may optionally be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.15 as the role of the Image Archive. This requires support for the following SOP Class:

**Table 16 Optional Presentation State Query – SCP**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	SCP

This Annex stipulates no specializations beyond IHE.

#### 4.3.13. Retrieve Images SCU (Mandatory)

Digital Dental modalities are required to be able to retrieve (perform a C-MOVE request) images from remote servers. This enables the dental modalities to pull relevant patient images to the modality.

Digital Dental modalities shall be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.16 as the role of the Image Display. This requires support for the following SOP Class:

**Table 17 Mandatory Retrieve and Storage SOP Classes**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.1	SCU
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	SCP
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	SCP
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.1.7	SCP
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	SCP

This Annex stipulates no specializations beyond IHE.

#### 4.3.14. Retrieve Images SCP (Optional)

Digital Dental modalities may optionally support the IHE Profile in the role of the Image Archive. This enables the modalities to function as a server in the network.

Digital Dental modalities may optionally be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.16 as the role of the Image Archive. This requires support for the following SOP Class:

**Table 18 Optional Retrieve and Storage SOP Classes**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.1	SCP
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	SCU
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	SCU
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.1.7	SCU

SOP CLASS NAME	SOP CLASS UID	ROLE
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	SCU

This Annex stipulates no specializations beyond IHE.

#### 4.3.15. Retrieve Presentation States SCU (Mandatory)

Digital Dental modalities are required to be able to retrieve (perform a C-MOVE request) presentation states from remote servers. This enables the ability to pull relevant patient images and presentation states to the modality.

Digital Dental modalities shall be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.17 as the role of the Image Display. This requires support for the following SOP Class:

**Table 19 Mandatory Retrieve Presentation State**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.1	SCU
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	SCP

This Annex stipulates no specializations beyond IHE.

#### 4.3.16. Retrieve Presentation States SCP (Optional)

Digital Dental modalities may optionally support the IHE Profile in the role of the Image Archive. This enables the modalities to function as a server in the network.

Digital Dental modalities may optionally be conformant to the IHE profile as specified in the IHE Technical Framework Rev 5.5, Vol 2, section 4.17 as the role of the Image Archive. This requires support for the following SOP Class:

**Table 20 Optional Retrieve Presentation State**

SOP CLASS NAME	SOP CLASS UID	ROLE
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.1	SCP
Grayscale Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.1	SCU

This Annex stipulates no specializations beyond IHE.

#### 4.3.17. Print Composer (Optional)

No specializations are stipulated for grayscale printing in this Annex; therefore see section 4.8 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

For dental systems that support color (Visible Light), and support the optional DICOM print feature, they shall support the following DICOM Meta SOP Class:

**Table 21 Optional DICOM Support for Color Printing**

<b>SOP CLASS NAME</b>	<b>SOP CLASS UID</b>	<b>ROLE</b>
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	SCU

**5. SERVICE AND SUPPORT REQUIREMENTS**

No specializations are stipulated in this Annex, therefore see section 5 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**6. COMMUNICATION PROFILES**

No specializations are stipulated in this Annex, therefore see section 6 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**7. SUPPORT FOR FUTURE ENHANCEMENTS**

No specializations are stipulated in this Annex, therefore see section 7 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements.

**8. TESTING PRIOR TO PROCUREMENT**

No specializations are stipulated in this Annex, therefore see section 8 of *Joint VA / DoD DICOM Conformance Requirements for Digital Acquisition Modalities* for requirements