



# ***Modality Interface DICOM Conformance Requirements***

***Final Version 1.2***

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## **Preface to Version 1.2**

The latest Federal Modality Vendor Workshop held on May 5, 1999 resulted in several comments, but none of them was as important as the suggestion from IHE that the VA synchronize its requirements with the IHE requirements. In that spirit the VA team undertook the restructuring of this document. The main requirements of this document are now organized around the Actor Role definitions set forth by IHE for the acquisition devices.

This document retains some of its original structure to provide context to the VA specific requirements. These are requirements not explicitly defined by IHE but vital to the proper operation of the VA imaging system.

Other specific changes are detailed in the change log of this preface.

### **Changes for Version 1.2**

This list of changes is included to easily identify sections and paragraphs changed from the previous version. The nature of the change is identified in the accompanying note:

1. The [Domain of this specification](#) (section 4) is changed to reflect the relation of this specification to the IHE Technical Version 3.0 document.
2. The section describing the Hierarchical Integrated Data Model has changed to include a modified IHE data consistency model diagram.
3. Section [6.1\(Process steps\)](#) is now replacing the section formerly titled "Sequencing"
4. The individual process steps are labeled to reflect their relationship with the IHE process steps.
5. Since IHE makes no distinction between the creation and the update of the MPPS record, we eliminated the Modality Performed Procedure Step Updated event. We also combined the Storage and Storage Commitment steps.
6. The section "AE Specifications" is moved after "Association Acceptance Policies"
7. In section [6.7.1.1 \(C-FIND Attributes\)](#), we removed paragraphs 2 and 3 because they were redundant.
8. Section [6.7.2 \(Modality Performed Procedure Step Attribute Requirements\)](#) is now located after the section on Modality Worklist C-FIND Attribute Requirements.
9. The section [6.7.3.1 Pixel representation issues](#). is revised to clarify the differences between the minimum acquired and the minimum stored pixel values.
10. Table 9 in section [6.7.5 \(Attribute Mapping from Modality Worklist Attributes to the Image Header\)](#) is changed to for closer correspondence with the IHE C-1 Table.

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## **Preface to Version 1.1**

Nine months after the release of the Version 1.0 Requirements Document, the HIMSS and RSNA published the Integrating the Healthcare Enterprise (IHE) Technical Framework Version 3.0 document. The IHE document establishes a similar set of DICOM interoperability goals for image acquisition equipment, which hopefully will evolve into the definitive requirement specification used by all vendors.

This Version 1.1 of the VA/DOD Modality DICOM Conformance Requirements document follows the IHE document as much as possible. There are three areas where the changes in the VA/DOD requirements in the Version 1.0 document are needed in order to become compatible with the DICOM portion of the IHE Version 3.0 document:

- 1) Minor change in the CPT/Local Procedure Code mapping in the response to a Modality Worklist query.
- 2) Additional support for Modality Worklist query by Requested Procedure ID. The VA/DOD Version 1.0 document only required query by Accession Number
- 3) Correction of misinterpretation of the Modality Performed Procedure Step complete message. The VA/DOD 1.0 document assumed that the MPPS complete message indicated successful storage of all images. It only indicates completion of image acquisition, and has no relationship to the storage of images.

This document will reference the IHE requirements where they are identical to the VA/DOD's and the direct reference is warranted. The Appendix points out differences between the VA and the IHE requirements.

This requirements document is also incorporating the results of several phases of comments received from the vendor community, and the direct input during the workshop held at Silver Spring, Maryland on February 16, 1999. Additionally, this Document concentrates more on the sequence of events and their relationship with the DICOM message exchanges.

It should also be noted that this document is not a Standard. It is part of an implementation model and as such it does restrict certain aspects of the DICOM standard in order to conform to others. Not all interpretations of the DICOM standard will conform to the implementation model defined in this document.<sup>2</sup>

### **Changes for Version 1.1**

This list of changes is included to easily identify sections and paragraphs changed from the previous version. The nature of the change is identified in the accompanying note:

1. The definition of terms has been extended to include all the acronyms appearing in this document ([Section 1. Definition of terms:](#))

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<sup>2</sup>The version 1.1 document was distributed to the attendees of the May 3-5, 1999 IHE-Federal Modality Vendor Workshop.

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2. As a result of the feedback from the recent workshop on February 16, 1999 and the progress made on the IHE project, it became obvious that Modality Performed Procedure Step (MPPS) is not going to provide the definitive indication of End of Study as needed by the VA. The VA is still planning to utilize the Modality Perform Procedure Step to manage Modality Worklist items. As a result, Section [5.4 \(DICOM Modality Performed Procedure Step:\)](#) has been significantly changed to reflect the new intent of the usage of MPPS.
3. The intended use of Storage Commitment and its relation to the other SOP Classes is clarified. The section describing the SOP behavior is defined in [section 5.5 \(DICOM Storage Commitment:\)](#). The section is further enhanced by the expected Storage Commitment SCU behavior description.
4. The implementation model has been updated to reflect the association handling policies. For details consult [Section 6.3 \(Association Acceptance Policies\)](#)
5. [Section 6.1.2 \(Real life events and message sequence relationship\)](#) was added to define the timeline of events along which the DICOM message exchanges occur between the modalities and VA Application Entities
6. Added [section 6.5](#). The section describes the entity relations of the VA data objects.
7. Added a clarification to the section specifying the display of all the attributes on a user screen at the modality.
8. Added clarification. The section has been expanded to describe the SCP behavior in handling identical instances.
9. [Section 6.2 \(Implementation Model\)](#) has been modified to correspond with the distribution of functionality across multiple Application Entities.
10. [Section 5.4 \(DICOM Modality Performed Procedure Step:\)](#) has been modified to reflect the revised usage of MPPS.
11. Removed one of the example specifics from the on [page 24](#). It created unnecessary confusion.

## ***Preface to Version 1.0***

This Requirements Document is based on a RFC, which was issued in November of 1997. The RFC process was very successful, and detailed comments were received from many manufacturers as well as users. The majority of those comments were included in this version of the document. Significant changes in this document with regard to the RFC are:

- The DICOM Modality Performed Procedure Step Service is incorporated as a requirement.
- Several optional attributes, which were incorporated in the Image header, have been removed eliminating the need for a Standard Extended SOP Class.
- The requirement to send images from a modality simultaneously to different destinations was removed. The requirement to be able to send to different destinations has not changed.
- Supporting the DICOM Verification SOP class as a Provider has been removed. Supporting the DICOM Verification SOP class as a User has been retained.
- The Type specification of the image attributes is now identical to the Type specification in the DICOM standard. For example, this means that the Patient name and Patient ID remain Type 2. However, there is now a "VA Type requirement", i.e. certain attributes are always required, even although they might be Type 2 according to the DICOM standard.
- The requirement to incorporate new changes to the DICOM standard has been changed from 6 to 12 months.
- A minimum requirement for the number of characters in a Patient Name, Accession Number and Patient ID has been added.

Several other details have been changed; the reader is encouraged to review the document in its entirety.

## ***General Preface to this Requirements Document***

The purpose of this Requirements Document is to specify how the modalities should provide the DICOM functionality required by the VA. The requirements in this document are mandatory for all VA purchases of image producing modality and related equipment. This document is based on a Request For Comment (RFC) document, issued in November 1997. Comments received as part of the RFC process, when reasonable and applicable, were incorporated into this Requirements Document.

The Veterans' Health Administration (VHA), Patient Care Services, which represents all of the clinical patient care programs that utilize image producing equipment and modalities at the Headquarters level, strongly supports and recommends the requirements of this document. This document is considered essential to provide interoperability between imaging equipment and modalities and the VistA hospital information system, which is necessary for efficacious veteran patient care.

The DOD and IHS also will use this document as the standard requirement for image producing modalities and related equipment.

This document is available online at <http://www.va.gov/oa&mm/busopp/formats.htm>. The files are modality.zip and modality.doc. It is also available on the web site <http://www.otechimg.com>.



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**1. DEFINITION OF TERMS:**

ASCII	American Standard Code for Information Interchange
AE	Application Entity
ANSI	American National Standards Institute
CR	Computed Radiography
CT	Computed Tomography
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
DIMSE-C	DICOM Message Service Element Composite
DIMSE-N	DICOM Message Service Element Normalized
DOD	Department Of Defense
DX	Digital Radiography
FTP	File Transfer Protocol (part of the TCP/IP protocol suite)
HL7	Health Level 7
HIS/RIS	Hospital Information System/ Radiology Information System
ID	Identifier
IE	Information Entity
IHE	Integrating the Healthcare Enterprise
IHS	Indian Health Services
HIMSS	Healthcare Information and Management Systems Society
IS	Information System
IOD	Information Object Definition
ISO	International Standards Organization
MPPS	Modality Performed Procedure Step
NEMA	National Electrical Manufacturers Association
MR	Magnetic Resonance
OSI	Open Systems Interconnection
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
PN	Person Name
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
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
VA	Department of Veterans Affairs
VistA	VA Hospital Information System Technology Architecture
VL	Visible Light
VR	Value Representation
XA	X-Ray Angiography

## **2. AUDIENCE**

The intended audience of this document is:

- Technical staff from vendors planning to interface to VistA Imaging. The document is intended to clarify the differences to implementers who are well versed in IHE.
- VA personnel. The document familiarizes the reader with the IHE concepts and puts them in context of the VistA Imaging environment
- Anyone wishes to interface to VistA Imaging

## **3. INTRODUCTION:**

### **3.1. Background and Scope:**

The Department of Veterans Affairs (VA) has been one of the pioneers of implementing Picture Archiving and Communications Systems (PACS) in a clinical environment. The VA was also one of the first to implement interfaces between commercial PACS systems, image generating modalities, and the Hospital/Radiology Information System (VistA), based on the Digital Imaging and Communications in Medicine (DICOM)<sup>1</sup> standard. Several VA hospitals are using this technology on a daily basis, thereby increasing their efficiency, lowering cost, and reducing turnaround time for diagnostic exams. This has a positive impact on improving patient care in the VA hospital environment.

Based on these early implementations, it has become clear that there is a need to specify uniform and consistent requirements for modality vendors supporting the DICOM standard. Currently in many cases, information that is critical in uniquely identifying a patient or a study (for example the accession number) is often entirely missing from the image header, or is encoded in different fields (for example as Comments). In addition, the VA found that certain modalities do not accommodate a sufficient number of characters in the patient data entry, causing the Patient Name and/or Patient ID to be truncated.

In order to resolve this situation, the VA requires that modality vendors support a common core subset of the DICOM standard that would properly communicate this critical patient and study information.

The scope of this document is to define exactly this DICOM core subset in the form of requirements for the image producing modalities. These include Magnetic Resonance, Computerized Tomography, Ultrasound, Nuclear Medicine, Computed Radiography and other digital radiography applications, film digitizers, and digital Xray systems such as Cardiology, Fluoroscopy, and the non-radiology Visible Light modalities, such as Cardiology, Dental, Endoscopy, Ophthalmology, Pathology, etc. By adhering to this DICOM core subset, compatibility and interoperability with VistA imaging will be greatly enhanced. This core subset consists of a required set of attributes for all objects that are exchanged, and a set of DICOM services. (DICOM Modality Worklist Management, Storage, Modality Performed Procedure Step, Storage Commitment and Verification.)

The core subset and additional services require no private extensions to the DICOM standard. Additional services, beyond the initial core set of capabilities, are included in Annex 8. One or more

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<sup>1</sup> National Electrical Manufacturers Association: Digital Imaging and Communications in Medicine standard PS 3.1 to 3.14-1998

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of these additional services, such as Query/Retrieve or extended roles (Provider vs. User), or Print might be required depending on the specific application.

### **3.2. HIMMS/RSNA IHE Initiative**

The Healthcare Information and Management Systems Society (HIMSS) and the Radiological Society of North America (RSNA) organizations are sponsoring the Integrating the Healthcare Enterprise (IHE) initiative to address some of the very same interoperability issues that the VA and DOD are trying to solve. This effort has drawn participation from many leading commercial information and imaging systems vendors. Through a series of biannual demonstrations at the HIMSS and RSNA annual meetings, IHE provides a framework to improve the interoperability of commercial systems in an open, standards-based environment. The real goal of this effort is not merely to demonstrate interoperability at the respective shows, but to get the industry to actually modify their products so that they will be able to work better together in real life. The IHE hopes to achieve this goal by establishing a good standards-based technical framework with which all the vendors can comply.

The IHE initiative has been undertaken with the purpose of creating a highly visible forum and showcase for demonstration of interoperability capabilities. While development of standards is a very intense area of activity, the IHE connectivity demonstrations seek to provide a framework for showcasing accepted standards, and encouraging support of them by health care institutions and industry. IHE is primarily an educational effort. An inclusive planning process has resulted in the selection of an initial set of transactions for which connectivity will be demonstrated, and will determine priorities for subsequent demonstrations on a year-to-year basis.

The IHE's vision statement declares pointedly that it is not a standards-making body, but a vendor-driven group whose work is intended to bolster ongoing standards efforts. The IHE goal is to facilitate interoperability through the judicious use of the existing standards. The IHE Technical Framework defines a set of choices in implementation of the DICOM and HL7 standards. Where the IHE committees identify gaps in or necessary extensions to current standards, they will submit their findings to the appropriate standards body for consideration.

This VA Requirements Document references the applicable DICOM portion of IHE's Technical Framework Document.<sup>1</sup> The support of the largest government-owned healthcare networks adds further momentum to the IHE project and signals the willingness of purchasers, vendors, and government software developers to work together toward interoperability.

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<sup>1</sup> Sections 4.8 to 4.13 of the IHE Technical Framework V3.0 document dated April 26, 1999. HIMSS/RSNA Integrating the Healthcare Enterprise Technical Framework, Version 3.0, available on the [www.RSNA.org/IHE](http://www.RSNA.org/IHE) web site

#### 4. DOMAIN OF THIS SPECIFICATION

##### 4.1. VA Radiology Device Interface Architectures

The VA currently supports two different architectures with regard to radiology device interfaces, depending on whether a commercial PACS system or the VA VistA PACS solution is used. The modalities shall perform the same functions whether they directly interface to VistA Imaging or they interface through a commercial PACS. This document defines the domain of specification strictly as the point of interface between the modality and VistA Imaging. The document does not define the interface between VistA Imaging and a commercial PACS.

##### Architecture 1: Using a commercial PACS system:

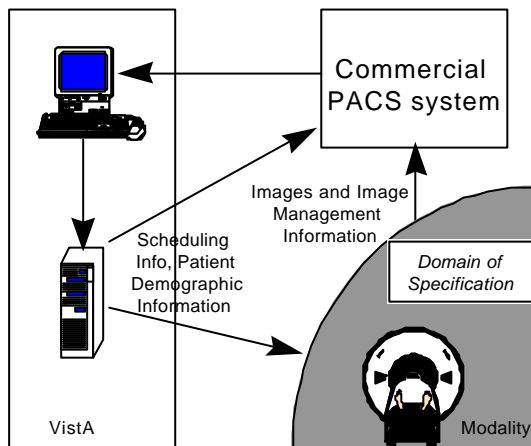


Figure 1

This architecture has three high level components, the Modality itself, the VistA Information System, and a commercial PACS system. In this architecture, the Modality will interface to the VistA Information system for the patient demographic information and to a Commercial PACS system for exchanging Images and Image Management Information (see Fig 1).

##### Architecture 2: Using the VistA Imaging System as a PACS system:

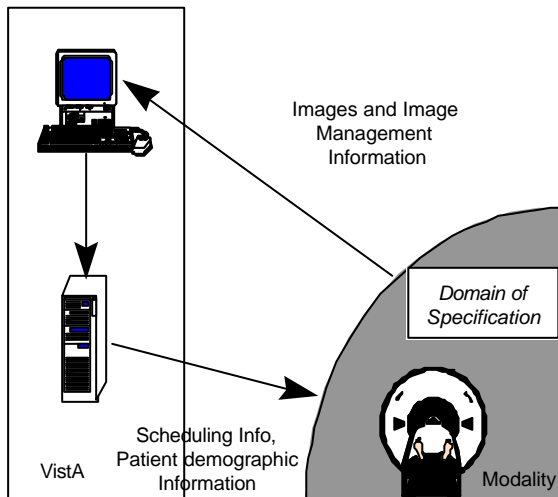


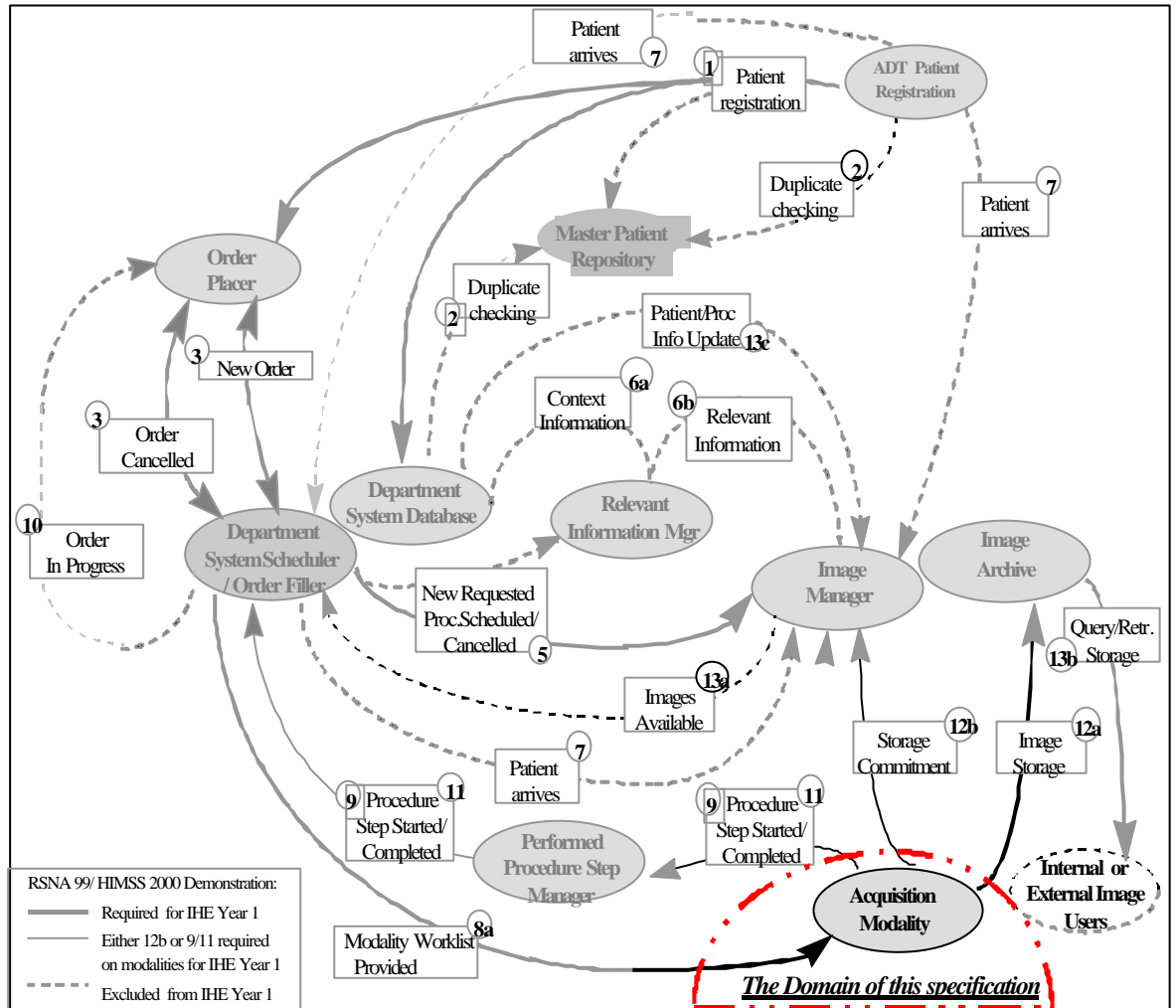
Figure 2

In this architecture, the PACS system is incorporated within the VistA Information system (see Fig 2). Note that from a modality functional perspective there is no real difference between architecture 1 and 2. The interface from the modality to a commercial PACS system is now used between the modality and the VistA Imaging System.

The domain of this specification i.e. the DICOM interface of the modality, is identified in the Figures by the shaded area.

### 4.2. Domain relationship with IHE

This document specifies only a small portion of the IHE defined domain. Figure 3.2-1 of the IHE framework 3.0 document is included to illustrate the overlap between the IHE specification and this document. This document is only concerned about the interfaces specified in interacting with the system from a purely modality centric view. All the items not directly used or directly affected by the modality interfaces have been represented in gray color. Whether the modality interfaces to VistA Imaging directly or to a Commercial PACS, the interface requirements for the modality do not change.



IHE Figure 3.2-1. System Transactions Overview

This Document is based on the IHE Technical Framework. The intent is to document notable differences from the requirements set forth by the IHE Technical Framework. The document is not intended to replace the IHE document but to augment it and provide implementation context. Procedural and definition details covered by IHE are not repeated by this document. The reader is expected to be fully familiar with the concepts of the IHE Technical Framework. The document inherits the relationships, definitions and nomenclature established by the IHE Technical Framework.

## **5. REQUIRED DICOM SERVICES:**

The Department of Veteran Affairs requires the DICOM services specified below to be supported by a Modality:

### **5.1. DICOM Verification Service:**

The modality shall fully support the DICOM Verification SOP Class both as a SCP and a SCU. When supporting DICOM Verification as a SCU the modality shall establish an Association with another DICOM device and issue a C\_ECHO Request. When the modality supports Verification as a SCP, it shall accept an association and respond to a C-ECHO request. The VA requires this capability of a modality so that it can be used for troubleshooting. Additionally, support of the Verification SCP on modalities with no apparent SCPs is dictated by the reverse role negotiation requirement of the Storage Commitment Push Model (see DICOM PS 3.2 - B.2.1.3.3.1 [SOP Specific Conformance to Verification SOP Class]).

### **5.2. DICOM Storage Service:**

The primary function of a Modality is to acquire images. The DICOM Storage service is required in order to send those Image objects to specific destinations. The Modalities shall support the Storage SOP classes appropriate for the modality, and optionally may support the Secondary Capture Storage SOP class.

### **5.3. DICOM Modality Worklist:**

The DICOM Modality Worklist service is required, allowing a modality to query for Patient and Study information (i.e., issue a "C-FIND" request). For example, the modality can request the list of patients that are scheduled based on certain search criteria. The information returned in the C-FIND responses correspond to the Scheduled Procedure Step level of the information model defined by DICOM.

### **5.4. DICOM Modality Performed Procedure Step:**

The Modality Performed Procedure Step messages indicate the authoritative start of the procedure step (start of image acquisition) and the completion or cancellation of the procedure step (end of image acquisition). Although the Modality Performed Procedure Step does not necessarily signal the starting and the completion of the transmission of the images, some modality vendors may include the delivery of the images to at least the primary destination as part of the Performed Procedure Step. The Modality Performed Procedure Step N-CREATE event can be used with the Modality Worklist SCP to prevent other modalities from starting the same procedure step.

The MPPS Complete N-SET message can be used to indicate that the Scheduled Procedure Step is eligible for removal from the worklist.

### **5.5. DICOM Storage Commitment:**

The VA specifies the use of the Storage Commitment SOP Class Push Model implementation in order to guarantee the safe storage of imaging information generated by the modalities. The VA system interprets Storage Commitment as a request from a modality to guarantee safe storage of the IOD instances. For details [see Sections 6.1.2.7 and 6.7.4](#)



6.SPECIFIC DICOM REQUIREMENTS:

6.1. Process steps

6.1.1. Unique Study and Image Identification:

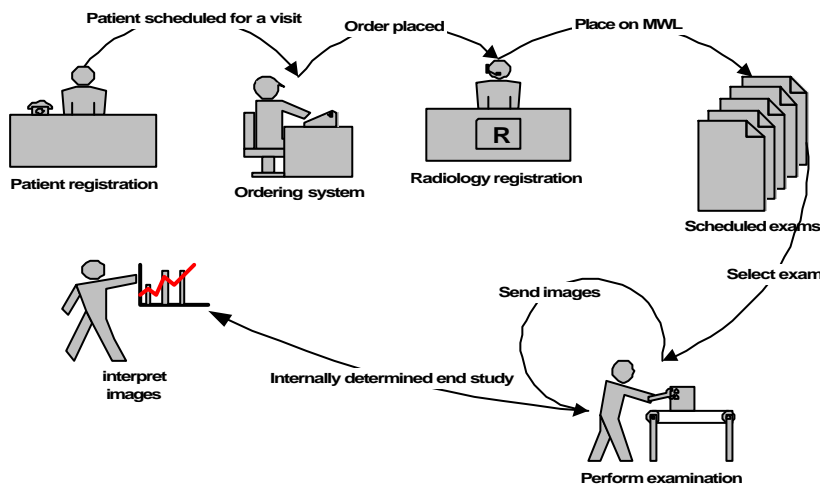
The HIS/RIS passes the same Patient and Study information to both the Modality Worklist provider and the commercial PACS (if present). The DICOM Study Instance UID attribute, which uniquely identifies the study, is assigned by the HIS/RIS and is passed to the Modality Worklist provider and the PACS. The Worklist Provider passes this Study Instance UID to the Modality, which incorporates it into the Image header. The Modality Worklist provider shall use the Study Instance UID that is supplied by the HIS/RIS, and the Modality shall use the Study Instance UID that is supplied by the Modality Worklist provider. These requirements allow the images to be properly related to the Study within the HIS/RIS and/or PACS.

In case the Study Instance UID is generated at the modality (i.e. when the RIS is unavailable), the modality shall guarantee that this value is unique for the particular object it generates. If a particular Image object is sent again later from a particular modality, the same Study Instance UID shall be used to identify the Study.

The Image SOP Instance UID is assigned by the modality and permanently identifies the Image object. By definition it must be unique for each Image object. It is not allowed to be subsequently changed, for example, when the same image is re-sent from the modality. However, when the Image object is modified and clinically significant changes are made, the modality shall create a new instantiation. New instances received with the same UID will be ignored.

6.1.2. Real life events and message sequence relationship

The model followed by IHE is applicable in describing the real world sequence of events and their relationship to message exchanges in the system. The sequence described here does not imply any time scale, just the temporal order of events (i.e. event A must occur before event B and so on and so forth).



In each state transition of the process, the underlying information systems exchange the necessary messages. Each activity results in the generation of specific HL7 or DICOM messages. Only the DICOM interfaces and the modality related messages are described in this document. (Text interface messages generated to send to a commercial PACS are not within the scope of the document.)

The individual steps of the process are correlated to the IHE defined steps using the numbering scheme established by Figure 3.1-1 of the IHE Technical Framework

**6.1.2.1. Patient Registration (IHE Step 1)**

When the patient is registered, the patient related information is entered into the database. There are no modality specific interface actions taken, there are no modality specific messages generated.

**6.1.2.2. Order Entry (IHE Step 2)**

The Ordering system generates a new order for the patient. The transaction generates internal messages, prepares the patient for the arrival at Radiology. None of the modality specific DICOM interfaces are affected.

**6.1.2.3. Patient Registration (Radiology) (IHE Step 7)**

At the time of the arrival of the patient in Radiology, the respective Scheduled Procedure Steps are generated from the requested procedures and the information is made available on the Modality Worklist.

**6.1.2.4. Worklist (IHE Step 8a)**

The Scheduled Procedure Steps are placed on the Modality Worklist. The worklist is accessible by using the MWL service class.

**6.1.2.5. Modality Performed Procedure Step Started. (IHE Step 9)**

The start of the Modality Performed Procedure Step signifies the beginning of image acquisition.

**6.1.2.6. Modality Performed Procedure Step Completed. (IHE Step 11)**

The completion status of the Performed Procedure Step indicates the modality completed the actions related to the Scheduled Procedure Step.

**6.1.2.7. Image Instance Storage and Storage Commitment. (IHE Steps 12a &12b)**

The Storage of the first image shall occur only after the start of the MPPS.

**6.1.2.8. Images Available (IHE Step 13a)**

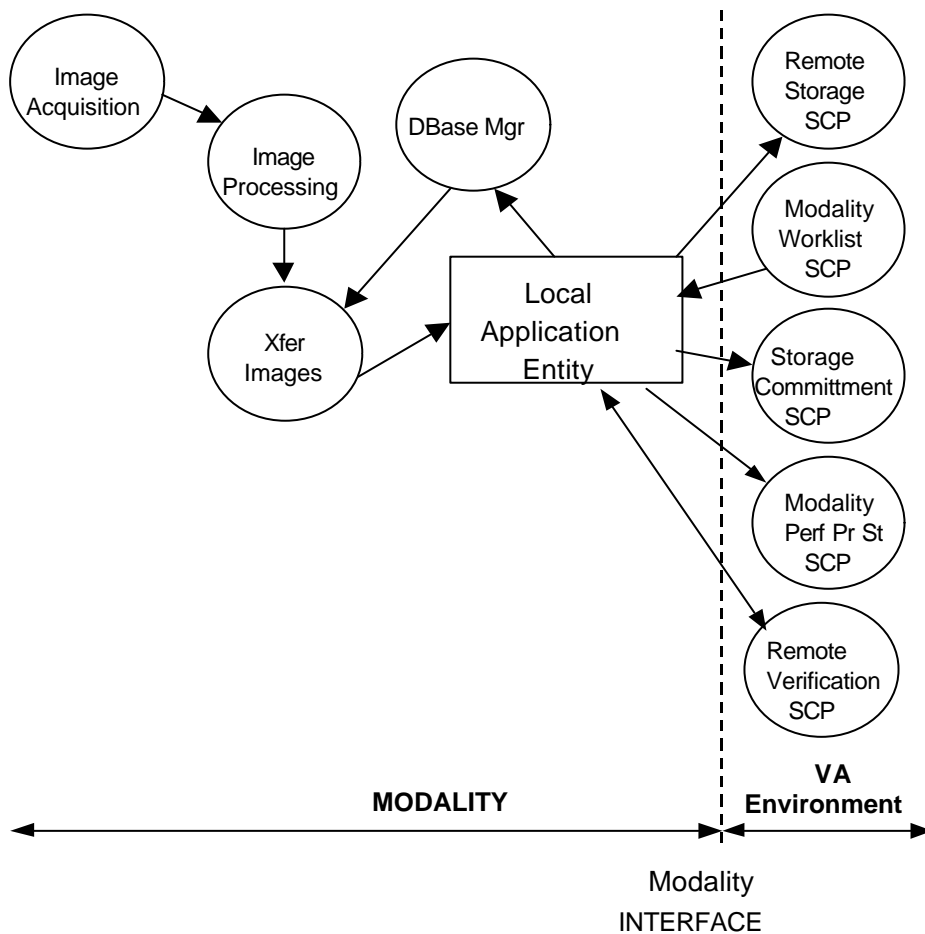
There is currently no DICOM notification message signaling that all the images in a Performed Procedure Step have been transferred from the acquisition modality to the archive. Such a message would be the natural trigger signal to place the study on the "unread list" for the radiologists. The IHE committee recognizes the same deficiency and is working with the DICOM committee to correct this situation. The VA and DOD wholeheartedly support this effort.

**6.1.2.9. Examination Verification(No IHE equivalent)**

In the VistA HIS/RIS, after the study's images have been safely stored in the image database, the technologist verifies the images on a workstation. As a result of this event, the VistA system removes the Scheduled Procedure Step from the Modality Worklist.

**6.2. Implementation Model**

The Implementation Model describes the function of the image producing modality related to the DICOM services. The DICOM services for the modality are implemented by a software process, called an "Application Entity" (AE). The "bubble diagram" (Application Data Flow Diagram) shows the interaction of the modality AE with the outside world across the dashed line, i.e. the DICOM interface. The Application Data Flow Diagram depicts graphically the relationship of the modality DICOM AE with local functions at the modality as well as the relationship with external activities. Note that the modality DICOM AE receives data from the Modality Worklist SCP, sends images to the Remote Storage SCP, and communicates the procedure status and related information using the Modality Performed Procedure Step. The modality will also function as a User and Provider of the Verification Service. The implementation model described below functions as an illustration of a potential implementation of the DICOM services. Note that a Modality for example might implement more than one Application Entity (AE) for the different services.



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The Remote Storage SCP corresponds to the IHE Image Archive. In the IHE model the Modality Worklist SCP resides on the departmental system/order filler, the Modality Performed Procedure Step SCP resides on the Modality Performed Procedure Step Manager, the Storage Commitment SCP resides on the Image Manager.

### **6.3. Association Acceptance Policies**

The VistA environment typically implements the DICOM services using multiple Application Entities. Each of these AE's supports the Verification SOP class (as a SCU/SCP) and one or more additional SOP classes. The modality SCUs utilizing the services of the SCPs shall be prepared to support each service class residing on a separate AE in the VA environment.

Each modality SCU shall be able to be configured to use a different AE SCP for each of the SOP Classes (Storage, Modality Worklist, Modality Performed Procedure Step, and Storage Commit). This provides the greatest flexibility for the modality when interfacing to different system configurations, and is consistent with the implicit assumption of the IHE model depicted in Figure 3.2-1 of the IHE Technical Framework document.

The modality shall be capable of utilizing the full 16-bit range (1-65535) of port numbers.

### **6.4. AE Specifications**

#### **6.4.1. SOP Class Support**

The VA modality interface shall provide Standard Conformance to the following DICOM Version 3.0 SOP Class(es):

**Table 1: Required SOP Classes:**

<b>SOP CLASS NAME</b>	<b>SOP CLASS UID</b>	<b>USAGE</b>
Modality Storage SOP Class (depends on modality Type, e.g. CT, MR, etc.)	1.2.840.10008.5.x.x.x.x	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
Verification SOP Class	1.2.840.10008.1.1	SCU/SCP
Storage Commitment Push Model SOP Class	1.2.840.10008.1.20.1	SCU

Note 1: Support of the retired Nuclear Medicine and Ultrasound Image Storage SOP classes is optional, support of the new SOP classes is required.

Note 2: A modality can optionally support the Secondary Capture SOP class in addition to its "true" SOP class such as DX, XA, VL, CT, MR, PT etc. Support of Secondary Capture ONLY is not sufficient (except for Film Digitizer modalities).

Note 3: Computed Radiography modalities are required to support the DX SOP Classes in addition to the CR SOP Class.

Note 4: Some modality vendors seem to implement a Verification service using a non-DICOM mechanism such as FTP. There is no guarantee that this will work and it is unacceptable if it is implemented in lieu of the true DICOM Verification service.

**6.4.2. Presentation Context**

Each SOP class supports a particular Presentation Context, which is the combination of the SOP class as specified above in Section 6.4.1 and the Transfer Syntax. The Transfer Syntax defines the encoding of the DICOM basic elements, i.e. its attributes and how the data is represented. The encoding of the attributes, in the form of a so-called Value Representation, can be done in two ways, i.e. either Explicitly or Implicitly. This means either that each attribute has an explicit specification as part of the Data Element Field that represents its Value Representation, or that it does not and it is assumed that the receiver implicitly knows the Value Representation from interpreting the Attribute Tag. For example, when receiving the Attribute "Patient Name" in an Explicit Transfer Syntax, there is an additional "Person Name" field (i.e., "PN") to identify the Value Representation. In the case of an Implicit Value Representation, the Value Representation is assumed to be known by the receiver and is not explicitly specified.

The Transfer Syntax of the modality shall match the specification in Table 2 and 3:

**Table 2: Proposed Presentation Context for Verification, Modality Worklist, Storage Commitment, and Modality Performed Procedure Step:**

<b>Presentation Context Table</b>						
<b>Name</b>	<b>Abstract Syntax</b>		<b>Transfer Syntax</b>		<b>Role</b>	<b>Ext. Neg.</b>
	<b>UID</b>		<b>Name List</b>	<b>UID List</b>		
Verification	1.2.840.10008.1.1		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Worklist	1.2.840.10008.5.1.4.31		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
MPPS	1.2.840.10008.3.1.2.3.3		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Storage Commitment	1.2.840.10008.1.20.1		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

**Table 3: Proposed Presentation Context for all Storage SOP classes:**

<b>Presentation Context Table</b>					
<b>Abstract Syntax</b>		<b>Transfer Syntax</b>		<b>Role</b>	<b>Extended Negotiation</b>
<b>Name</b>	<b>UID</b>	<b>Name List</b>	<b>UID List</b>		
See Note 1	See Note 1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
See Note 1	See Note 1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

Note 1: Applicable for all Storage SOP classes

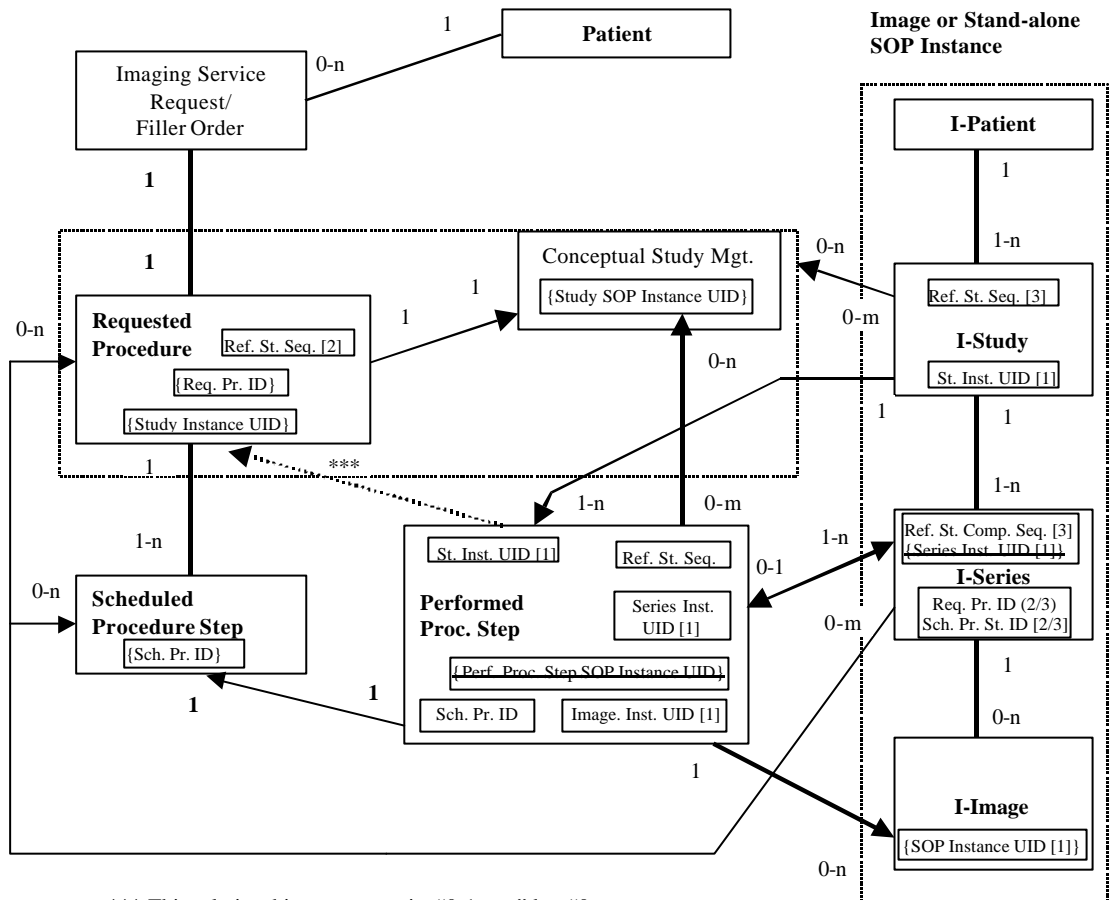
The preferred transfer syntax that will be accepted by the SCP will be the Explicit VR Little Endian. (The Explicit VR transfer syntax is preferred over the default, implicit VR, because it gives more complete information about the attribute.)

A modality, at its option, could propose additional Transfer syntaxes, such as Big Endian or compressed. Those will be ignored by the PACS/VistA system.

**6.5. Hierarchical Integrated Data Model**

The VA uses two forms of a single accession number to track radiology examinations. The first and more complete Long Case Number has the representation MMDDYY-NNNNN, where NNNNN may be 1-5 digits long. The VA also uses a user-friendly shortcut for the accession number, called the Short Case Number, which consists of just the trailing numeric portion of the Long Case Number (that is, NNNNN). Since the relationship between the Imaging Service Request and the Requested Procedure is 1:1, the VA has elected to use the Long Case Number to identify the Imaging Service Request, and the Short Case Number to identify the Requested Procedure, that is, to be the Requested Procedure ID. This corresponds to the ER model established and described in the IHE Technical Framework document (section 3.3 Data Model). Other references to Accession Number in this document refer to the Long Case Number.

The Scheduled Procedure Step ID is meaningful for requested procedures resulting in multiple performed steps on the same or different modalities. An example would be a composite fluoroscopic study where the same XRay generator is used to take a set of supporting CR images. The IHE Data Consistency model (IHE Figure C-1) applies with two modifications. The mapping from Imaging Service Request to Requested Procedure is 1:1, not 1:n, and the mapping from the Scheduled Procedure Step to the Performed Procedure Step is 1:1, not 0-n:0-m.



\*\*\* This relationship may not exist "0-1 to n" but "0-n to m" when multiple Scheduled Procedure Steps are satisfied by one Performed Procedure Step.

**Legend:**

- {xxx} : An Attribute which is a unique identifier (DICOM UID) or an identifier (DICOM ID) or for the entity
- yyy : An Attribute which is used in the entity to reference another entity as show by the associated arrow.
- [n] : The Attribute Type as defined by DICOM for this entity (IHE may strengthen this requirement)
- : A relationship between two entities using a unique identifier (DICOM UID)
- ↔ : A bidirectional relationship between two entities using a pair of unique identifiers (DICOM UID)
- : A relationship between two entities using a simple identifier (DICOM ID)
- n-m : Cardinality of the relationship between the entities, not the identifiers. (Direction of the arrow is irrelevant to cardinality.)

IHE Figure C-1. Data Consistency Model: Modality Worklist Information Model, Image and Standalone IODs and Modality Performed Procedure Step IOD

## **6.6. Functional Requirements**

The Modality shall support all of the following modes of operation:

1. Send images to multiple destinations. The different destinations should be operator selectable.
2. As an option, for some specific modalities (e.g. Angiography, Cardiology), it may be necessary that the operator be able to select a subset of clinically significant images to be sent to a specific destination.
3. Send images automatically without any operator interaction to its destinations during the acquisition (send as you go).
4. Send images to its destination initiated by an operator at the modality (manual mode)
5. Send images automatically after a configurable period of time if the images were not sent manually prior to the expiration of the interval timer (manual mode, automatic time out).
6. The modality shall retry failed transmission either automatically or initiated by the operator.
7. The modality shall retry failed storage commitments

## **6.7. Specific attribute Requirements**

### **6.7.1. Modality Worklist C-FIND Attribute Requirements (IHE Step 8)**

There are different scenarios under which image producing equipment can use the Modality Worklist service to obtain patient and study information from a Modality Worklist provider. In each instance, the modality "pulls" the data (i.e. uses a DIMSE-C C-FIND) to obtain the data from the Modality Worklist provider. Different capabilities are needed to handle the different situations that occur in the hospital information system environment:

#### **Example 1 - Current Radiology Study**

A technologist wants to obtain patient and study information on a currently active radiology study. The radiology information system software is sufficiently developed to output event transactions that signal the patient's arrival in the radiology department, as well as the completion of the examination. These events are used to dynamically populate and prune a small database, which is used to support the classic Modality Worklist provider.

The technologist can obtain the patient and study information for a single case either by entering the Accession Number or the Requested Procedure ID, or can obtain the entire set of active patients and studies for the modality, and then pick the case from the list.

#### **Example 2 – Prior Radiology Study**

It is sometimes necessary to scan film of a previous radiology study. In this situation, the Radiology Information system does not generate any event transactions that can be used to update the classic Modality Worklist provider database. Nonetheless, given the Accession Number of the previous study, the VistA Modality Worklist provider can obtain the information about the study directly from the radiology information system database.



### Example 3 – Non-Radiology Study

The VistA Imaging System supports non-radiology image producing DICOM modalities. Outside of Radiology, the Hospital Information System may not generate any event transactions about non-radiological imaging examinations, and the classic Modality Worklist provider database can not be constructed. Again, given the Accession Number, the VistA Modality Worklist provider can obtain appropriate information about the study from the specific application database within the hospital information system.

These three examples demonstrate the requirement for supporting the Accession Number and Requested Procedure ID query capability of Modality Worklist.

The timing of the Modality Worklist query is very important. The radiology staff takes responsibility for the study and registers the patient in the department. This produces the “arrival event”. Because of the way the VA’s radiology information system works, the “arrival event” is the first notification that a Modality Worklist provider receives about a study. The most efficient use of Modality Worklist facility would be to perform a single query shortly after the patient has been registered. A query prior to the arrival event produces negative results.

Frequently querying the Modality Worklist provider (i.e., “polling”) to retrieve patient data has proven to be inefficient. It is therefore strongly discouraged as the primary method for obtaining such data.

A major issue surfaced in early implementations of Modality Worklist within the VA system. In some implementations, the user interface design of the modality makes it relatively easy to select the wrong patient information to associate with a particular image. The result is a mismatch of the patient demographic data and image(s), with serious effects on data integrity and potentially adverse effects on patient safety. Therefore, in the Accession Number, Requested Procedure ID, or Worklist query, ***it is mandatory that the user interface require a second patient/study identification verification step to ensure that the images are matched to the correct patient***

#### **6.7.1.1. C-FIND Attributes**

The Basic Modality Worklist SCP shall support the Accession Number (0008,0050) and Requested Procedure ID (0040,1001) as a required Matching Key attributes of the C-FIND Request.

The Accession Number or Requested Procedure ID shall be retrieved with Single Value Matching (that is, wildcard matching shall not be allowed; an error shall be returned).

Because the relationship between the Imaging Service Request and the Requested Procedure is 1:1, the Accession Number or Requested Procedure ID queries produce identical results. The two queries and their arguments can be used interchangeably. The SCP will always return the Accession Number in the Accession Number Return Key attribute and Case Number in the Requested Procedure ID Return Key attribute. Note that this is even true if a Case Number is used in the Accession Number field of a query.

Table 4 specifies the Matching and Return Key attributes showing the mapping from the VistA data elements. The table below represents the list of attributes that VA requires to have retrieved by the modality and inserted into the corresponding entry fields of the user interface. Most of the information specified in Table 4 was selected based on input from the clinicians using the systems on a daily basis.

**Table 4  
ATTRIBUTES FOR THE MODALITY WORKLIST INFORMATION MODEL**

<b>VistA Name</b>	<b>Description/ Module</b>	<b>Tag</b>
<b>Scheduled Procedure Step</b>		
	Scheduled Procedure Step Sequence	(0040,0100)
	>Scheduled Station AE Title	(0040,0001)
	>Scheduled Procedure Step Start Date	(0040,0002)
	>Scheduled Procedure Step Start Time	(0040,0003)
Room location for study	> Scheduled Procedure Step Location	(0040,0011)
Modality	>Modality	(0008,0060)
Technologist / Physician performing the study	>Scheduled Performing Physician's Name	(0040,0006)
VA Procedure Description	>Scheduled Procedure Step description	(0040,0007)
VA Procedure (see note 1)	>Scheduled Action Item Code Sequence	(0040,0008)
VA Procedure Code (IEN)	>>Code Value	(0008,0100)
VA Coding Scheme (L)	>>Coding Scheme Designator	(0008,0102)
VA Procedure Description	>>Code Meaning	(0008,0104)
	>Scheduled Procedure Step ID	(0040,0009)
<b>Requested Procedure</b>		
<i>To be used as needed</i>	Requested Procedure Comments	(0040,1400)
CPT Procedure Description	Requested Procedure Description	(0032,1060)
CPT Procedure	Requested Procedure Code Sequence	(0032,1064)
CPT Procedure Code	>Code Value	(0008,0100)
CPT Coding Scheme (C4)	>Coding Scheme Designator	(0008,0102)
CPT Procedure Description	>Code Meaning	(0008,0104)
Study SOP Instance UID	Study Instance UID	(0020,000D)
Case Number (NNNNN)	Requested Procedure ID	(0040,1001)
Attending Physician	Names of Intended recipients of results	(0040,1010)
<b>Imaging Service Request</b>		
<i>To be used as needed</i>	Imaging Service Request Comments	(0040,2400)
Accession Number	Accession Number (MMDDYY-NNNNN)	(0008,0050)
Ordering Physician	Requesting Physician	(0032,1032)
Requesting Service	Requesting Service	(0032,1033)
Primary Care Provider	Referring Physician's Name	(0008,0090)
<b>Visit Information</b>		
Patient Location	Current Patient Location	(0038,0300)
<b>Patient Identification</b>		
Patient Name	Patient's Name	(0010,0010)
Patient ID	Patient ID	(0010,0020)
Other Patient or Study ID's	Other Patient ID's	(0010,1000)
<b>Patient Demographic</b>		
Patient Date of Birth	Patients Birth Date	(0010,0030)
Patient Sex	Patient's Sex	(0010,0040)
Patient Race	Ethnic Group	(0010,2160)
Patient Comment	Patient Comment	(0010,4000)
<b>Patient Medical</b>		
Pregnancy Status	Pregnancy Status	(0010,21C0)
Allergies	Medical Alerts	(0010,2000)

**Modality Interface DICOM Conformance Requirements**

<b>VistA Name</b>	<b>Description/ Module</b>	<b>Tag</b>
Reason for Study (history)	Additional Patient History (see note 2)	(0010,21B0)

Note 1: Starting in Version 1.1, the Scheduled Action Item Code Sequence contained the VA (local) procedure codes, in order to be compatible with the IHE.

Note 2: In the VA HIS/RIS the reason for the study is often a short patient history summarizing the condition of the patient and giving background information for the reason for the study. It usually exceeds the 64 character Long String Value Representation provided by the DICOM standard attributes Reason for the Study (0032,1030), Reason for the Request Procedure (0040,1002), and Reason of the Imaging Service Request (0040,2001). In order to faithfully communicate this essential field, the VA has chosen to map it to the Additional Patient History (0010,21B0) attribute.

**6.7.2. Modality Performed Procedure Step Attribute Requirements**

Modality Performed Procedure Steps correspond to IHE step 9. The Modality Performed Procedure Steps track the acquisition of the image instances.

**Table 5  
Modality Performed Procedure Step SOP CLASS N-CREATE, N-SET AND  
FINAL STATE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Req. Type N-CREATE</b>	<b>Req. Type N-SET</b>
<b>Performed Procedure Step Relationship</b>			
Scheduled Step Attribute Sequence	(0040,0270)	1	Not allowed
>Study Instance UID	(0020,000D)	1	Not allowed
>Accession Number	(0008,0050)	2	Not allowed
>Requested Procedure ID	(0040,1001)	2	Not allowed
>Requested Procedure Description	(0032,1060)	2	Not allowed
>Scheduled Procedure Step ID	(0040,0009)	2	Not allowed
>Scheduled Procedure Step Description	(0040,0007)	2	Not allowed
Patient's Name	(0010,0010)	2	Not allowed
Patient ID	(0010,0020)	2	Not allowed
Patient's Birth Date	(0010,0032)	2	Not allowed
Patient's Sex	(0010,0040)	2	Not allowed
<b>Performed Procedure Step Information</b>			
Performed Procedure Step ID	(0040,0253)	1	Not allowed
Performed Station AE Title	(0040,0241)	1	Not allowed
Performed Station Name	(0040,0242)	2	Not allowed
Performed Location	(0040,0243)	2	Not allowed
Performed Procedure Step Start Date	(0040,0244)	1	Not allowed
Performed Procedure Step Start Time	(0040,0245)	1	Not allowed
Performed Procedure Step Status	(0040,0252)	1	3
Performed Procedure Step Description	(0040,0254)	2	3
Performed Procedure Type Description	(0040,0255)	2	3

**Modality Interface DICOM Conformance Requirements**

Attribute Name	Tag	Req. Type N-CREATE	Req. Type N-SET
Procedure Code Sequence	(0008,1032)	2	3
>Code Value	(0008,0100)	1C <sup>1</sup>	1C
>Coding Scheme Designator	(0008,0102)	1C	1C
>Code Meaning	(0008,0104)	3	3
Performed Procedure Step End Date	(0040,0250)	2	3
Performed Procedure Step End Time	(0040,0251)	2	3
<b>Image Acquisition Results</b>			
Modality	(0008,0060)	1	Not allowed
Study ID	(0020,0010)	2	Not allowed
Performed Series Sequence	(0040,0340)	2	3
>Performing Physician's Name	(0008,1050)	2C	2C
>Protocol Name	(0018,1030)	1C	1C
>Operator's Name	(0008,1070)	2C	2C
>Series Instance UID	(0020,000E)	1C	1C
>Series Description	(0008,103E)	2C	2C
>Retrieve AE Title	(0008,0054)	2C	2C
>Referenced Image Sequence	(0008,1140)	2C	2C
>>Referenced SOP Class UID	(0008,1150)	1C	1C
>>Referenced SOP Instance UID	(0008,1155)	1C	1C
All other attributes from Radiation Dose Module and Billing and Material Code Module		3	3

**6.7.3. C-STORE Attribute Requirements:**

The attributes that shall be sent as part of the composite objects shall adhere to the DICOM specification with regard to their Type and syntax. Although certain attributes might not have to be provided according to their Type definition in the DICOM standard, the VA requires those attributes specified in Table 5 as "Required" to be always sent with a length greater than 0 bytes.

The Modality shall be equipped with overrides to allow the technologist to manually enter patient and study data into the system in the event that such data is not available automatically from the Modality Worklist SCP. In no circumstances shall the modality have "built-in" default values for this data. The VA is aware that in the case that the Modality Worklist is unavailable, the information might not necessarily be unique or correct. The technologist will do a "best effort" to enter this data correctly.

"No MWL" in the table signifies that the attribute is required even when no Modality Worklist service is available (it could be temporary unavailable)

"With MWL" in the table means that the attribute values from the Modality Worklist (and no other values) must be used

"MWL + MPPS" means the relevant attributes from the Modality Worklist are required to be used, when Modality Performed Procedure Step is supported

<sup>1</sup> Types 1C and 2C are required if the sequence item is present.

**Table 6  
IMAGE STORAGE ATTRIBUTES**

Attribute Tag	Description	No MWL	With MWL	MWL+MPPS
(0010,0010)	Patient Name	Required	Required	Required
(0010,0030)	Patient's Birth Date		Required	Required
(0010,0020)	Patient ID	Required	Required	Required
(0010,0040)	Patient's Sex	Required	Required	Required
(0010,2160)	Ethnic Group			
(0010,1000)	Other Patient ID's			
(0010,21B0)	Additional Patient History			
(0010,4000)	Patient Comments			
(0008,0090)	Referring Physician's Name	Required	Required	Required
(0008,1048)	Physician(s) of Record			
(0020,0010)	Study ID			
(0020,000D)	Study Instance UID		Required	Required
(0008,0020)	Study Date			
(0008,0050)	Accession Number	Required	Required	Required
(0008,1030)	Study Description			
(0008,1060)	Modality	Required	Required	Required
(0008,0070)	Manufacturer	Required	Required	Required
(0008,0080)	Institution Name	Required	Required	Required
(0008,1010)	Station Name	Required	Required	Required
(0008,1090)	Manufacturer Model Name	Required	Required	Required
(0008,1070)	Operators' Name			
(0008,1111)	Referenced Study Component Sequence			Required
(0018,1020)	Software Version	Required	Required	Required
(0018,1030)	Protocol Name			Required
(0040,0253)	Performed Procedure Step ID			Required
(0040,0244)	Performed Procedure Step Start date			Required
(0040,0245)	Performed Procedure Step Start time			Required
(0040,0254)	Performed Procedure Step Description			Required
(0040,0275)	Requested Attributes Sequence			Required
(0040,1001)	Requested Procedure ID			Required
(0040,0009)	Scheduled Procedure Step ID			Required
(0040,0007)	Scheduled Procedure Step Description			Required

The modality shall support at least the number of characters specified for the following Attributes:

Patient Name:	32
Patient ID:	16
Accession number:	16

**6.7.3.1. Pixel representation issues.**

<b>Attribute Tag</b>	<b>Description</b>	<b>Required/allowed values</b>
(0028,0004)	Photometric Interpretation	MONOCHROME1, MONOCHROME2 or RGB (see Note 1)

Note 1: DICOM images contain the attribute Photometric Interpretation (0028,0004), which for monochromatic images specifies whether the minimum pixel value is intended to be displayed or printed as black or white.

The concept of how a pixel value is intended to be displayed is different from the concept of how a pixel value is related to incident X-ray intensity (or inversely, how a pixel value is related to X-ray attenuation). This is not specified at all in any existing DICOM objects. Thus, regardless of whether the minimum pixel value is intended to be displayed as black (MONOCHROME2) or white (MONOCHROME1), whether it corresponds to air or bone/lead/contrast is unspecified in DICOM.

The most common expectation of a radiologist is that air be displayed as black, and bone/lead/contrast be displayed as white. An exception is for subtracted images, in which the radiologist's preference varies, and it is sometimes desired to show the contrast as black on a white background.

There is also an interaction with the area outside the display shutter, which should usually be shown as black. Display workstations should not invert the area outside the shuttered area when the image is inverted.

Accordingly, the VA requires of all X-ray modalities that, if images are sent with a Photometric Interpretation of MONOCHROME2 either:

- air will always be sent as the minimum acquired pixel value<sup>1</sup>,
- the system may be configured such that air will always be sent as the minimum acquired pixel value, or
- the operator can follow a procedure such that air will be sent as the minimum acquired pixel value and the area outside the display shutter will be black.

If images are sent with a Photometric Interpretation of MONOCHROME1 either:

- air will always be sent as the maximum acquired pixel value,
- the system may be configured such that air will always be sent as the maximum acquired pixel value, or

---

<sup>1</sup> In this context acquired pixel value is the resulting value of the digitized X-ray energy at the detector. The minimum or maximum acquired pixel value is not necessarily the minimum or maximum pixel value in the image. The pixel representation usually allows for pixel values outside of the range of the acquired pixel values. (For example: if an image is using 12 bit signed data representation and the ADCs convert to 10 bits; air may be represented as -512, but the minimum pixel value may be as low -2048.)

- the operator can follow a procedure such that air will be sent as the maximum acquired pixel value and the area outside the display shutter will be black.

It is expected that future DICOM objects will follow the model proposed in Supplement 32 (Digital Radiography) which specifies an additional attribute, Pixel Intensity Relationship Sign, which defines the relationship of pixel value to X-Ray intensity, and allows workstations, displays and printers to exercise the radiologist's preference as to whether or not air is displayed as black or white. It is recognized that the semantics of existing DICOM objects cannot be altered by a Change Proposal to address this issue, since that would break existing implementations that have been made in good faith.

#### **6.7.4.Storage Commitment N-Event Report and N-Action Attribute Requirements:**

Under most circumstances, it is preferable to commit all images of a study at one time. Usually the practice of individually committing SOP instances is discouraged. However, there are some situations (e.g., ship-to-shore teleradiology applications) where it may be desirable to commit image instances one at a time as they are sent. The modality must be configurable to operate in both modes.

The VA system specifies the Storage Commitment Push model. The VistA system always returns the N-EVENT-REPORTs on a separate association. This association is opened with reverse role negotiation, that is, the Calling AE is the SCP and the Called AE is the SCU (PS 3.4-1996 Annex J.2.1).

In the VistA system, Storage Commitment indicates the safe storage and insertion of the instances into the image database after linking the image instances with the proper patient and study in the VistA database. If image objects that have been received by VistA can not be linked properly to the corresponding patient and study, safe storage can not be achieved and the storage commitment will fail.

After an N-ACTION request containing the Study Component Sequence has been received, the Storage Commitment N-EVENT-REPORT message is returned upon one of several triggering events:

- 1) An N-EVENT-REPORT message with status of success will be returned if all the image objects have already been received, linked into the database, and safely stored.
- 2) If the image objects have not been completely received, or they have not been linked to the patient and study at the time of the N-ACTION request message is received, and an N-EVENT-REPORT message with status of success will be returned later upon successful completion of the these steps.
- 3) If a sufficiently long period of time has elapsed and the image objects have not been safely stored and inserted into the image database, the N-EVENT-REPORT message with the status of failure will be returned. The error conditions for Storage Commitment are returned in the Failed SOP sequence.

The requesting systems shall generate a new transaction UID for each N-ACTION request, regardless of the receipt of the corresponding N-EVENT-REPORT.

The modality shall retry a failed commitment a configurable number of times.

**Table 7  
STORAGE COMMITMENT REQUEST - ACTION INFORMATION**

Action Type Name	Action Type ID	Attribute	Tag	Requirement Type SCU/SCP
Request Storage Commitment	1	Transaction UID	(0008,1195)	1/1
		Referenced SOP Sequence	(0008,1199)	1/1
		>Referenced SOP Class UID	(0008,1150)	1/1
		>Referenced SOP Instance UID	(0008,1155)	1/1
		Referenced Study Component Sequence	(0008,1111)	1C/1
		>Referenced SOP Class UID	(0008,1150)	1/1
		>Referenced SOP Instance UID	(0008,1155)	1/1

**Table 8  
STORAGE COMMITMENT RESULT - EVENT INFORMATION**

Event Type Name	Event Type ID	Attribute	Tag	Requirement Type SCU/SCP
Storage Commitment Request Successful	1	Transaction UID	(0008,1195)	-/1
		Referenced SOP Sequence	(0008,1199)	-/1
		>Referenced SOP Class UID	(0008,1150)	-/1
		>Referenced SOP Instance UID	(0008,1155)	-/1
Storage Commitment Request Complete Failures Exist	2	Transaction UID	(0008,1195)	-/1
		Referenced SOP Sequence	(0008,1199)	-/1C This Attribute shall be provided if Storage Commitment for one or more SOP Instances has been successful
		>Referenced SOP Class UID	(0008,1150)	-/1
		>Referenced SOP Instance UID	(0008,1155)	-/1
		Failed SOP Sequence	(0008,1198)	-/1
		>Referenced SOP Class UID	(0008,1150)	-/1
		>Referenced SOP Instance UID	(0008,1155)	-/1
		>Failure Reason	(0008,1197)	-/1



**6.7.5. Attribute Mapping from Modality Worklist Attributes to the Image Header**

Table 9 summarizes the mapping from the attributes from the Basic Modality Worklist SCP to the Modality for inclusion in the Image header as well as in the Modality Performed Procedure Step (MPPS). Note that the requirements conform the DICOM standard, i.e. a single Requested Procedure may involve one or more pieces of equipment. The Scheduled Procedure Step involves only one piece of Imaging equipment.

**Table 9<sup>1</sup>**  
Attribute Mapping from Modality Worklist to Image Header and Modality Performed Procedure Step Attributes

VA Field Name	Modality Worklist Attribute		Image Header Attribute		MPPS Attributes (N>Create,N*Set)	
	DICOM Name	Tag	DICOM Name	Tag	DICOM Name	Tag
Patient Name	Patient Name	(0010,0010)	Patient Name	(0010,0010)	Patient Name	(0010,0010)
Patient DOB	Patient's Birth Date	(0010,0030)	Patient's Birth Date	(0010,0030)	Patient's Birth Date	(0010,0030)
Patient ID	Patient ID	(0010,0020)	Patient ID	(0010,0020)	Patient ID	(0010,0020)
Patient Sex	Patient's Sex	(0010,0040)	Patient Sex	(0010,0040)	Patient Sex	(0010,0040)
Patient Race	Ethnic Group	(0010,2160)	Ethnic Group	(0010,2160)		
Other Patient or Study ID's	Other Patient ID's	(0010,1000)	Other Patient ID's	(0010,1000)		
Reason for the Study	Additional Patient History	(0010,21B0)	Additional Patient History	(0010,21B0)		
					Scheduled Attribute Sequence	(0040,0270)
Study Instance UID	Study Instance UID	(0020,000D)	Study Instance UID	(0020,000D)	>Study Instance UID	(0020,000D)
Accession #	Accession Number	(0008,0050)	Accession Number	(0008,0050)	>Accession Number	(0008,0050)
				Requested attribute sequence		(0040,0275)
Case #	Requested Procedure ID	(0040,1001)	>Requested Procedure ID	(0040,1001)	>Requested Procedure ID	(0040,1001)
	Scheduled Procedure Step ID	(0040,0009)	>Scheduled Procedure Step ID	(0040,0009)	>Scheduled Procedure Step ID	(0040,0009)
	Scheduled Procedure	(0040,0007)	>Scheduled	(0040,0007)	>Scheduled	(0040,0007)

<sup>1</sup> Note that the table is identical to the IHE Technical Framework Table C-1 with the additions of the VistA field name and DICOM Tag columns.

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VA Field Name	Modality Worklist Attribute		Image Header Attribute		MPPS Attributes (N-Create,N-Set)	
	DICOM Name	Tag	DICOM Name	Tag	DICOM Name	Tag
	Step description		Procedure Step description		Procedure Step description	
	Scheduled Action Item Code Sequence	(0040,0008)	>Scheduled Action Item Code Sequence	(0040,0008)	>Performed Action Item Code Sequence	(0040,0260)
Patient Comments	Patient Comments	(0010,4000)	Patient Comments	(0010,4000)		
Primary Care Provider	Referring Physician's Name	(0008,0090)	Referring Physician's Name	(0008,0090)		
Attending Physician	Names of Intended Recipients of Results	(0040,1010)	Physician(s) of Record	(0008,1048)		
	Modality	(0008,0060)	Modality	(0008,0060)	Modality	(0008,0060)
Technologist performing study	Scheduled Performing Physician's Name	(0040,0006)	Operators' Name	(0008,1070)		
Room for study	Scheduled Procedure Step Location	(0040,0011)	Performed Procedure Step ID	(0040,0253)	Performed Procedure Step ID	(0040,0253)
			Performed Procedure Step Start date	(0040,0244)	Performed Procedure Step Start date	(0040,0244)
			Performed Procedure Step Start Time	(0040,0245)	Performed Procedure Step Start Time	(0040,0245)
			Performed Procedure Step Description	(0040,0254)	Performed Procedure Step Description	(0040,0254)
			Referenced Study Comp. Sequence	(0008,1111)		
			>Referenced SOP Class UID	(0008,1150)	Affected SOP Class UID	(0000,0002)

VA Field Name	Modality Worklist Attribute		Image Header Attribute		MPPS Attributes (N-Create,N-Set)	
	DICOM Name	Tag	DICOM Name	Tag	DICOM Name	Tag
			>Referenced SOP Instance UI	(0008,1155)	Affected SOP Instance UID	(0000,1000)
			Protocol Name	(0018,1030)		

## **7.COMMUNICATION PROFILES**

### **7.1. TCP/IP stack**

The TCP/IP stack shall be the only supported protocol.

### **7.2. Datalink and Physical media:**

Modalities shall support 10 BaseT, and/or 100 BaseT

### **7.3. Configurable parameters**

All parameters that are required to be configurable including their range shall be specified by the modality. This includes, but is not limited to:

- Number of simultaneous associations
- Max PDU sizes
- Time out values
- Local IP address and netmask
- Gateway address
- Port Numbers
- Station Name
- Local AE Title(s)
- Remote AE Title(s)

## **8. SUPPORT FOR FUTURE ENHANCEMENTS**

Several extensions and modifications to the DICOM standard are being considered. A vendor is obviously free to implement any of the new services as they are being specified. However, some of them are critical to resolve difficulties that the VA is experiencing, others are necessary extensions to the current operation.

In general, the vendor shall implement extensions to the DICOM standard within 12 months after the applicable supplement has been balloted and approved by the DICOM committee members.

**9.ANNEX**

**9.1. Usage Profiles:**

Depending on specific Site and Modality requirements, as specified in the respective profiles, the modality shall support the following Uses:

**Table 10: Optional SOP classes and usage:**

Profile:	Modality Storage	Basic Print Meta SOP Class	Patient Root Info Model FIND	Patient Root Info Model MOVE	Study Root Info Model FIND	Study Root Info Model MOVE	Mod Worklist Info Model FIND	Storage Commitment	Modality Performed Procedure Step	Verification
1.Basic Core Profile	SCU						SCU	SCU	SCU	SCU/SCP
2.Basic Print	SCU	SCU					SCU	SCU	SCU	SCU/SCP
3.Storage User/Provider	SCU/SCP (Same SOP Class)						SCU	SCU/SCP	SCU	SCU/SCP
4.Query User	SCU/SCP		SCU	SCU	SCU	SCU	SCU	SCU/SCP	SCU	SCU/SCP
5.Query User/Provider	SCU/SCP		SCU/SCP	SCU/SCP	SCU/SCP	SCU/SCP	SCU	SCU/SCP	SCU	SCU/SCP

**9.2. Additional SOP Classes:**

The following Query/Retrieve SOP classes shall be supported when required according to the Profile definition:

**Table 11: Specification of Optional SOP Classes:**

SOP Class Name	SOP Class UID	Usage
Patient Root Query/Retrieve Information mode+FIND	1.2.840.10008.5.1.4.1.2.1.1	See Table 10
Patient Root Query/Retrieve Information mode+MOVE	1.2.840.10008.5.1.4.1.2.1.2	See Table 10
Study Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.2.1	See Table 10
Study Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	See Table 10

Basic Greyscale Print Mgt Meta SOP Class	1.2.840.10008.5.1.1.9	See Table 10
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## **10.APPENDIX – DIFFERENCES BETWEEN THE VA/DOD AND IHE REQUIREMENTS**

There are several reasons for differences between the VA/DOD Requirements Document and the IHE Technical Framework Version 3.0. IHE is interested in demonstrating interoperability, while the VA and DOD are trying to solve practical problems with operational systems. The IHE document makes several implicit assumptions that the VA chose to explicitly state as a requirement in its document.

The Notable differences between this VA/DOD requirement document and the IHE Technical Framework are as follows:

- 1) The VA absolutely requires valid Patient Name, Patient ID, and Accession Number data in each image header. The VA states a minimum length requirement for these fields. The VA requires image acquisition modalities to provide a mechanism to allow the technologist to enter this data manually, in the event that the Modality Worklist SCP is not accessible.

The IHE Technical Framework document allows these fields in the image header to have zero length, when the Modality Worklist SCP is not available, and furthermore, requires receiving systems to be able to handle zero-length values for such attributes.

These two statements are not inconsistent. The IHE is trying to demonstrate uninterrupted functionality during a degraded mode of operation, while the VA is requiring manual intervention to fix the same problem.

- 2) The DICOM elements Reason for the Study (0032,1030), Reason for the Requested Procedure (0040,1002), and Reason for the Imaging Service Request (0040,2001) are all limited to 64 characters in length by the DICOM Long String Value Representation.

In the VA and DOD HIS/RIS the reason for the study is often a short patient history summarizing the condition of the patient and giving background information for the reason for the study, and often exceeds the 64-character length restriction. In order to faithfully communicate this essential field, the VA has chosen to map it to the Additional Patient History (0010,21B0) attribute.

- 3) The VA has a 1:1 mapping from the Accession Number to the Requested Procedure. IHE allows for a more comprehensive 1:N mapping.
- 4) The VA/DOD requirement does not allow for wild card matching in a Modality Worklist query in either the Accession Number or Requested Procedure ID elements.
- 5) The VA requires that all image acquisition modalities support the Verification SOP Class, both as a SCU and a SCP. This is absent from the IHE document, but is a requirement due to the Storage Commit role reversal.
- 6) The VA explicitly states its Association Acceptance policies, and requirements for the full range of port numbers.
- 7) The VA states that the Image SOP Instance UID should not change for an image instantiation.
- 8) The VA elaborates on the difference between deferred and immediate Storage Commitment, and the need for supporting both.

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- 9) The Examination Verification process is described in the VA/DOD document.
- 10) Modality Worklist Query scenarios for old studies and non-radiology studies are described in the VA/DOD document.
- 11) The VA emphasizes the requirement for double verification for users of Modality Worklist, since in the past it has been so easy to pick the wrong patient/study.
- 12) The VA requires images in Explicit VR Little Endian transfer syntax.
- 13) The VA states a pixel representation requirement clarifying the usage of MONOCHROME1 and MONOCHROME2.