DICOM

Conformance Statement

HD 11
Software Version 1.0

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0. Introduction

This chapter provides general information about the purpose, scope and contents of this Conformance Statement.

0.1 Purpose of this Document

Context: Expansion of Headings and sub-headings

- ➢ Introduction
    - ➢ Purpose of this Document

The Digital Imaging and Communications in Medicine (DICOM) standard was originally developed by a joint committee of the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) to

"Facilitate the open exchange of information between digital imaging computers".

It specifies how medical images and related clinical information are passed between medical devices.

The DICOM Conformance Statement (DCS) is a required document for any device that claims conformance to DICOM. Since the DICOM standard specifies the structure and content of this document (PS3.2 - 2001) a DCS describes the DICOM capabilities and key features of a particular product in a standardized, defined manner.

This DCS defines the DICOM capabilities and key features of Philips Medical Systems' HD11 ultrasound imaging system.

For a hospital's Information Technology (IT) department, matching DICOM Conformance Statements between vendor product offerings is a key element to determine interconnectivity between vendors' devices.

This Conformance Statement should be read in conjunction with the DICOM standard and its addenda [DICOM].

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0.2 Intended Audience

Context: Expansion of Headings and sub-headings

➢ Introduction

    ➢ Intended Audience

This Conformance Statement is intended for:

- Potential customers
- System integrators of medical equipment
- Marketing staff interested in system functionality
- Software designers implementing DICOM interfaces

It is assumed that the reader is familiar with the DICOM standard.

0.3 Overview of DICOM product offering

Context: Expansion of Headings and sub-headings

- ➢ Introduction
  - ➢ Overview of DICOM product offering

HD11 is an ultrasound system. The services supported by HD11's DICOM subsystem are derived from the following customer needs:

Name	Customer Need	Options package
Optioning	Ability to purchase some features and not others.	N/A
Archival	Archival of digital images to: 1. Removable media or 2. Across the network	1. DICOM Media 2. DICOM Networking
Printing of medical images	Printing to a DICOM compatible printer.	DICOM Networking
Verification	Ability to verify the existence of and communicate with a DICOM server on the network.	DICOM Networking
Modality WorkList (MWL)	Ability to obtain lists of patients and procedures from the hospital's information system.	DICOM Networking
Modality Performed Procedure Step (MPPS)	Ability to update the information in the hospital's information system with regard to the status of a scheduled procedure.	DICOM Networking

The base HD11 system will be sold with no DICOM services enabled. Customers requiring functionality beyond that provided by the base system purchase DICOM services as options on top of the base system.

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Philips Medical Systems offers customers two DICOM options:

1. DICOM Media   Capability to read/write studies from/to a CD-RW or MOD. This is enabled/disabled via hardware: based on the presence or absence of the MOD drive.

2. DICOM Networking   Capability to store studies across a network, transfer ownership of studies to the PACS and print a hardcopy to a DICOM printer. Capability to request lists of scheduled work from the hospital's information system and the ability to update study status information in the hospital's information system. Enabled via access codes.

Note: DICOM Networking encompasses what in HD11 had been two separate options: DICOM Basic and DICOM Advanced.

While the DICOM Conformance Statement is not intended to be a complete HD11 product specification, some areas of this document will refer to system operation where it is necessary to add a context for the discussion or to help explain a capability.

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0.4 Sources for this Document

Context: Expansion of Headings and sub-headings

➢   Introduction

   ➢ Sources for this Document

The source for this document is:

- American College of Radiology-National Electrical Manufacturers Association (ACR-NEMA) Digital Imaging and Communications in Medicine (DICOM) V3.0. 2001

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0.5 Important Note to the Reader

Context: Expansion of Headings and sub-headings

- ➢ Introduction
  - ➢ Important Note to the Reader

This Conformance Statement by itself does not guarantee successful interoperability of Philips equipment with non-Philips equipment. The user (or user's agent) should be aware of the following issues:

Interoperability

Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into an IT environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of Philips equipment with non-Philips equipment.   It is the user's responsibility to analyze thoroughly the application requirements and to specify a solution that integrates Philips equipment with non-Philips equipment.

Validation

Philips equipment has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance Statement. Where Philips equipment is linked to non-Philips equipment, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user's agent) to specify the appropriate test suite and to carry out the additional validation tests.

New versions of the DICOM Standard

The DICOM Standard will evolve in future to meet the user's growing requirements and to incorporate new features and technologies. Philips is actively involved in this evolution and plans to adapt its equipment to future versions of the DICOM Standard. In order to do so, Philips reserves the right to make changes to its products or to discontinue its delivery.   The user should ensure that any non-Philips provider linking to Philips equipment also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into Philips equipment may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

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0.6 Acronyms, Abbreviations and Glossary of Terms

Context: Expansion of Headings and sub-headings

> ➢ Introduction
>
>> ➢ Acronyms, Abbreviations and Glossary of Terms

DICOM definitions, terms and abbreviations are used throughout this Conformance Statement. For a description of these, see NEMA PS 3.3 and PS 3.4.

ACC ------------------------American College of Cardiology

ACR-------------------------American College of Radiology
  Initiated the DICOM standardization effort in the early
  1980's.

AE --------------------------Application Entity
  A software process that implements DICOM. HD11 uses a
  single AE.

AE Title----------------------AE's require a unique 'AE Title', typically set up during
  installation through HD11's setup key on the control panel.
  Application Entities (AE's) identify themselves to each other
  via the AE Title at application level.

ANSI ------------------------American National Standard Institute

Association -----------------A connection between AE's for DICOM exchange.

ASCII------------------------American Standard Code for Information Exchange
  Known for standardizing codes for text.

Attribute --------------------Attributes are the components of an object (IOD),
  describing its properties. Examples of attributes are Patient
  Name, Patient ID etc. Each attribute has a unique DICOM
  tag.

Big Endian ------------------An encoding method for storing the most significant Byte in
  the high order bits of a 16 bit word. Motorola based
  CPU's expect information to be stored this way.
  Exchanged as part of the transfer syntax. Conversion to
  little endian would require swapping each byte within the
  words.

CD-RW --------------------Compact Disk, multi-write
  An option for the physical specification for the DICOM
  media exchange standard and used by HD11 as a removable
  media device.

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DICOM----------------------Digital Imaging and Communications In Medicine
Version 3.0 is the current defined version and is that used by this in this document.

DICOM Media -------------A DICOM option that can be purchased by the customer, it allows the user to write DICOM studies to removable media.

DICOM Networking------A DICOM option that can be purchased by the customer, it allows the user to perform network export of DICOM studies and DICOM print as well as to select a procedure from a Modality Worklist and to send study status information to the department scheduler. It includes DICOM Media.

DICOMDIR-----------------The standard directory structure specified for DICOM media exchange.

DIMSE -----------------------DICOM Message Service Element.
The DICOM set of commands (e.g. C_ECHO, C_STORE, etc.)

HD11 ------------------------Philips Medical Systems' HD11 ultrasound system.

Explicit VR ------------------Explicit Value Representation
A transfer syntax which is negotiated by which the receiver is explicitly told the VR syntax and context. This is in contrast to Implicit VR.

FSC---------------------------File-set creator
The function of a device that creates DICOM exchange media, typically an acquisition device such as an ultrasound. HD11 is a FSC.

FSR --------------------------File-set reader
The function of a device that reads DICOM exchange media - typically a viewing station.   HD11 is also a FSR and can view studies created by other HD11 systems.

FSU---------------------------File-set updater
The function of a device that can read DICOM exchange media and update the DICOMDIR.

Implementation Class UID   A unique number, which is exchanged during the set up of the association, by which HD11 identifies itself. This UID is guaranteed not to change for a specific release of HD11.

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Implicit VR ------------------Implicit Value Representation
A transfer syntax which is negotiated by which the receiver
is assumed to know the VR syntax and context.

HIS --------------------------Hospital Information System

IOD ------------------------Information Object Definition
Specification of a DICOM object such as a US Image
Object.

ISO -------------------------International Standards Organization

JPEG ------------------------An image compression technique created by the Joint
Photographic Experts Group

Little Endian ----------------An encoding method by which the least significant byte is
stored in the high order bits in a 16 bit word. This is how
Intel based CPU's store data.

LUT -------------------------Look Up Table
Specifying mapping from specific values such as pixel values
into luminance.

MOD------------------------Magneto Optical Disk
Used by HD11 as one of the physical exchange media
options for the DICOM exchange standard.

Modality --------------------An acquisition system such as CT, MR, US. HD11 is an
ultrasound (US) modality.

Module ---------------------A group of attributes, specified as a unit for convenience
reasons.
Examples are Patient module, Study module etc.

MPPS-----------------------Modality Performed Procedure Step
Used by HD11 for informing a department scheduler of the
status of a study.

MWL -----------------------Modality WorkList
Used to provide on the HD11 system a Worklist of
scheduled procedures.

NEMA ----------------------National Electrical Manufacturers Association
US trade organization, members of which defined the first
version of the DICOM standard together with the ACR.

PACS----------------------Picture Archiving and Communications System
An image archive.

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PaletteColor ---------------- A color format for images in which the pixel values are indices into a color table. See RGB and YBR for other color formats.

PDU ------------------------- Protocol Data Unit
Packet that is created at the DICOM lower-level protocol.

Pixel ------------------------ Smallest, single element or dot of an image.

RGB ------------------------- A color format for images in which the pixel values contain the red, green and blue color intensities. See PaletteColor and YBR for other color formats.

RIS -------------------------- Radiology Information System
Which typically schedules and maintains patient demographic information.

RLE ------------------------- Run Length Encoding
A lossless image compression scheme.

SCP------------------------- Service Class Provider
DICOM AE that functions as a server or 'provides' a service such as Storage, Print etc.

SCU ------------------------- Service Class User
DICOM AE that functions as a client, or uses a service, i.e. for printing, storage etc.

Service Class -------------- A service class is a group of one or more SOP classes e.g. the Storage Service class contains all the storage SOP classes (CT_STORE, US_STORE etc).

SOP ------------------------- Service Object Pair
Combination of a service such as US_STORE and an object such as image.

TCP/IP --------------------- Transmission Control Protocol/Internet Protocol
The communication standard supported by DICOM.

Transfer Syntax ------------ Encoding specification of DICOM messages, negotiated while setting up an association. Examples of different transfer syntaxes are Little Endian or Big Endian, Implicit or Explicit VR, or a compression scheme (such as RLE or JPEG).

Type------------------------ Specification of rule for whether an attribute has to be present in an object. Type 1 attributes are required; Type 2 are required but can be left blank when unknown; Type 3 are optional.

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U/U--------------------------Usage specification for a specific service, meaning (user-) optional for SCU and mandatory for SCP.

U/M ------------------------Usage specification for a specific service, meaning (user-) optional for both SCU and SCP.

UID-------------------------Unique Identifier
A world-wide unique numbering scheme which is used by the NEMA to, for example, identify SOP classes, syntaxes etc and vendors for identifying SOP instances.

US --------------------------Ultrasound

VM--------------------------Value Multiplicity
Defining whether or not an attribute can have multiple elements, for example multiple phone numbers.

VR -------------------------Value Representation
The definition of rules and encoding of groups of similar attributes. For example the VR Person Name (PN) specifies exactly the sequence of last name, first name etc.

YBR ------------------------A color format for images in which the pixel values contain one luminance and two chrominance planes. See PaletteColor and RGB for other color formats.

1. **Implementation Model**

Context: Expansion of Headings and sub-headings

> ➢ Implementation Model

This section describes the functional relationship between the device and the DICOM services:

Customer Need	Provided in options package	Functionality	DICOM Service Classes Required
Optioning	Bundled	Ability to install/remove optional features	
Archive to Media	Bundled	Saving BMP's, AVI's, and HTML docs to media	
		Formatting removable media: MOD.	
	DICOM Media	Saving DICOM studies to removable media.	Media Storage Service Class – File Set Creator
			Media Storage Service Class – File Set Updater
Retrieval from Media	DICOM Media	Reading DICOM studies from removable media	Media Storage Service Class – File Set Reader
Archive to Network	DICOM Networking	Network export of DICOM studies.	Storage SCU
		Transfer ownership of acquired images to an image management system.	Storage Commitment SCU

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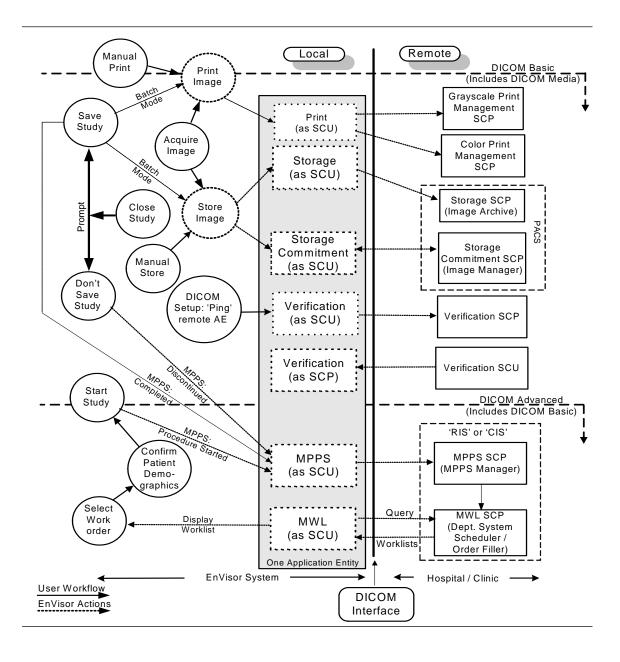| Customer Need	Provided in options package	Functionality	DICOM Service Classes Required
Print	Bundled	Print images to PC based printers, non-DICOM film printers.	
	DICOM Networking	Print studies to a DICOM printer – both color and B&W.	Print Management SCU
Modality Worklist (MWL)	DICOM Networking	Request modality worklists from the Modality Worklist Server.	MWL SCU
Modality Performed Procedure Step (MPPS)	DICOM Networking	Inform the hospital of the status of a performed procedure.	MPPS SCU
Setup	DICOM Networking	Verification that a network device is a DICOM server.	Verification SCU
		Response to requests from the network to verify that HD11 is a DICOM device.	Verification SCP
		Set the AE Title for HD11; Specify which network server is the storage SCP, storage commit SCP; List servers, add servers etc	

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1.1 Application Data Flow Diagrams

1.1.1 Network Relationships

The diagram in Figure 1.1-1 represents the relationship between HD11's Application Entity and it's use of DICOM to real-world activities. Figure 1.1-1 shows the relationships for DICOM activities on the network.

Figure 1.1-1 Network Relationships

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The left side of the diagram (labeled 'Local') represents the HD11 system being described in this DICOM Conformance Statement. The right side (labeled 'Remote') represents equipment that HD11 is meant to exchange information with (the Hospital/Clinic), and the vertical line in between is the DICOM Interface.

The long rectangular gray box represents the one and only Application Entity that is used in the implementation of all HD11's DICOM services. This single AE supports all the HD11 services: print, storage, storage commitment, verification, MWL and MPPS.

Since an AE must have a unique AE Title across a hospitals network (HIS), the user can configure the AE's title through setup. The dotted rectangular boxes within the Application Entity represent the various DICOM services used (SCU) and supported (SCP).

The circles, on the left side of the diagram, represent real-world activities that a user can perform with the HD11 system, such as saving a study and acquiring an image.

The diagram shows that HD11 supports storing images to a remote PACS, as well as transferring ownership of the images to an image manager so that the study can automatically be deleted from HD11's hard-drive.

Images can be:

1. Sent to the Storage SCP as soon as they are acquired (circle 'Acquire Image'), this is called send-as-you-go mode.

2. Batched up and sent all at once each time the study is saved (circle 'Save Study').

3. A study can be selected, by the user, from a list of studies on HD11's local hard-drive, and manually exported (circle 'Manual Store').

HD11 also supports printing studies to a grayscale or color DICOM printer. As with storing studies to a remote PACS, images can be printed as soon as they are acquired (but only when there are enough to fill a page); they can be batched for printing all at once when the study is saved, or the study can be selected manually for printing.

If color images are sent to a grayscale printer, they will be converted to grayscale. If both a color and grayscale printer is configured, color images will be routed to the color printer and grayscale images will be routed to the grayscale printer.

HD11 supports Modality Worklists (MWL) and Modality Performed Procedure Step (MPPS.) These two capabilities work together to allow HD11 to communicate with a Hospital Information System (HIS) to obtain and display lists of patients scheduled for imaging procedures and to update the HIS whenever the status of a scheduled procedure changes (for example, when a scheduled study is completed.)

The diagram shows that when a study is started (circle 'Start Study'), HD11 sends an MPPS Study Started message to the department system scheduler (MPPS SCP) and when

the user finishes the study a MPPS Study Completed message is sent to the department system scheduler (circle 'Save Study'). It also shows that the user can discontinue a study (circle 'Don't Save Study'), in which case a MPPS Study Discontinued message is sent to the department system scheduler.

The user can disconnect the network cable and use HD11 in walk-about or portable mode. When reconnected to the network, HD11 will process any queued jobs including storage, printing and Storage Commitment. Queued MPPS status updates will also be performed. Also, on reconnect, HD11 resumes the periodic retrieval of the modality worklist.

1.1.2 Removable Media Relationships

Context: Expansion of Headings and sub-headings

➢ Implementation Model

➢ Application Data Flow Diagrams

➢ Removable Media Relationships

The diagram in Figure 1.1-2 represents the relationship between HD11's Application Entity and it's use of DICOM to real-world activities.   Figure 1.1-2 shows the relationships for DICOM activities involving local storage to removable media.

Figure 1.1-2 Removable Media Relationships

As with the previous diagram, circles represent real-world activities performed on the HD11 system.

The diagram shows that HD11 supports the writing of DICOM studies to the ultrasound systems removable media (CD-RW or MOD).   This is useful for exporting the studies to the image archive when the hospitals network is down. It is also useful for long term archival to CD of studies for sites that have not purchased the networking capability provided in the 'Networking' package.

HD11 can also read back into the system studies that it (another HD11 system or an EnVisor system) have previously written to removable media. However, since HD11 is not an image archive but an image modality, it will not allow a user to read studies into the system that were not generated by an HD11 (or EnVisor) system.

The rationale behind allowing HD11 to read studies generated by an EnVisor system is that HD11 is a potential 'next' purchase for EnVisor customers. It is an upgrade and therefore the customer would want to be able to read studies that they generated with

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the EnVisor. However, the opposite is not true – an EnVisor system will not be able to read studies generated by an HD11 system.

1.2 Functional Definition of HD11 AE

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model
  - ➢ Functional Definition of HD11 AE

HD11 is implemented as a single AE. The DICOM AE Title and Port number are configurable by the user through the 'Setup' screens. The default AE Title that HD11 will use is the host name of the computer. Since AE Titles must be unique across a hospital's network and computer names must also be unique, some institutions institute a policy where the AE Title is derived from the computer name. HD11 supports this by allowing the user to specify a fixed string for a prefix and suffix. The AE Title is then generated from the prefix, the computer's name and the suffix.

The default port number is 104 but as with the AE Title, the port number can be configured by the user.

There are ten real-world activities that the HD11 AE performs. These are:

1. Storage of DICOM studies to a PACS,
2. Issuing of Storage Commitment requests to an image manager,
3. Verification of the existence of DICOM servers on the hospital's network,
4. Printing DICOM studies to a B&W or color printer,
5. Responding to a verification request from a remote DICOM server,
6. Saving a DICOM study to removable media,
7. Reading a DICOM study from removable media,
8. Writing and Reading a study to/from removable media in Non-DICOM formats
9. Obtaining a list of scheduled work from the HIS via the MWL Server, and
10. Updating the HIS whenever a scheduled procedure changes using the MPPS Server.

These real-world activities are described, in general terms, in the following sub-sections.

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1.2.1 Storage of DICOM studies to a PACS

Context: Expansion of Headings and sub-headings

➢ Implementation Model

    ➢ Functional Definition of HD11 AE

        ➢ Storage of DICOM studies to a PACS

HD11 acts as a Service Class User (SCU) of the 'Ultrasound Image Store' SOP Class using DIMSE C-STORE commands to transmit images to the storage server. It provides a set of DICOM configuration settings used to set up the network interface and storage options. The configurable options include specification of the DICOM storage server (host-name, port number and AE Title). These options can be accessed through the DICOM Setup screen.

Just before the first image is sent from the system, the storage AE establishes an association with the storage SCP and maintains the open association as long as images for storage are in the queue to that SCP. If the queue empties, the storage AE will close the association. This process will repeat for subsequent images. Therefore, images sent quickly one after the other would share the same association. This reduces overhead and improves performance. Therefore

- In Batch Mode, where all the images are sent to the storage SCP when the user closes (and saves) the study, all the images will be sent on the same association.

- In send-as-you-go mode, where the images are sent one-at-a-time as the user acquires them, each image will be sent on a separate association.

If any images in a study are not successfully stored to the Storage SCP, then the study is marked with an icon indicating failure in the 'Search for Study' screen. If the user subsequently manually exports the study, all the images will be resent to the Storage SCP (both those that were previously successfully stored and those that failed). The Storage SCP will detect, without detrimental consequences (per the DICOM standard), that some images are duplicates.

1.2.2 Issuing of Storage Commitment requests to an image manager

HD11 serves as a Storage SCU and sends images to a remote DICOM PACS.

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1.2.2.1 Batch Mode and Manual Export

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model
  - ➢ Functional Definition of HD11 AE
    - ➢ Issuing of Storage Commitment requests to an image manager
      - ➢ Batch Mode and Manual Export

If the user has configured, through DICOM setup, a Storage Commitment server, then after the last image of the study is stored to the storage SCP, HD11 will generate an N-Action to request Storage Commitment by the Storage Commitment SCP of all the images that were successfully stored.   Storage Commitment will not be requested for images that the Storage SCP rejected.

The N-Action command contains a list of image Instance UIDs. After the Storage Commitment SCP sends the N-ACTION-RSP, HD11 immediately closes the association without waiting for the N-EVENT-REPORT from the Storage Commitment SCP.

Some time later, the Storage Commitment SCP will open an association with HD11's AE using reverse-role negotiation, and will send an N-Event Report with a list of the image Instance UIDs that were successfully committed and if applicable, a list of those that were not.

HD11 will reject an association requested by a Storage Commitment SCP that does not employ role-reversal.

1.2.2.2 Send-As-You-Go Mode

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model
  - ➢ Functional Definition of HD11 AE
    - ➢ Issuing of Storage Commitment requests to an image manager
      - ➢ Send-As-You-Go Mode

If the user has configured, through DICOM setup, a Storage Commitment server, then after each image of the study is successfully stored to the storage SCP, HD11 will generate an N-Action to request Storage Commitment of the image by the Storage Commitment SCP.

Therefore, in send-as-you-go mode, where the images are sent one-at-a-time as the user acquires them, multiple N-Action requests are generated and sent to Storage Commitment SCP. One N-Action request corresponds to one image.

The N-Action command contains the transaction UID of the just acquired image. HD11 then, as with batch mode, closes the association and waits for a reply from the STORAGE COMMITMENT server.

1.2.3 Verification of the existence of DICOM server on the hospitals network

Context: Expansion of Headings and sub-headings

  ➢ Implementation Model

    ➢ Functional Definition of HD11 AE

      ➢ Verification of the existence of DICOM server on the hospitals network

When the user configures one of the SCP servers (for example the Storage SCP or B&W printer SCP), he/she can optionally 'ping' the SCP to verify it is a DICOM server, it is on-line and it is enabled to communicate with this HD11 system.

When the user requests a 'DICOM Ping', the verification SCU will initiate an association with the remote server and send a C-Echo request to the server.

1.2.4 Printing DICOM studies to a B&W or color printer

HD11 serves as a print SCU and sends images to a remote DICOM print device.

1.2.4.1 Monochromization and Intelli-print

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model
    - ➢ Functional Definition of HD11 AE
        - ➢ Printing DICOM studies to a B&W or color printer
            - ➢ Monochromization and intelli-print

The operator can configure up to two print SCPs: one B&W and one COLOR. If only a B&W print SCP is configured, then color images will be converted to grayscale. If both B&W and color print SCP's are defined then HD11 uses an "intelli-print" process to send color images to the color SCP and grayscale images to the B&W SCP.

If both a color and BW printer are configured, HD11 creates two separate requests for printing, one for the color images in the study and the other for the gray images. These two requests lead to two separate Print Jobs, and since, HD11 executes only one print job at a time, these jobs would be executed sequentially.

1.2.4.2 Batch Mode and Manual Print

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model
    - ➢ Functional Definition of HD11 AE
        - ➢ Printing DICOM studies to a B&W or color printer
            - ➢ Batch Mode and Manual Print

In Batch Mode, where all the images are printed when the user closes (and saves) the study, all the images will be sent on the same association.   Each page will contain the configured number of images. The last page may be a partial page if there are not enough images to fill the page; this ensures that a printed page cannot have images from multiple studies

1.2.4.3 Send-As-You-Go Mode

Context: Expansion of Headings and sub-headings

➢ Implementation Model

    ➢ Functional Definition of HD11 AE

        ➢ Printing DICOM studies to a B&W or color printer

            ➢ Send-As-You-Go Mode

In send-as-you-go mode, as images are acquired they are held until a full page of images is ready for printing. When a full page of images is ready for printing, HD11 will open an association with the printer, send the images and then close the association.

When the study is closed (or Saved), any partially filled page is printed. As with Batch Mode, this ensures that a printed page cannot have images from multiple studies

1.2.5 Responding to a verification request from a remote DICOM server

Context: Expansion of Headings and sub-headings

➢ Implementation Model

    ➢ Functional Definition of HD11 AE

        ➢ Responding to a verification request from a remote DICOM server

The ultrasound system employs a Verification SCP to reply to verification requests sent by remote devices. This will allow the remote device to ensure the availability of HD11 on the network, within the constraints of the network topology, and timeout values.

HD11 employs a 'high security' paradigm for responding to verification requests by remote devices. This means, HD11 will only respond to C-Echo requests from DICOM Servers that it knows about. Specifically, the following steps must have been performed:

1. In DICOM Setup, add the DICOM server to the list of DICOM servers.
2. Assign the server to the appropriate role.
3. Reboot the system.

Note: Philips considers step 3 (the reboot) a limitation that may be removed in some future release.

1.2.6 Saving a DICOM study to removable media

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model

  - ➢ Functional Definition of HD11 AE

    - ➢ Saving a DICOM study to removable media

HD11 is a DICOM file set creator (FSC) and updater (FSU). Studies can be saved (exported) to HD11's removable media (MOD or CD-RW), in DICOM format, for long-term storage. Also, if a customer chooses not to purchase DICOM Networking, then DICOM media can be used as a 'sneaker-net' to get DICOM studies off HD11 and onto the PACS.

1.2.7 Reading a DICOM study from removable media

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model

  - ➢ Functional Definition of HD11 AE

    - ➢ Reading a DICOM study from removable media

HD11 is a DICOM file set reader (FSR). Studies that HD11 has saved to removable media may also be loaded into another HD11 system or even into the same HD11 system (as long as the original study has already been deleted). Since HD11 is not an image review station, it will check the originator of the study and only import studies created by another HD11 system.

1.2.8 Writing and Reading a study to/from removable media in Non-DICOM formats

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model

  - ➢ Functional Definition of HD11 AE

    - ➢ Writing and Reading a study to/from removable media in Non-DICOM formats

Users that do not purchase DICOM Media can write the images in DICOM studies to removable media as bmp's and AVI's. They can also write a study to removable media in an HD11 proprietary format that includes patient demographic information and can be

read back into (the same) or another HD11 system. This format, however, is not DICOM and cannot be read by non-HD11 systems. EnVisor also allowed the user to write a study to removable media in an EnVisor proprietary format that includes patient demographic information. HD11 will be able to read studies generated in the EnVisor proprietary format.

1.2.9 Obtaining a list of scheduled work from the HIS via the MWL Server

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model
    - ➢ Functional Definition of HD11 AE
        - ➢ Obtaining a list of scheduled work from the HIS via the MWL Server

HD11 acts as a Service Class User (SCU) of the 'Modality Worklist (MWL)' SOP Class using DIMSE C-FIND commands to retrieve lists of scheduled protocols (imaging sessions) from the HIS.

A set of standard MWL queries is available (e.g. Show today's worklist entries, show today's worklist entries assigned to this system, show yesterday, today and tomorrow's worklist entries etc.). The user can also configure their own queries based on start date, AE Title of performing HD11 etc.

The current work lists can be retrieved manually (when the HD11 system is connected to the network) or automatically polled in the background.

1.2.10 Updating the status of a scheduled procedure using the MPPS Server

Context: Expansion of Headings and sub-headings

- ➢ Implementation Model
    - ➢ Functional Definition of HD11 AE
        - ➢ Updating the status of a scheduled procedure using the MPPS Server

HD11 also acts as a Service Class User (SCU) of the 'Modality Performed Procedure Step (MPPS)' SOP Class.

The start procedure message (N-CREATE) is sent when the user presses the OK button on the Patient ID Window to bring up live imaging. The MPPS Server is also notified, with a N-SET command, when the study is completed (when the study is saved to HD11's disk and closed), or when it is discontinued (when the study is closed without saving.)

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1.3 Sequencing of Real-World Activities

Context: Expansion of Headings and sub-headings

➢ Implementation Model

    ➢ Sequencing of Real-World Activities

For printing and storing using the Print Gray Image, Print Color Image, and Store Image commands, the user must have previously completed the Patient ID screen (which creates a study).   For accessing and updating procedures scheduled by the HIS, the HD11 user must first select a patient from the Patient Selection screen which displays a list of patients scheduled for procedures on HD11.

2. Application Entity Specifications

HD11 is implemented as a single AE.

2.1 HD11 AE Specification

2.1.1 Association Establishment Policies

2.1.1.1 General

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Establishment Policies
            - ➢ General

The following Application Context Name will be proposed and recognized by HD11:

- • DICOM 3.0 Application Context   **1.2.840.10008.3.1.1.1**

The PDU size is configurable with a minimum size of 100 and a maximum size of 16,000. The default PDU size is 16,000.

2.1.1.2 Number of Associations

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Establishment Policies
      - ➢ Number of Associations

HD11 **establishes** one association per destination at a time. The total number of associations possible at one time is six: 1 B&W printer, 1 Color printer, 1 Storage Server, 1 Storage Commitment server, 1 MWL server, and 1 MPPS server.

HD11 accepts simultaneous associations for Storage Commitment and Verification. If multiple servers issue a Storage Commitment or verification request at the same time, HD11 will accept all the associations. The maximum number of simultaneous associations **accepted** by HD11 is limited only by resource constraints.

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2.1.1.3 Asynchronous Nature

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Establishment Policies
      - ➢ Asynchronous Nature

HD11 allows a single outstanding operation on any association. Therefore, HD11 does not support asynchronous operations window negotiation, other than Storage Commitment reverse-role negotiation for N-Event Report's.

2.1.1.4 Implementation Identifying Information

Context: Expansion of Headings and sub-headings

➤ Application Entity Specifications

    ➤ HD11 AE Specification

        ➤ Association Establishment Policies

            ➤ Implementation Identifying Information

Element	Implementation Value
Implementation Class UID	1.2.840.113543.6.6.4.0
Implementation Version Name	HD11_1.0

Table 1: Implementation Identifying Information

Note: This Class UID and Version Name will be used for the release of HD11 described in this DICOM Conformance Statement. The Class UID and Version Name may be updated with subsequent HD11 releases to capture the version level of the new release, however the Implementation Version Name for the HD11 product will always start with the characters "HD11" and the Implementation Class UID will always be of the form 1.2.840.113543.6.6.4.n

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2.1.2 Association Initiation by Real-World Activity

2.1.2.1 Storage of DICOM studies to a PACS

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Storage of DICOM studies to a PACS

The HD11 provides standard conformance to the following DICOM V3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID	Role
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCU

Table 2: SOP Classes Supported by Network Storage AE

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2.1.2.1.1 Associated Real-World activity

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Storage of DICOM studies to a PACS
        - ➢ Associated Real-World activity

The real world activities that will trigger HD11 to initiate an association with the Storage Server is dependent on the mode of operation:

1. **In Manual mode**

   An association is initiated when the user selects a study from the list of studies on HD11's local hard-drive and requests that the selected study be exported to the PACS.

2. **In Send-As-You-Go mode**

   An association is initiated when the first image is acquired. HD11 will close the association after the image has been stored. A new association will be initiated when the next image is acquired.

3. **In Batch mode**

   An association is initiated whenever the user saves the study. The images that have been acquired since the previous 'save' are stored to the PACS. To enhance network performance images that have already been stored to the PACS are not resent.

Store Association Negotiation - Association Status (Send-As-You-Go mode)

User Action	DICOM Activity – Store Send As You Go Mode
Acquires Image from system	Association Negotiation, then C-Store for the acquired image, then Association Release Request is sent.

Store Association Negotiation - Association Status (Batch Mode & Manual Mode)

User	DICOM Activity – Store

Action	
Save Study	Association Negotiation then C-Store until all images sent, then Association Release Request is sent.

The user can also configure the photometric interpretation and transfer syntax of the image pixel data so that HD11's images can be viewed with a wide range of DICOM viewers.

For an export to the PACS the user can specify that the images be sent to the Storage SCP in one of seven formats:

- Palette Color, RLE Compressed

- Palette Color, Uncompressed (Implicit VR, Little Endian)

- Palette Color, Uncompressed (Explicit VR, Little Endian)

- RGB, RLE Compressed

- RGB, Uncompressed (Implicit VR, Little Endian)

- RGB, Uncompressed (Explicit VR, Little Endian)

- YBR FULL 422, JPEG compressed.

Notes:

Palette Color – Pixels are indices into a palette

RGB - pixels are intensities of Red, Green and Blue color components

YBR FULL 422 - pixels are described by one luminance and two chrominance planes, sampled with twice as a much luminance as chrominance

HD11 will try to negotiate the transfer using the appropriate transfer syntax as per the user selected image format. The Image transfer could fail if the storage SCP does not support the transfer syntax. In this case HD11 will report an error condition to the user in the 'Search for Studies' screen. Therefore, as a network administrator you should not configure HD11 to send the images in formats not supported by your image archive.

For manual export to removable media the user has the same seven transfer syntaxes that are supported in network export:

- Palette Color, RLE Compressed

- Palette Color, Uncompressed (Implicit VR, Little Endian)

- Palette Color, Uncompressed (Explicit VR, Little Endian)

- RGB, RLE Compressed
- RGB, Uncompressed (Implicit VR, Little Endian)
- RGB, Uncompressed (Explicit VR, Little Endian)
- YBR FULL 422, JPEG compressed.

Table 3 describes the behavior of the Network Storage AE in response to various error conditions and C-STORE-RSP status indicators. After all images in the study have been processed, the association is closed.

Establishing the association

Condition (After C-Store)	Status Codes (C-Store-RSP)	Response
Could not establish the association within 30-second time window (Connect Timeout) due to NO RESPONSE from the Storage Server	Not Applicable	The association attempt is aborted, and after 5-minutes a new association is attempted. HD11 will make three attempts to open an association with the configured Storage SCP before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the 'Retry Interval' input control on the 'DICOM Setup screen and the number of retries is mapped to 'Maximum Retries' on the DICOM Setup screen.
Refused	A7xx	If the Storage SCP server refuses the association, then the association attempt is aborted. HD11 will wait 5-minutes and then reattempt the association. HD11 will make three attempts to establish the association before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. As an example, the association would be refused if the storage server employs a high security mechanism whereby it only accepts association requests from DICOM Servers that it knows about and the HD11's AE Title was not in the PACS database. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the ''Retry Interval' input control on the DICOM Setup screen and the retry is mapped to 'Maximum Retries' on the DICOM Setup Screen.

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During image transfer

Condition (After C-Store)	Status Codes (C-Store-RSP)	Response
After association has been accepted, there is no response to a request within 5-minute time window (Read Timeout).	Not Applicable	If the association is lost during active image transfer to the Storage SCP server, HD11 will initiate a new association after 5 minutes, and attempt to store all the images. If during transfer, the association is again lost, HD11 will wait another 5 minutes and try again. HD11 will make three attempts to send all the images before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the ''Retry Interval' input control on the DICOM Setup screen and the retry is mapped to 'Maximum Retries' on the DICOM Setup Screen.
Error	A9xx, Cxxx, 0122, Other	HD11 will treat all errors as failure of Storage request (also called as Job). A failed job is automatically retried after 5 minutes. If the job fails even after three attempts, HD11 will abort this request and place the job in an Error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error. The 5-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 5-minute timeout is mapped to the ''Retry Interval' input control on the DICOM Setup screen and the retry is mapped to 'Maximum Retries' on the DICOM Setup Screen.
Warning	D000, B000, B006, B007 0111	If the Storage SCP issues a warning on a particular image (perhaps it had to use coercion, HD11 logs the warning to the DICOM log file as an informational event and continues on as if the image was successfully stored to the PACS (see row below).

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Condition (After C-Store)	Status Codes (C-Store-RSP)	Response
Success	0000	When an image is successful store to the Storage SCP (PACS), HD11 will keep a record of the successful storage. If all the images in the job are successfully stored, HD11 will notify the user (through an icon on the list of studies). And the job will be removed from the job manager.

Table 3: Responses to Image Storage Error Conditions

If more images of the same study are presented to the HD11 system, additional associations will be initiated to transfer the remaining images using the same Study and Series Instance UIDs.

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2.1.2.1.2 Proposed Presentation Context

Context: Expansion of Headings and sub-headings

 ➢ Application Entity Specifications

  ➢ HD11 AE Specification

   ➢ Association Initiation by Real-World Activity

    ➢ Storage of DICOM studies to a PACS

     ➢ Proposed Presentation Context

Each time the Network Storage service initiates an association in response to the store request, it requests services summarized in Table 4.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Ultrasound Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.6.1	JPEG baseline (Used if Image Format is YBR)	1.2.840.10008.1.2.50	SCU	None
		DICOM RLE Lossless (Used if Image format is 'Palette Color, RLE Compressed' or 'RGB, RLE Compressed'	1.2.840.10008.1.2.5		
		DICOM Implicit VR Little Endian (Used if Image format is 'Palette Color, Uncompressed ILE Compressed' or 'RGB, Uncompressed ILE')	1.2.840.10008.1.2		
		DICOM Explicit VR Little Endian (Used if Image format is 'Palette Color, Uncompressed ELE Compressed' or 'RGB, Uncompressed ELE')	1.2.840.10008.1.2.1		

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Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Ultrasound Multi-frame Image Storage SOP Class	1.2.840.10008. 5.1.4.1.1.3.1	JPEG baseline (Used if Image Format is YBR)	1.2.840.10008.1.2.50	SCU	None
		DICOM RLE Lossless (Used if Image format is 'Palette Color, RLE Compressed' or 'RGB, RLE Compressed'	1.2.840.10008.1.2.5		
		DICOM Implicit VR Little Endian (Used if Image format is 'Palette Color, Uncompressed ILE Compressed' or 'RGB, Uncompressed ILE')	1.2.840.10008.1.2		
		DICOM Explicit VR Little Endian (Used if Image format is 'Palette Color, Uncompressed ELE Compressed' or 'RGB, Uncompressed ELE')	1.2.840.10008.1.2.1		

Table 4: Transfer Syntaxes

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The values of certain image attributes used in the transfer of each image depend on the Image Format as configured by the user in DICOM Setup (or specified during a manual export) as well as the type of image acquired.

The seven tables below, one for each image format, describe the relationships among these parameters.

1. Palette Color, RLE Compressed

Image Type	Resultant Attribute Values						
Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
2D B&W Image[1]	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	8	564 (520 without borders)	800 (688 without borders)
2D color Image	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	16	564 (520 without borders)	800 (688 without borders)
2D B&W loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	8	564 (520 without borders)	800 (688 without borders)
2D color loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	16	564 (520 without borders)	800 (688 without borders)
Stress B&W 'quad' loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	8	320	245
Stress color 'quad' loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	16	320	245
Report	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	16	564	800
3D single frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
3D multi frame	Explicit VR Little Endian (1.2.840.10008.1.	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.	RGB	3	8	520	680

[1] 2D B&W Image include "Colorized" images, which map a sample to a color instead of a gray scale value.

Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
	2.1)	1.4.1.1.3.1)					
Panview	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680

2. Palette Color, Uncompressed (Implicit VR, Little Endian)

	Resultant Attribute Values						
Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
2D B&W Image[2]	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	8	564 (520 without borders)	800 (688 without borders)
2D color Image	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	16	564 (520 without borders)	800 (688 without borders)
2D B&W loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	8	564 (520 without borders)	800 (688 without borders)
2D color loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	16	564 (520 without borders)	800 (688 without borders)
Stress B&W 'quad' loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	8	320	245
Stress color 'quad' loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	16	320	245
Report	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	16	564	800
3D single frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
3D multi frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	520	680

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[2] 2D B&W Image include "Colorized" images, which map a sample to a color instead of a gray scale value. p

| Panview | Explicit VR Little Endian (1.2.840.10008.1.2.1) | Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1) | RGB | 3 | 8 | 520 | 680 |

3. Palette Color, Uncompressed (Explicit VR, Little Endian)

	Resultant Attribute Values						
Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
2D B&W Image[3]	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	8	564 (520 without borders)	800 (688 without borders)
2D color Image	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	16	564 (520 without borders)	800 (688 without borders)
2D B&W loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	8	564 (520 without borders)	800 (688 without borders)
2D color loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	16	564 (520 without borders)	800 (688 without borders)
Stress B&W 'quad' loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	8	320	245
Stress color 'quad' loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	PALETTE COLOR	1	16	320	245
Report	Explicit VR Little Endian (1.2.840.10008.1.2.1) (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	PALETTE COLOR	1	16	564	800
3D single frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
3D multi frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	520	680

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[3] 2D B&W Image include "Colorized" images, which map a sample to a color instead of a gray scale value.

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	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
Panview							

4. RGB, RLE Compressed

			Resultant Attribute Values				
Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
2D B&W Image[4]	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D color Image	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D B&W loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D color loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
Stress B&W 'quad' loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	320	245
Stress color 'quad' loop	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	320	245
Report	RLE Lossless (1.2.840.10008.1.2.5)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564	800
3D single frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
3D multi frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	520	680

[4] 2D B&W Image include "Colorized" images, which map a sample to a color instead of a gray scale value.

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	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
Panview							

5. RGB, Uncompressed (Implicit VR, Little Endian)

	Resultant Attribute Values						
Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
2D B&W Image[5]	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D color Image	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D B&W loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D color loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
Stress B&W 'quad' loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	320	245
Stress color 'quad' loop	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	320	245
Report	Implicit VR Little Endian (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564	800
3D single frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
3D multi frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	520	680

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[5] 2D B&W Image include "Colorized" images, which map a sample to a color instead of a gray scale value.

| Panview | Explicit VR Little Endian (1.2.840.10008.1.2.1) | Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1) | RGB | 3 | 8 | 520 | 680 |

6. RGB, Uncompressed (Explicit VR, Little Endian)

	Resultant Attribute Values						
Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
2D B&W Image[6]	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D color Image	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D B&W loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
2D color loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	564 (520 without borders)	800 (688 without borders)
Stress B&W 'quad' loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	320	245
Stress color 'quad' loop	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	320	245
Report	Explicit VR Little Endian (1.2.840.10008.1.2.1) (1.2.840.10008.1.2)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	564	800
3D single frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
3D multi frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	520	680

[6] 2D B&W Image include "Colorized" images, which map a sample to a color instead of a gray scale value.

| | Explicit VR Little Endian

(1.2.840.10008.1.2.1) | Ultrasound Image Storage

(1.2.840.10008.5.1.4.1.1.6.1) | RGB | 3 | 8 | 520 | 680 |
| Panview | | | | | | | |

7. YBR, JPEG Compressed

			Resultant Attribute Values				
Image Type	Transfer Syntax (0002,0010)	File SOP Class UID (0002.0002)	Photometric Interpretation (0028,0004)	Samples Per Pixel (0028, 0002)	Bits allocated (0028, 0100)	Rows (0028, 0010)	Cols (0028, 0011)
2D B&W Image[7]	JPEG Baseline Process 1 (1.2.840.10008.1.2.4.50)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	YBR_FULL_422	3	8	564 (520 without borders)	800 (688 without borders)
2D color Image	JPEG Baseline Process 1 (1.2.840.10008.1.2.4.50)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	YBR_FULL_422	3	8	564 (520 without borders)	800 (688 without borders)
2D B&W loop	JPEG Baseline Process 1 (1.2.840.10008.1.2.4.50)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	YBR_FULL_422	3	8	564 (520 without borders)	800 (688 without borders)
2D color loop	JPEG Baseline Process 1 (1.2.840.10008.1.2.4.50)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	YBR_FULL_422	3	8	564 (520 without borders)	800 (688 without borders)
Stress B&W 'quad' loop	JPEG Baseline Process 1 (1.2.840.10008.1.2.4.50)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	YBR_FULL_422	3	8	320	245
Stress color 'quad' loop	JPEG Baseline Process 1 (1.2.840.10008.1.2.4.50)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	YBR_FULL_422	3	8	320	245
Report	JPEG Baseline Process 1 (1.2.840.10008.1.2.4.50)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	YBR_FULL_422	3	8	564	800
3D single frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680
3D multi frame	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Multi-frame Image Storage (1.2.840.10008.5.1.4.1.1.3.1)	RGB	3	8	520	680

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[7] 2D B&W Image include "Colorized" images, which map a sample to a color instead of a gray scale value.

Panview	Explicit VR Little Endian (1.2.840.10008.1.2.1)	Ultrasound Image Storage (1.2.840.10008.5.1.4.1.1.6.1)	RGB	3	8	520	680

Tables 5: Image Attributes based upon Photometric Interpretation and Image Type

Notes:

1. The bits allocated (0028,0100) and the bits stored (0028,0101) are always the same.
2. The high bit (0028,0102) is always one less than the bits allocated.
3. The pixel representation (0028,0103) is always zero
4. Ultrasound data present (0028,0014) is always 1 (true).
5. 3D and Panview images always employ an RGB photometric interpretation irrespective of the 'image format' configured by the user. Also 3D and Panview images are slightly smaller (520 rows by 680 columns) than 2D images.
6. 2D stills and loops may be acquired including the top and right border information or without borders.   Stress 'quad' loops are 320x245 and never have top or side information borders.

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2.1.2.1.2.1 SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Storage of DICOM studies to a PACS
        - ➢ Proposed Presentation Context
          - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class

The HD11 AE uses the Ultrasound Image IOD Modules for both Ultrasound Image (1.2.840.10008.5.1.4.1.1.6.1) and Ultrasound Multi-frame Image (1.2.840.10008.5.1.4.1.1.3.1) IODs as follows:

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2.1.2.1.2.1.1 Ultrasound Image & Ultrasound multi-frame image Storage Modules Used

Context: Expansion of Headings and sub-headings

- ➤ Application Entity Specifications
  - ➤ HD11 AE Specification
    - ➤ Association Initiation by Real-World Activity
      - ➤ Storage of DICOM studies to a PACS
        - ➤ Proposed Presentation Context
          - ➤ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
            - ➤ US Image & US multi-frame image Storage Modules Used

For each SOP class, DICOM defines what modules must be supported. A module simply defines a set of DICOM tags that must be present in the DICOM file.

Per the DICOM standard (PS3.3-2001 A.1.3), modules may be mandatory, optional or conditionally mandatory:

- **Mandatory** modules shall be supported per the definitions, semantics and requirements defined in PS3.3-2001, Annex C.

- **User Option** Modules may or may not be supported. If an optional Module is supported, the Level 1 (and
  Level 2) Attribute Types specified in the Modules shall be supported.

- **Conditional** Modules are Mandatory Modules if specific conditions are met. If the specified conditions are not met, this Module shall not be supported; that is, no information defined in that Module shall be sent.

The following table defines the modules that are supported by HD11 for ultrasound images when they are sent to a Storage SCP (PACS).

Module	US Image (Still) DICOM Standard	US Image (Still) Supported in HD11	US Multi-frame Image (Loop) DICOM Standard	US Multi-frame Image (Loop) Supported in HD11
Patient	Mandatory	✓	Mandatory	✓
General Study	Mandatory	✓	Mandatory	✓
Patient Study	User Option	✓	User Option	✓
General Series	Mandatory	✓	Mandatory	✓
Frame of Reference	User Option		User Option	
Synchronization	User Option		User Option	
General Equipment	Mandatory	✓	Mandatory	✓
General Image	Mandatory	✓	Mandatory	✓
Image Pixel	Mandatory	✓	Mandatory	✓
Palette Color Lookup Table	Conditional	✓	Conditional	✓
Contrast/Bolus	Conditional		Conditional	
Cine	Unused		Mandatory	✓
Multi-Frame	Unused		Mandatory	✓
Ultrasound Image	Mandatory	✓	Mandatory	✓
Overlay Plane	Unused		User Option	
Curve Identification	Mandatory	Not used since Curve & Curve Id is mutually exclusive with Image Pixel	Mandatory	Not used since Curve & Curve Id is mutually exclusive with Image Pixel
Curve	Mandatory		Mandatory	
Audio	User Option		User Option	
VOI LUT	User Option		User Option	
SOP Common	Mandatory	✓	Mandatory	✓

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For each module that must be present in an ultrasound image that is going to be sent to a storage SCP, a subsequent sub-section defines the tags in that module that are supported by HD11.

Note: *Unused type "3" tags are* **not** *listed.*

2.1.2.1.2.1.2 Patient Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Storage of DICOM studies to a PACS
        - ➢ Proposed Presentation Context
          - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
            - ➢ Patient Module

The Patient Module (PS3.3-2001, Table C.7.1.1) defines attributes that provide information about the Patient who is the subject of a diagnostic Study. This module is mandatory for storage of ultrasound single-frame or multi-frame images.

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*Note: If MWL is enabled, the user-generated values in the table below are provided by the modality worklist.

Attribute Name	Tag	Type	VR	Description	Generated by Usr	Sys	Value
Patient's Name	0010, 0010	2	PN	Patient's full name.	✓		Entered by user from the Patient ID screen.
Patient ID	0010, 0020	2	LO	Primary hospital identification number or code for the patient.	✓		Entered by user from the Patient ID screen. This maps to the MRN field of the Patient ID screen and can be up to a maximum of 18 characters. If the user does not enter a value, the system will automatically generate one.
Patient's Birth Date	0010, 0030	2	DA	Birth date of the patient.	✓		Entered by user from the Patient ID screen. If the user does not enter a value, the system includes this tag as the empty string.
Patient's Sex	0010, 0040	2	CS	Sex of the named patient. Enumerated Values: M = male F = female O = other	✓		Selected from a drop-down list, by the user, from the Patient ID screen. If the user selects 'Unknown', this attribute is the empty string.
Other Patient IDs	0010, 1000	3	LO	Other identification numbers or codes used to identify the patient.	✓		Entered by user from the Patient ID screen. This maps to the Alternate ID Number of the Patient ID screen. If the user does not enter a value, the tag is not sent.

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2.1.2.1.2.1.3 General Study Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Storage of DICOM studies to a PACS
                - ➢ Proposed Presentation Context
                    - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
                        - ➢ General Study Module

The General Study Module (PS3.3-2001, Table C.7.2.1) defines Attributes that provide information about the Study that was performed.   This module is mandatory for storage of ultrasound single-frame or multi-frame images.

*Note: If MWL is enabled, the user-generated values in the table below are provided by the modality worklist.

Atribute Name	Tag	Type	VR	Description	Generated by Usr	Generated by Sys	Value
Study Instance UID	0020, 000D	1	UI	A unique identifier for the Study.		✓	A system generated Unique Identifier of the form: 1.2.840.113543.6.6.4.0.Mnnnnnnn nnnnnnnnnnnnnnnnnnnnnnnn (64 characters) The first part is for HD11. The right-most digits (nnnnnn) are unique based on timestamp and machine characteristics. Note: The 24th character (denoted by 'M') is always '6', however this may be changed in future releases and an implementation should not rely on knowledge of this character.
Study Date	0008, 0020	2	DA	Date the Study started. The format is yyyymmdd		✓	The system computes this value as the date the study was created. Every image (with the same Study Instance UID) will have the same Study date.
Study Time	0008, 0030	2	TM	Time the Study started. The format is hhmmss		✓	The system computes this value as the time the study was created. Every image (with the same Study Instance UID) will have the same Study time.
Referring Physician Name	0008, 0090	2	PN	Physician(s) who are responsible for overall patient care at time of Study	✓		Entered by user from the Patient ID screen. If the user does not enter a value, the system includes this tag as the empty string. The characters entered map to the 'Last Name' component of the Person Name.

Atribute Name	Tag	Type	VR	Description	Generated by		Value
					Usr	Sys	
							Note: If MWL is defined, only the last and first name components of the name are used.
Study ID	0020, 0010	2	SH	User or equipment generated Study identifier.		✓	A system generated Study identifier that is unique only within the HD11 system that generated the study. The Study Identifier starts at 1 and is incremented by one for each new study created on that system. Study Identifiers will not be unique across multiple HD11 systems.
Accession Number	0008, 0050	2	SH	A RIS generated number, which identifies the order for the Study.	✓		Entered by user from the Patient ID screen. If the user enters a value for this field, then it must be unique. If the user does not enter a value, the system includes this tag as the empty string.
Study Description	0008, 1030	3	LO	Institution-generated description or classification of the Study (component) performed.	✓		Configurable by the user through setup. Can either be a fixed list or (for users with a MWL server), can be obtained from the MWL Server. The string used will be the first non-empty string from the following list: o Requested Procedure description tag (0032,1060), o Scheduled Procedure Step description tag (0040,0007) o Scheduled Procedure Step, "Code Meaning" tag (0008,0104) o Reason for the requested

Atribute Name	Tag	Type	VR	Description	Generated by Usr	Generated by Sys	Value
							procedure tag (0040,1002) ○ Reason for imaging service request tag (0040,2001)

2.1.2.1.2.1.4 Patient Study Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Storage of DICOM studies to a PACS
        - ➢ Proposed Presentation Context
          - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
            - ➢ Patient Study Module

The Patient Study Module (PS3.3-2001, Table C.7.2.2) defines Attributes that provide information about the Patient at the time the Study was performed.   This module is optional for storage of ultrasound single-frame or multi-frame images.

*Note: If MWL is enabled, the user-generated values in the table below are provided by the modality worklist.

Attribute Name	Tag	Type	VR	Description	Generated by Usr	Generated by Sys	Value
Patient's Size	0010, 1020	3	DS	Length or size of the Patient, in meters.			Entered by user from the Patient ID screen. If the user does not enter a value, this tag is not sent.
Patient's Weight	0010, 1030	3	DS	Weight of the Patient, in kilograms.			Entered by user from the Patient ID screen. If the user does not enter a value, this tag is not sent.
Additional Patient's History	0010, 21B0	3	LT	Additional information about the Patient's medical history.			Entered by user from the Patient ID screen. If the user does not enter a value, this tag is not sent.

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2.1.2.1.2.1.5 General Series Module

Context: Expansion of Headings and sub-headings

> ➢ Application Entity Specifications
>> ➢ HD11 AE Specification
>>> ➢ Association Initiation by Real-World Activity
>>>> ➢ Storage of DICOM studies to a PACS
>>>>> ➢ Proposed Presentation Context
>>>>>> ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
>>>>>>> ➢ General Series Module

The General Series Module (PS3.3-2001, Sec C.7.3.1, Table C.7-5) defines Attributes that identify and describe general information about a Series within a Study. .   This module is mandatory for storage of ultrasound single-frame or multi-frame images. . Each HD11 Study has exactly one Series.

*Note: If MWL is enabled, the user-generated values in the table below are provided by the modality worklist.

Attribute Name	Tag	Type	VR	Description	Generated by Usr	Generated by Sys	Value
Modality	0008, 0060	1	CS	Type of equipment that originally acquired the data used to create the images in this Series.		✓	Always "US" for ultrasound
Series Instance UID	0020, 000E	1	UI	Unique identifier of the Series.		✓	A system generated Unique Identifier of the form: 1.2.840.113543.6.6.4.0.Mnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn (64 characters) The first part is for HD11. The right-most digits (nnnnnn) are unique based on timestamp and machine characteristics.

Attribute Name	Tag	Type	VR	Description	Generated by Usr	Generated by Sys	Value
							Note: <u>For Non-PanView Images</u> The Series Instance UID is derived from the Study Instance UID by changing the 24th character (denoted by 'M' in the template above) from '6' to '3' (or '5' for stress protocol studies). However in future releases the Series Instance UID may be generated by alternative means. A DICOM server implementation should not use the 24th character to define behavior. <u>For PanView images</u> The Series Instance UID is the same as the Study Instance UID.
Series Number	0020, 0011	2	IS	Number of the series		✓	HD11 studies have exactly one series and the series number is always "1"
Performing Physician's Name	0008, 1050	3	PN	Name of the physicians administering the Series.	✓		Entered by user from the Patient ID screen. This maps to the 'Performed by' field of the Patient ID screen. If the user does not enter a value, this tag is not sent. The intent is for the user to enter the performing physicians initials and the system limits the user to entering a maximum of five characters. The characters entered map to the 'Last Name' component of the Person Name.
Series Description	0008, 103E	3	LO	User provided description of the Series.	✓		Entered by user from the Patient ID screen. This maps to the 'Indication' field of the Patient ID screen. If the user does not enter a value, this tag is

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Attribute Name	Tag	Type	VR	Description	Generated by Usr	Generated by Sys	Value
							not sent.
Operator's Name	0008, 1070	3	PN	Name of the operator (or technician) using the system.		✓	Entered by the system as the same text as 'Performing Physician's Name', (tag 0008,1050).
Patient Position	0018, 5100	2C	CS	Required for CT and MR images. See C.7.3.1.1.2 of the DICOM standard for Defined Terms and further explanation.	N/A	N/A	Not used as not required for Ultrasound (US).

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2.1.2.1.2.1.6 General Equipment Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Storage of DICOM studies to a PACS
        - ➢ Proposed Presentation Context
          - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
            - ➢ General Equipment Module

The General Equipment Module (PS3.3-2001, Sec C.7.5.1, Table C.7-8) defines attributes that identify and describe the piece of equipment that produced a Series of Images. This module is mandatory for storage of ultrasound single-frame or multi-frame images.

Attribute Name	Tag	Type	VR	Description	Generated by Usr	Generated by Sys	Value
Manufacturer	0008, 0070	2	LO	Manufacturer of the equipment that produced the digital images.		✓	"Philips Medical Systems"

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2.1.2.1.2.1.7 General Image Module

Context: Expansion of Headings and sub-headings

> Application Entity Specifications

>> HD11 AE Specification

>>> Association Initiation by Real-World Activity

>>>> Storage of DICOM studies to a PACS

>>>>> Proposed Presentation Context

>>>>>> SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class

>>>>>>> General Image Module

The General Image Module (PS3.3-2001, Sec C.7.6.1, Table C.7-9) defines Attributes that describe an image within a particular series.   This module is optional for storage of ultrasound single-frame or multi-frame images.

All attributes are system generated.

Attribute Name	Tag	Type	VR	Description	Value
Instance Number	0020, 0013	2	IS	A number that identifies this image. Note: This Attribute was named Image Number in earlier versions of this Standard.	The system computes this value as a unique number for each image in a study. The value ascends as each image is acquired but the value does not start at "1" for each study. Gaps may be present if images were deleted before DICOM store was requested.
Patient Orientation	0020, 0020	2C	CS	Patient direction of the rows and columns of the image.	The system sends the empty tag for 2D images, not used in PanView images.
Content Date	0008, 0023	2C	DA	The date the image pixel data creation started. Required if image is part of a series in which the images are	The system computes this value as the date that image was acquired. . The format is yyyymmdd.

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Attribute Name	Tag	Type	VR	Description	Value
				temporally related. *Note: This Attribute was formerly known as Image Date.*	
Content Time	0008, 0033	2C	TM	The time the image pixel data creation started. Required if image is part of a series in which the images are temporally related. *Note: This Attribute was formerly known as Image Time.*	The system computes this value as the time that image was acquired. The format is hhmmss
Image Type	0008, 0008	3	CS	Image identification characteristics.	The system computes this value as the four component multi-value attribute: "<Pixel Data Characteristics> / <Patient Examination Characteristics> / <Modality Specific Characteristics> / <Implementation Specific Identifiers>" **<Pixel Data Characteristics>** Palette Color & RGB: "ORIGINAL" denotes original source-data YBR: "DERIVED" denotes pixels that have been derived from the original – in this case by

Attribute Name	Tag	Type	VR	Description	Value
					lossy compression. **\<Patient Examination Characteristics>** Always "PRIMARY" **\<Modality Specific Characteristics>** This is based on the user-selected entry in the drop down list 'Additional Data Type' on the Patient Id screen. It is mapped to the most appropriate value from the DICOM standard (Ex: "ABDOMINAL"). **\<Implementation Specific Identifiers>"** Always blank. Note: The third and fourth fields are **not** present in PanView images.
Acquisition Date	0008, 0022	3	DA	The date the acquisition of data that resulted in this image started	The system uses the same value as the Content Date, tag 0008,0023.
Acquisition Time	0008, 0032	3	TM	The time the acquisition of data that resulted in this image started	The system uses the same value as the Content time, tag 0008,0033.
Acquisition Datetime	0008, 002A	3	DT	The date and time that the acquisition of data that resulted in this image started.	The system generates this as a combination of Acquisition Date and Acquisition Time. . The format is yyyymmddhhmmss

Attribute Name	Tag	Type	VR	Description	Value
Image Comments	0020, 4000	3	LT	User-defined comments about the image.	Images (2D,3D etc): Not Used Reports: "Report Version x Page x of x"
Lossy Image Compression	0028, 2110	3	CS	Specifies whether an Image has undergone lossy image compression. Enumerated Values: 00 = Image has NOT been subjected to lossy image compression. 01 = Image has been subjected to lossy image compression.	00 - for uncompressed images or RLE compressed images. 01 – for JPEG compressed images.

2.1.2.1.2.1.8 Image Pixel Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Storage of DICOM studies to a PACS
                - ➢ Proposed Presentation Context
                    - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
                        - ➢ Image Pixel Module

The Image Pixel Module (PS3.3-2001, Sec C.7.6.3, Table C.7-11) defines Attributes that describe the pixel data of an image. This module is mandatory for storage of ultrasound single-frame or multi-frame images.

Attribute Name	Tag	Type	VR	Description	Value
Samples per Pixel	0028, 0002	1	US	Number of samples (planes) in this image.	Based on the 'Image Format' that is set by the user in DICOM Setup. Palette Color Mode: 2D B/W and Color stills/loops: 1 3D & Panview: 3 Reports 1 RGB Mode: 2D B/W and Color stills/loops: 3 3D & Panview: 3 Reports: 3 YBR Mode: 2D B/W and Color stills/loops: 3 3D & Panview: 3 Reports: 3

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Attribute Name	Tag	Type VR		Description	Value

Photometric Interpretation	0028, 0004	1	CS	Specifies the intended interpretation of the pixel data.	2D Images & Reports:
					    Based on the 'Image Format' that is set by the user in DICOM Setup. Can be either:
					        PALETTE COLOR, RGB, or YBR_FULL_422
					
					3D & Panview Images:
					    Always RGB

Rows	0028, 0010	1	US	Number of rows in the image.	2D B/W & Color stills/loops acquired with top & right border: 564 2D B/W & Color stills/loops acquired without borders: 520 2D B/W & Color quad-sized loops from stress: 245 Reports: 564 PanView: 520
Columns	0028, 0011	1	US	Number of columns in the image	2D B/W & Color stills/loops acquired with top & right border: 800 2D B/W & Color stills/loops acquired without borders: 688 2D B/W & Color quad-sized loops from stress: 320 Reports: 800 PanView: 680
Bits Allocated	0028, 0100	1	US	Number of bits allocated for each pixel	Based on the 'Image Format' that is set by the user in DICOM Setup.

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Attribute Name	Tag	Type VR		Description	Value
				sample.	Palette Color Mode:
					2D B&W, 3D & PanView: 8 bits
					2D Color & Reports: 16 bits
					RGB Mode:
					2D B&W, 3D & PanView: 8 bits
					2D Color & Reports: 8 bits
					YBR Mode:
					2D B&W, 3D & PanView: 8 bits
					2D Color & Reports: 8 bits
Bits Stored	0028, 0101	1	US	Number of bits stored for each pixel sample.	Based on the 'Image Format' that is set by the user in DICOM Setup. The number of Bits Stored and Bits Allocated are always the same.
					Palette Color Mode:
					2D B&W, 3D & PanView: 8 bits
					2D Color & Reports: 16 bits
					RGB Mode:
					2D B&W, 3D & PanView: 8 bits
					2D Color & Reports: 8 bits
					YBR Mode:
					2D B&W, 3D & PanView: 8 bits
					2D Color & Reports: 8 bits
High Bit	0028, 0102	1	US	Most significant bit for pixel sample data.	Based on the 'Image Format' that is set by the user in DICOM Setup. The High Bit is always one less than the Bits Allocated.
					Palette Color Mode:

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Attribute Name	Tag	Type VR		Description	Value
					2D B&W, 3D & PanView: 7 bits
					2D Color & Reports: 15 bits
					RGB Mode:
					2D B&W, 3D & PanView: 7 bits
					2D Color & Reports: 7 bits
					YBR Mode:
					2D B&W, 3D & PanView: 7 bits
					2D Color & Reports: 7 bits
Pixel Representation	0028, 0103	1	US	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values: 0000H = unsigned integer. 0001H = 2's complement	000H (Unsigned integers)
Pixel Data	7FE0, 0010	1	OB	A data stream of the pixel samples which comprise the Image.	The pixel data of the DICOM image.
Planar Configuration	0028, 0006	1 C	US	Indicates whether the pixel data are sent color-by-plane or color-by-pixel. Required if Samples per Pixel (0028,0002) has a value greater than 1.	Palette Color Images: Not present RGB Images: Always zero (color-by-pixel) YBR: Images: Always zero (color-by-pixel) Note: 3D and Panview images are always RGB, therefore this tag will always be zero for 3D and Panview images even if the user defines the image export format to be Palette Color.
Pixel Aspect Ratio	0028, 0034	1 C	IS	Ratio of the vertical size and horizontal size of the pixels in the	Always 1/1.

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Attribute Name	Tag	Type VR		Description	Value
				image specified by a pair of integer values where the first value is the vertical pixel size, and the second value is the horizontal pixel size.	
Red Palette Color Lookup Table Descriptor	0028, 1101	1 C	US	Specifies the format of the Red Palette Color Lookup Table Data	See 'Palette Color Lookup Table Module', section 2.1.2.1.2.1.9.
Green Palette Color Lookup Table Descriptor	0028, 1102	1 C	US	Specifies the format of the Green Palette Color Lookup Table Data	See 'Palette Color Lookup Table Module', section 2.1.2.1.2.1.9.
Blue Palette Color Lookup Table Descriptor	0028, 1103	1 C	US	Specifies the format of the Blue Palette Color Lookup Table Data	See 'Palette Color Lookup Table Module', section 2.1.2.1.2.1.9..
Red Palette Color Lookup Table Data	0028, 1201	1 C	OW	Red Palette Color Lookup Table Data.	See 'Palette Color Lookup Table Module', section 2.1.2.1.2.1.9.
Green Palette Color Lookup Table Data	0028, 1202	1 C	OW	Green Palette Color Lookup Table Data.	See 'Palette Color Lookup Table Module', section 2.1.2.1.2.1.9.
Blue Palette Color Lookup Table Data	0028, 1203	1 C	OW	Blue Palette Color Lookup Table Data.	See 'Palette Color Lookup Table Module', section 2.1.2.1.2.1.9.

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2.1.2.1.2.1.9 Palette Color Lookup Table Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Storage of DICOM studies to a PACS
        - ➢ Proposed Presentation Context
          - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
            - ➢ Palette Color Lookup Table Module

The Palette Color Lookup Module (PS3.3-2001, Sec C.7.9, Table C.7-22) defines Attributes that describe the Lookup table data for images with Palette Color photometric interpretation. This module is present for HD11 2D B/W and Color stills/loops but is not present in (RGB) files created by HD11's 3D/Panview application.

All attributes are system generated.

Attribute Name	Tag	Type	VR	Description	Value

Red Palette Color Lookup Table Descriptor	0028, 1101	1C	US	Specifies the format of the Red Palette Color Lookup Table Data	Used only for 2D
					  Loops: 256, 0, 16
					  Stills: 0, 0, 16
					This tag and other tags related to Palette Color are not present in 3D/PanView since these files are RGB.

Green Palette Color Lookup Table Descriptor	0028, 1102	1C	US	Specifies the format of the Green Palette Color Lookup Table Data	Used only for 2D
					  Loops: 256, 0, 16
					  Stills: 0, 0, 16

Blue Palette Color Lookup Table Descriptor	0028, 1103	1C	US	Specifies the format of the Blue Palette Color Lookup Table Data	Used only for 2D
					  Loops: 256, 0, 16
					  Stills: 0, 0, 16

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Attribute Name	Tag	Type	VR	Description	Value
Red Palette Color Lookup Table Data	0028, 1201	1C	OW	Red Palette Color Lookup Table Data.	Used only for 2D.
Green Palette Color Lookup Table Data	0028, 1202	1C	OW	Green Palette Color Lookup Table Data.	Used only for 2D.
Blue Palette Color Lookup Table Data	0028, 1203	1C	OW	Blue Palette Color Lookup Table Data.	Used only for 2D.
Segmented Red Palette Color Lookup Table Data	0028, 1221	1C	OW	Segmented Red Palette Color Lookup Table Data.	Not used
Segmented Green Palette Color Lookup Table Data	0028, 1222	1C	OW	Segmented Green Palette Color Lookup Table Data.	Not used
Segmented Blue Palette Color Lookup Table Data	0028, 1223	1C	OW	Segmented Blue Palette Color Lookup Table Data.	Not used

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2.1.2.1.2.1.10 Cine Module

Context: Expansion of Headings and sub-headings

> Application Entity Specifications
>> HD11 AE Specification
>>> Association Initiation by Real-World Activity
>>>> Storage of DICOM studies to a PACS
>>>>> Proposed Presentation Context
>>>>>> SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
>>>>>>> Cine Module

The Cine Module (PS3.3-2001, Sec C.7.6.5, Table C.7-13) defines Attributes of a Multi-frame Cine image. This module is mandatory for Multi-frame images but is not used for Single-frame images.

All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
Recommended Display Frame Rate	0008, 2144	3	IS	Used for Multiframe
Cine Rate	0018, 0040	3	IS	Used for Multiframe
Effective Series Duration	0018, 0072	3	DS	Used for Multiframe
Frame Time Vector	0018, 1065	1C	DS	An array that contains the real time increments (in msec) between frames for a Multi-frame image. Present if Frame Increment Pointer (0028,0009) points to Frame Time Vector.
Frame Time	0018,1063	1C	DS	Nominal time (in msec) per individual frame. Present if Frame Increment Pointer (0028,0009) points to Frame Time.

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2.1.2.1.2.1.11 Multi-Frame Module

Context: Expansion of Headings and sub-headings

- ➤ Application Entity Specifications
    - ➤ HD11 AE Specification
        - ➤ Association Initiation by Real-World Activity
            - ➤ Storage of DICOM studies to a PACS
                - ➤ Proposed Presentation Context
                    - ➤ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
                        - ➤ Multi-Frame Module

The Multi-Frame Module (PS3.3-2001, Sec C.7.6.6, Table C.7-14) defines Attributes of a Multi-frame pixel data image. This module is mandatory for Multi-frame images but is not used for Single-frame images. All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
Number of Frames	0028, 0008	1	IS	Used
Frame Increment Pointer	0028, 0009	1	AT	Configurable by the user in DICOM Setup. If the user selects a loop timing preference where each frame in a loop has the same duration then Frame Increment Pointer takes the value 0018,1063 (Frame Time). If the user selects a loop timing preference where each frame in a loop has the different duration then Frame Increment Pointer takes the value 0018,1065 (Frame Time Vector).

2.1.2.1.2.1.12 US Region Calibration Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Storage of DICOM studies to a PACS
                - ➢ Proposed Presentation Context
                    - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
                        - ➢ US Region Calibration Module

The US Region Calibration Module (PS3.3-2001, Sec C.8.5.5.1, Table C.8-17) defines Attributes that describe an ultrasound region calibration. This module is optional for ultrasound.

All attributes are system generated.

Atribute Name	Tag	Type	VR	Value
Sequence of Ultrasound Regions	0018, 6011	1	SQ	Used
Region Spatial Format	0018, 6012	1	US	Used
Region Data Type	0018, 6014	1	US	Used
Region Flags	0018, 6016	1	UL	Used
Region Location Min X0	0018, 6018	1	UL	Used
Region Location Min Y0	0018, 601A	1	UL	Used
Region Location Max X1	0018, 601C	1	UL	Used
Region Location Max Y1	0018,	1	UL	Used

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Atribute Name	Tag	Type	VR	Value
	601E			
Reference Pixel X0	0018, 6020	1	SL	Used
Reference Pixel Y0	0018, 6022	1	SL	Used
Physical Units X Direction	0018, 6024	1	US	Used
Physical Units Y Direction	0018, 6026	1	US	Used
Ref Pixel Physical Value X	0018, 6028	1	FD	Used
Ref Pixel Physical Value Y	0018, 602A	1	FD	Used
Physical Delta X	0018, 602C	1	FD	Used
Physical Delta Y	0018, 602E	1	FD	Used

2.1.2.1.2.1.13 US Image Module

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Storage of DICOM studies to a PACS
                - ➢ Proposed Presentation Context
                    - ➢ SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class
                        - ➢ US Image Module

The US Image Module (PS3.3-2001, Sec C.8.5.6, Table C.8-18) defines attributes that describe ultrasound images. This module is mandatory for storage of ultrasound single-frame or multi-frame images.

Attribute Name	Tag	Type	VR	Value
Samples per Pixel	0028, 0002	1	US	See 'Image Pixel Module' section 2.1.2.1.2.1.8.
Photometric Interpretation	0028, 0004	1	CS	See 'Image Pixel Module' section 2.1.2.1.2.1.8.
Bits Allocated	0028, 0100	1	US	See 'Image Pixel Module' section 2.1.2.1.2.1.8.
Bits Stored	0028, 0101	1	US	See 'Image Pixel Module' section 2.1.2.1.2.1.8.
High Bit	0028, 0102	1	US	See 'Image Pixel Module' section 2.1.2.1.2.1.8.
Planar Configuration	0028, 0006	1C	US	See 'Image Pixel Module' section 2.1.2.1.2.1.8.
Pixel Representation	0028, 0103	1	US	Always zero
Frame Increment Pointer	0028, 0009	1C	AT	See 'Multi-Frame Module' section 2.1.2.1.2.1.12

Attribute Name	Tag	Type	VR	Value
Image Type	0008, 0008	2	CS	See 'General Image Module' 2.1.2.1.2.1.7.
Lossy Image Compression	0028, 2110	1C	CS	See 'General Image Module' 2.1.2.1.2.1.7.
Ultrasound Color Data Present	0028, 0014	3	US	"1" for B/W and Color 2D and 3D/PanView stills/loops.
Number of Stages	0008, 2124	2C	N	Number of stages in a protocol. *For stress Multiframe images only, or else this tag is not used.*
Number of Views in Stage	0008, 212A	2C	N	Number of views in a stage. *For stress Multiframe images only*
Stage Name	0008, 2120	3	IS	Used in protocols *For stress Multiframe images only*
Stage Number	0008, 2122	3	IS	Which stage in a protocol. *For stress Multiframe images only*
View Number	0008, 2128	3	IS	Number of event timers used during acquisition *For stress Multiframe images only.* 1, 2, or 3 Null if timers not used
Number of Event Timers	0008, 2129	3	IS	If the stage requires a timer, the number of event timers used at the time of acquisition of a Multi-frame image.
Event Elapsed Time(s)	0008, 2130	3	DS	If the stage requires a timer, an array of values associated with each event timer. Units in milliseconds.
Event Timer Name(s)	0008, 2132	3	LO	If the stage requires a timer, the name that identifies the event timer.
Acquisition Datetime	0008, 002A	1C	DT	See 'General Image Module' 2.1.2.1.2.1.7
Heart Rate	0018, 1088	3	IS	Beats per minute. *For stress Multiframe images only*
View Name	0008, 2127	3	SH	The name of the view. *For stress Multiframe images only*
Transducer Data	0018,5	3	LO	Name of the transducer that was in use when the image was

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Attribute Name	Tag	Type VR		Value
	010			acquired. Since the DICOM standard specifies a VM of 3, the last two fields are written as "UNUSED".
Transducer Type	0018, 6031	3	LO	SECTOR_PHASED, LINEAR, CURVED LINEAR *Only used for 2D or 3D images; not used for doppler-only images (i.e. pencil probes)*
Preprocessing Function	0018,5 020	3	LO	Identifier that uniquely describes the preset that was active when the image was acquired.

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2.1.2.1.2.1.14 SOP Common Module

Context: Expansion of Headings and sub-headings

> Application Entity Specifications

> > HD11 AE Specification

> > > Association Initiation by Real-World Activity

> > > > Storage of DICOM studies to a PACS

> > > > > Proposed Presentation Context

> > > > > > SOP Specific Conformance Statement for Ultrasound Image Storage SOP Class

> > > > > > > SOP Common Module

The SOP Common Module (PS3.3-2001, Sec C.12.1, Table C.12-1) defines the Attributes that are required for proper functioning and identification of associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD. . This module is mandatory for storage of ultrasound single-frame or multi-frame images.

All attributes are system generated.

Attribute Name	Tag	Type	VR	Value
SOP Class UID	0008, 0016	1	UI	1.2.840.10008.5.1.4.1.1.6.1 (Single Frame) or 1.2.840.10008.5.1.4.1.1.3.1 (Multi-Frame)
SOP Instance UID	0008, 0018	1	UI	A system generated SOP Instance UID of the format 1.2.840.113543.6.6.3.1.6nnnnnnnnnnnnnnnnnnnnnnnn nnnnnnnnn (64 characters) The first part is for HD11. The right-most digits (nnnnnn) are unique based on timestamp and machine characteristics.
Specific Character Set	0008, 0005	1C	CS	This is the character set that expands or replaces the Basic Character set. The attribute is provided when the system requires characters beyond the Basic Graphic set, otherwise the attribute is not provided.

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| | | | | If provided the attribute contains all the characters sets used (this is a multi-value attribute). See section 7 titled "Support for Extended Character Sets" for more information on the character sets that this system uses.

The most likely scenario that would require a non Basic Character set would be when the system has been set to a locale that uses non Basic characters (e.g. Russia or Japan) AND the user has entered one of these characters into the Patient Identification screen, |

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2.1.2.2 Issuing of Storage Commitment requests to an image manager

Context: Expansion of Headings and sub-headings

> Application Entity Specifications

>> HD11 AE Specification

>>> Association Initiation by Real-World Activity

>>>> Issuing of Storage Commitment requests to an image manager

HD11 provides Standard Conformance to the following DICOM V3.0 **Storage Commitment** SOP Class as an SCU.

SOP Class Name	SOP Class UID	Role
Storage Commitment Push Model	1.2.840.10008.1.20.1.1	SCU

Table 6: SOP Class Supported by Storage Commitment service

HD11 sends images to the storage server for permanent storage. The request for Storage Commitment may then be transmitted from HD11 together with a list of references to one or more SOP instances. This action is invoked through the DIMSE N-ACTION primitive.

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2.1.2.2.1 Associated Real-World Activity

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Issuing of Storage Commitment requests to an image manager
        - ➢ Associated Real-World Activity

Storage Commitment is initiated when a study is saved by the user, or, in Send As You Go mode, after each image acquisition. The storage SCP and commit SCP can be different AE's.

Storage Commitment Association Behavior (By Save Study or Send As You Go)

User Action	DICOM Activity – Storage Commitment Device Association	Association Status
Save Study (Or Image acquisition in Send As You Go)	Each Save Study operation will initiate an association with the SC server, and send an N-Action Request, containing a list of all images that need to be committed. The Association is then released after receiving the N-ACTION-RSP from the SC Server. In Send As You Go mode, each image acquisition initiates the same DICOM activity as Save Study.	Association closed.
Reverse Role Negotiation	The system will remain available as long as it is connected to the network to receive Storage Commitment responses from the SC server. The SCP will send an N-Event Report with status. Then the association is released.	Association closed.

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2.1.2.2.2 Proposed Presentation Contexts

Context: Expansion of Headings and sub-headings

> Application Entity Specifications

>> HD11 AE Specification

>>> Association Initiation by Real-World Activity

>>>> Issuing of Storage Commitment requests to an image manager

>>>>> Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Explicit VR Little Endian (Preferred, see Note)	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		

Table 7: Storage Commitment - Presentation Context

Note: If the Storage Commitment server accepts both Explicit VR Little Endian and Implicit VR Little Endian then HD11 will use Explicit VR Little Endian as a transfer syntax.

In addition to the presentation contexts mentioned in the above table, HD11 will propose the presentation contexts associated with storage SOP classes. However, the actual association will always use the presentation context as mentioned in the table 7.

2.1.2.2.2.1 SOP Specific Conformance Statement for Storage Commitment SOP Class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Issuing of Storage Commitment requests to an image manager
        - ➢ Proposed Presentation Contexts
          - ➢ SOP Specific Conformance Statement for Storage Commitment SOP Class

HD11 provides standard conformance to the DICOM Storage Commitment Service Class.

HD11 supports the following elements for this SOP class as an SCU. The Transaction UID Attribute (0008,1195) value generated by HD11 uniquely identifies each Storage Commitment Request.

Action Type Name	Action Type ID	Attribute Name	Tag
Request Storage Commitment	1	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		>Referenced SOP Class UID	(0008,1150)
		>Referenced SOP Instance UID	(0008,1155)

Table 8 – Storage Commitment Request – Attributes

Subsequently, HD11 expects N-EVENT-REPORT's from the storage commit server although HD11 does not assume that the event will arrive at any particular time. HD11 does not wait but will process the event whenever it arrives.

HD11 might be either powered down or disconnected from the network and used in portable mode, it is possible for the N-EVENT-REPORT to arrive from the Storage Commitment SCP while HD11 cannot receive it. If an outstanding N-EVENT-REPORT

does not arrive within 96 hours, then HD11 will reissue the same Storage Commitment request. When the event arrives, HD11 returns an N-EVENT-REPORT response primitive with one of the following status codes.

Service Status	Further Meaning	Protocol Codes	Related Fields	Description
Success	Success	0000		N-EVENT-REPORT message understood.
Error	Failed	0110		N-EVENT-REPORT message was not processed successfully.

Table 9 - Storage Commitment status codes

2.1.2.3 Verification of the existence of DICOM server on the hospitals network

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications

    - ➢ HD11 AE Specification

        - ➢ Association Initiation by Real-World Activity

            - ➢ Verification of the existence of DICOM server on the hospitals network

HD11 provides standard conformance to the DICOM V3.0 SOP Class as shown in Table 10.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCU

Table 10: SOP Class Supported by Verification Service

2.1.2.3.1 Associated Real-World Activity

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Verification of the existence of DICOM server on the hospitals network
        - ➢ Associated Real-World Activity

The user can verify the existence of a DICOM server on the hospitals network, through a button in the 'DICOM Setup' screen. When the user presses this button, HD11 will initiate the association.

2.1.2.3.2 Proposed Presentation Contexts

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Verification of the existence of DICOM server on the hospitals network
        - ➢ Proposed Presentation Contexts

Only one association is established for each verification attempt. However, the proposed presentation contexts not only includes the 'Verification SOP class' but also includes all the SOP classes that HD11 could possibly be connected to as Servers. This is done in order to retrieve the capabilities of the remote Server.

Table 11 lists all the proposed presentation contexts.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Verification SOP Class	1.2.840.10008.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
Ultrasound Multiframe Image Store	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
		JPEG baseline	1.2.840.10008.1.2.50		
Ultrasound Image	1.2.840.10008.5.1.4.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None

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Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Store	.1.6.1	Implicit VR Little Endian	1.2.840.10008.1.2		
		JPEG baseline	1.2.840.10008.1.2.50		
StorageCommitment Push Model	1.2.840.10008.1.20.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
Modality Worklist-Find	1.2.840.10008.5.1.4.31	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		

Table 11: Proposed Presentation Contexts

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2.1.2.3.2.1 SOP Specific Conformance Statement for the Verification SOP class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Verification of the existence of DICOM server on the hospitals network
                - ➢ Proposed Presentation Contexts
                    - ➢ SOP Specific Conformance Statement for the Verification SOP class

The C-ECHO request primitive is sent to the Verification SCP. The Verification SCP with a status indicator of success returns the C-ECHO response primitive. The absence of a C-ECHO response within a specific timeout period is an indication that the server cannot be located through the Verification service.

2.1.2.4 Printing DICOM studies to a B&W or color printer

Context: Expansion of Headings and sub-headings

> Application Entity Specifications
>> HD11 AE Specification
>>> Association Initiation by Real-World Activity
>>>> Printing DICOM studies to a B&W or color printer

HD11 provides standard conformance to the following DICOM V3.0 SOP Class as an SCU.

SOP Class Name	SOP Class UID	Role
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	SCU
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	SCU

Table 12: SOP Classes Supported by Print Service

The meta SOP classes are defined by the set of supported SOP classes.

The SOP class "Basic Grayscale Print Management Meta" is defined by the following set of supported SOP classes.

- Basic Film Session SOP Class
- Basic Film Box SOP Class
- Basic Grayscale Image Box SOP Class
- Printer SOP Class

The SOP class "Basic Color Print Management Meta" is defined by the following set of supported SOP classes.

- Basic Film Session SOP Class
- Basic Film Box SOP Class
- Basic Color Image Box SOP Class
- Printer SOP Class

The following implementation remarks are important to understand HD11's usage of DICOM Print.

- The number of Film Boxes per Film Session is one.
- The number of images per Film Box is one.

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- The images to be printed on one film are rendered by the HD11 into one logical image. This logical image is very large, depending on the pixel matrix size (pixels per line, lines per image), use of color or not. A rough indication is 20 Mbytes. One should take this into account when selecting the DICOM printer and the printer configuration (e.g. the amount of memory).

- HD11 will release the association when the print command is given (i.e. the NACTION Request for the Film Box); the association is not kept open for receiving N-EVENTREPORT's of the Printer SOP Class.

2.1.2.4.1 Associated Real World Activity

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Printing DICOM studies to a B&W or color printer
        - ➢ Associated Real World Activity

HD11 issues Print Management requests to an SCP supporting the DICOM V3.0 Print services, in order to produce hard copy representations of DICOM images, based on user requests.

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2.1.2.4.2 Proposed Presentation Contexts

Context: Expansion of Headings and sub-headings

> ➤ Application Entity Specifications
>> ➤ HD11 AE Specification
>>> ➤ Association Initiation by Real-World Activity
>>>> ➤ Printing DICOM studies to a B&W or color printer
>>>>> ➤ Proposed Presentation Contexts

Print AE supports the following Presentation Contexts for **Print**.

Abstract Syntax		Transfer Syntax		Role	Extended
Name	**UID**	**Name List**	**UID List**	**Role**	**Negotiation**
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Explicit VR Little Endian (Preferred, see Note)	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Explicit VR Little Endian (Preferred, see Note)	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		

Table 13: Print Presentation Contexts

Note: If the print server accepts both Explicit VR Little Endian and Implicit VR Little Endian then HD11 will send the images using Explicit VR Little Endian.

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HD11 provides standard conformance to all the supported SOP classes of the "meta" SOP Classes, "Basic Grayscale Print Management Meta" and "Basic Color Print Management Meta". These SOP Classes are –

1. Basic Film Session SOP Class

2. Basic Film Box SOP Class

3. Basic Grayscale Image Box SOP Class

4. Basic Color Image Box SOP Class

5. Printer SOP Class

The SOP specific conformance of these classes is described below.

2.1.2.4.2.1 SOP Specific Conformance to Basic Film Session SOP Class

Context: Expansion of Headings and sub-headings

➢ Application Entity Specifications

    ➢ HD11 AE Specification

        ➢ Association Initiation by Real-World Activity

            ➢ Printing DICOM studies to a B&W or color printer

                ➢ Proposed Presentation Contexts

                    ➢ SOP Specific Conformance to Basic Film Session SOP Class

HD11 requests the following DIMSE-N commands for the Basic Film Session SOP Class: N-CREATE

1 = Generated By

Attribute Name	Tag	Usage	Attribute Description	DICOM Notes	1		Value	
					Usr	Sys	Options	Default
Number of Copies	(2000,0010)	U	Number of duplicate copies to print	DICOM supports an integer number.	✓		1 to 99	1
Print Priority	(2000,0020)	U	Print priority sets the 'importance' of your print job relative to other jobs received by the printer.	DICOM supports: LOW, MEDIUM, HIGH Print priorities		✓	HIGH	
Medium Type	(2000,0030)	U	The type of media the printer prints on.	DICOM Supports PAPER, CLEAR FILM & BLUE FILM s as well as 'Printer Specific' options	✓		PAPER CLEAR FILM BLUE FILM	PAPER
Film Destination	(2000,0040)	U	The processed film will be stored in a film magazine or processor.	DICOM supports PROCESSOR and MAGAZINE as well as 'Printer Specific'	✓		PROCESSOR MAGAZINE	PROCESSOR

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Attribute Name	Tag	Usage	Attribute Description	DICOM Notes	1		Value	
					Usr	Sys	Options	Default
				options				

Table 14 Basic Film Session Attributes

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2.1.2.4.2.2 SOP Specific Conformance to Basic Film Box SOP Class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Printing DICOM studies to a B&W or color printer
        - ➢ Proposed Presentation Contexts
          - ➢ SOP Specific Conformance to Basic Film Box SOP Class

HD11 requests the following DIMSE-N commands for the Basic Film Box SOP Class: N-CREATE

1 = Generated By

Attribute Name	Tag	Usage	Attribute Description	DICOM Notes	1		Value	
					Usr	Sys	Options	Default
Image Display Format	(2010,0010)	M	Images are arranged on the film in a rectangular grid. The columns and rows control the layout.	DICOM Supports STANDARD\cols,rows as well as SLIDE, ROW/COL symmetric and printer specific options.	✓		STANDARD*cols,rows* *Cols:1..99, Rows:1..99* Note: **Applied Value for this attribute (which is sent to the Print SCP) is always STANDARD\1,1**. This is because, HD11 internally creates a single 1x1 image	Always set to STANDARD\1,1

Attribute Name	Tag	Usage	Attribute Description	DICOM Notes	Usr	Sys	Options	Default
							corresponding to one page. This (large) image is formed based on the user selected value (e.g. STANDARD\2, 3) and the images that are part of the Print request.	
Film Orientation	(2010,0040)	U	The orientation of the printed film or paper.	DICOM Supports: PORTRAIT & LANDSCAPE	✓		PORTRAIT LANDSCAPE	PORTRAIT
Film Size ID	(2010,0050)	U	The overall size of the film or paper.	DICOM Supports all the user options as well as 'Printer Specific' options	✓		8INX10IN, 8_5INX11IN, 10INX12IN, 10INX14IN, 11INX14IN, 11INX17IN, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM, A4, A3	8INX10IN
Trim	(2010,0140)	U	Draw frame box around each image	DICOM Supports: YES or NO		✓	"NO"	
Max Density	(2010,0130)	U	Min and Max Density give the range of allowable image densities for an	Entered in hundredths of Optical Density (OD)	✓		0 - 999	300

Attribute Name	Tag	Usage	Attribute Description	DICOM Notes	Usr	Sys	Options	Default
			image on the film. If the density is outside the printer's range, the printer's limit will be used.					
Configuration Information	(2010,0150)	U	Printer-specific configuration Information	DICOM supports a config ID # or a config string	✓		Config ID # Or Config string	"CS000"
Referenced Film Session Sequence	(2010,0500)	M	Referenced Film Session Sequence	N/A		✓	Always set	
>Referenced SOP Class UID	(0008,1150)	M	>Referenced SOP Class UID	N/A		✓	Always set	
>Referenced SOP Instance UID	(0008,1155)	M	>Referenced SOP Instance UID	N/A		✓	Always set	

Table 15 Basic Film Box Attributes

N-ACTION

HD11 provides all possible printer settings. For a specific printer, the user must check the manufacturer's documentation to determine the subset of available settings that the printer actually supports. For example, if the user configures the B&W printer to use a film-size of 14Inx17IN but the maximum film size supported by the printer is 8_5INX11IN, then the printer may reject the images.

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2.1.2.4.2.3 SOP Specific Conformance to Basic Grayscale Image Box SOP Class

Context: Expansion of Headings and sub-headings

> Application Entity Specifications

>> HD11 AE Specification

>>> Association Initiation by Real-World Activity

>>>> Printing DICOM studies to a B&W or color printer

>>>>> Proposed Presentation Contexts

>>>>>> SOP Specific Conformance to Basic Grayscale Image Box SOP Class

Print AE issues the following DIMSE-N commands for the Basic Grayscale Image Box SOP Class:

N-SET

Attribute Name	Tag	Usage	Description	Generated By		Value	
				Usr	Sys	Options	Default
Image Position	(2020,0010)	M	The position of the image on the media		✓	Always set to 1	
Polarity	(2020,0020)	U	Polarity of image on media (NORMAL or REVERSE)		✓	NORMAL	
Basic Grayscale Image Sequence Type	(2020,0110)	M	The image data attributes		✓	Always set (but only for B&W Images.)	
>Samples Per Pixel	(0028,0002)	M	The number of data samples per pixel		✓	Always set (1)	

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Attribute Name	Tag	Usage	Description	Generated By		Value	
				Usr	Sys	Options	Default
>Photometric Interpretation	(0028,0004)	M	Interpretation of pixel data (MONOCHROME1/2, PALETTE COLOR, RGB, etc.)		✓	Always set (MONOCHROME2)	
>Rows	(0028,0010)	M	The number of rows in the image, specified by the value sizeY in the setup dialog. Default is 5216	✓		Always set	
>Columns	(0028,0011)	M	The number of columns in the image, specified by the value sizeX in the setup dialog. Default is 4096	✓		Always set	
>Bits Allocated	(0028,0100)	M	Number of bits per pixel allocated		✓	Always set (8)	
>Bits Stored	(0028,0101)	M	Number of bits per pixel actually stored		✓	Always set (8)	
>High Bit	(0028,0102)	M	The most-significant-bit in the pixel		✓	Always set (7)	
>Pixel Representation	(0028,0103)	M	Pixel representation (unsigned – 0 or signed – 1)		✓	Always set (0)	
>Pixel Data	(7FE0,0010)	M	The pixel data		✓	Always set	

Table 16 Basic Grayscale Image Box Attributes

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2.1.2.4.2.4 SOP Specific Conformance to Basic Color Image Box SOP Class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Printing DICOM studies to a B&W or color printer
                - ➢ Proposed Presentation Contexts
                    - ➢ SOP Specific Conformance to Basic Color Image Box SOP Class

Print AE issues the following DIMSE-N commands for the Basic Color Image Box SOP Class:
N-SET.

Attribute Name	Tag	Usage	Description	Generated By		Value	
				Usr	Sys	Options	Default
Image Position	(2020,0010)	M	Same as 2.1.2.4.2.3, SOP Specific Conformance to Basic Grayscale Image Box SOP Class				
Polarity	(2020,0020)	U	Same as 2.1.2.4.2.3, SOP Specific Conformance to Basic Grayscale Image Box SOP Class				
Basic Color Image Sequence	(2020,0111)	M	The image data attributes		✓	Always set (but only for Color Images.)	
>Samples Per Pixel	(0028,0002)	M	The number of data samples per pixel		✓	Always set (3)	
>Photometric Interpretation	(0028,0004)	M	Interpretation of pixel data (MONOCHROME1/2, PALETTE COLOR, RGB, etc.)		✓	Always set (RGB)	

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Attribute Name	Tag	Usage	Description	Generated By		Value	
				Usr	Sys	Options	Default
>Planar Configuration	(0028 0006)	M	Planar configuration (color-by-pixel = 0 or color-by-plane =1)	✓		Configurable by user in DICOM Setup as either color-by-pixel or color-by-plane.	
>Rows	(0028,0 010)	M	The number of rows in the image, specified by the value sizeY in the setup dialog. Default is 5216	✓		Always set	
>Columns	(0028,0 011)	M	The number of columns in the image, specified by the value sizeX in the setup dialog. Default is 4096	✓		Always set	
>Bits Allocated	(0028,0 100)	M	Number of bits per sample allocated		✓	Always set (8)	
>Bits Stored	(0028,0 101)	M	Number of bits per sample actually stored		✓	Always set (8)	
>High Bit	(0028,0 102)	M	The most-significant-bit in the sample		✓	Always set (7)	
>Pixel Representation	(0028,0 103)	M	Pixel representation (unsigned – 0 or signed – 1)		✓	Always set (0)	
>Pixel Data	(7FE0,0 010)	M	The pixel data		✓	Always set	

Table 17 Basic Color Image Box Attributes

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2.1.2.4.2.5 SOP Specific Conformance to Printer SOP Class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Printing DICOM studies to a B&W or color printer
        - ➢ Proposed Presentation Contexts
          - ➢ SOP Specific Conformance to Printer SOP Class

HD11 issues the following DIMSE-N commands for the Printer SOP Class:

N-GET.

Attribute Name	Tag	Usage SCU/SCP
Printer Status	(2110,0010)	U/M
Printer Status Info	(2110,0020)	U/M

Table 18 Printer Attributes

Note: These printer commands are issued for internal use only. The printer status is never reported back to the user.

2.1.2.5 Obtaining a list of scheduled work from the HIS via Modality Worklists

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Obtaining a list of scheduled work from the HIS via Modality Worklists

HD11 provides Standard Conformance to the following DICOM V3.0 **Worklist Management** SOP Class as an SCU.

SOP Class Name	SOP Class UID	Role
Modality Worklist Info Model - FIND	1.2.840.10008.5.1.4.31	SCU

Table 19: SOP Class Supported by Worklist Management Service

HD11 requests the transfer of worklists with the DIMSE C-FIND command.

2.1.2.5.1 Associated Real-World Activity

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Obtaining a list of scheduled work from the HIS via Modality Worklists
        - ➢ Associated Real-World Activity

HD11 obtains scheduled worklists from the Modality Worklist Server in two ways; the user can manually request a fresh copy of the desired worklist from the Modality Worklist Server by pressing the Refresh button on the Patient Selection screen, also requests can be made on a polled basis in the background, with a polling interval configured by the user.

If HD11 is not connected to the network, the 'Refresh' button is grayed-out.   If HD11 is connected to the network, the 'Refresh' button is enabled; the user can then press it to perform a manual refresh of HD11's worklist: HD11 will first negotiate a C-ECHO with the server to verify that the MWL server is live and if live, perform the C-Find.

Note that if HD11 is not connected to the Modality Worklist Server network, the worklist cached in HD11 may be out-of-date with the worklist maintained by the Modality Worklist Server. Nevertheless, the cached worklist is available for use on portable exams.

When HD11 is reconnected to the network a fresh copy of the current list is requested.

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2.1.2.5.2 Proposed Presentation Contexts

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Initiation by Real-World Activity
            - ➢ Obtaining a list of scheduled work from the HIS via Modality Worklists
                - ➢ Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist Info Model – FIND	1.2.840.10008.5.1.4.31	Explicit VR Little Endian (Preferred, see Note)	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2		

Table 20: Worklist Management - Presentation Context

Note: If the worklist server accepts both Explicit VR Little Endian and Implicit VR Little Endian then HD11 will use Explicit VR Little Endian as a transfer syntax.

2.1.2.5.2.1 SOP Specific Conformance Statement for the Modality Worklist SOP Class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Obtaining a list of scheduled work from the HIS via Modality Worklists
        - ➢ Proposed Presentation Contexts
          - ➢ SOP Specific Conformance Statement for the Modality Worklist SOP Class

HD11 provides standard conformance to the DICOM Worklist Management Service Class.

Table 21 describes the use of attributes as both Matching Key values in the C-FIND request message, and as Return Keys in the set of C-FIND-RSP messages. The Matching Key Usage follows the DICOM Standard for attribute matching, including Single Value matching and Range matching. For those Matching Keys that are used by HD11, the Attribute Type as defined by DICOM is indicated: Required or Optional. These values indicate the degree to which the MWL SCP must support the attribute as a Matching Key.

Similarly, the Attribute Type of values used as Return Keys is given as defined by DICOM: Type 1 (required), Type 1C (conditionally required), Type 2 (required but may be NULL), Type 2C (conditionally required but may be NULL), or Type 3 (optional).

An empty value in the Matching Key column means that this value is not used as a matching key. An empty value in the Return Key column means that HD11 ignores this value. If an attribute that is non-mandatory to the SCU is not used by HD11 as a matching key and its value as a return key is ignored, the attribute is omitted from the list of attributes.

Attribute Name	Tag	Matching Key Usage	Return Key Usage
SOP Common			
Specific Character Set	(0008,0005)		Ignored by HD11.
Scheduled Procedure Step			

Attribute Name	Tag	Matching Key Usage	Return Key Usage
Scheduled Procedure Step Sequence	(0040,0100)	Required	Type 1
> Scheduled Station AE Title	(0040,0001)	Required	Type 1 Set in MPPS.
> Scheduled Procedure Step Start Date	(0040,0002)	Required	Type 1 Used in Patient Selection screen. Set in MPPS.
> Scheduled Procedure Step Start Time	(0040,0003)	Required	Type 1 Used in Patient Selection screen. Set in MPPS.
> Modality	(0008,0060)	Required	Type 1 Set in MPPS.
> Scheduled Performing Physician's Name	(0040,0006)		Type 2 Sets "Performing Physician's Name" in the MPPS. Note: This is not used to set the 'Performed by' field in the Patient Id screen however it is expected that a future release would set this value.
> Scheduled Procedure Step Description	(0040,0007)		Type 1C Set in MPPS and images. May be used to set "Description" field on the Patient Selection screen, and "Study Description" in images: 2nd choice, configurable

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Attribute Name	Tag	Matching Key Usage	Return Key Usage
> Scheduled Procedure Step Location	(0040,0011)		Type 2 Sets "Location" field on the Patient Selection screen.
> Scheduled Protocol Code Sequence	(0040,0008)		Type 1C Set as "Scheduled Action Item Code Sequence" and "Performed Action Item Code Sequence" in MPPS, and as "Scheduled Protocol Code Sequence" in images.
>> Code Value	(0008,0100)		Type 1 Set in MPPS and images.
>> Coding Scheme Designator	(0008,0102)		Type 1 Set in MPPS and images.
>> Coding Scheme Version	(0008,0103)		Type 3 If present, set in MPPS and images.
>> Code Meaning	(0008,0104)		Type 3 If present, set in MPPS and images. May also be used to set "Description" field on the Patient Selection screen, and "Study Description" in images: 3rd choice, configurable
> Scheduled Procedure Step ID	(0040,0009)		Type 1

Attribute Name	Tag	Matching Key Usage	Return Key Usage
			Set in MPPS and images.
Requested Procedure			
Requested Procedure ID	(0040,1001)		Type 1 Set in MPPS and images.
Requested Procedure Description	(0032,1060)		Type 1C Set in MPPS. May also be used to set "Description" field on the Patient Selection screen, and "Study Description" in images: 1st choice, configurable
Requested Procedure Code Sequence	(0008,1064)		Type 1C If present, set as "Procedure Code Sequence" in MPPS.
> Code Value	(0008,0100)		Type 1C Set in MPPS.
> Coding Scheme Designator	(0008,0102)		Type 1C Set in MPPS.
> Coding Scheme Version	(0008,0103)		Type 3 If present, set in MPPS.
> Code Meaning	(0008,0104)		Type 3 If present, set in MPPS.
Study Instance UID	(0020,000D)		Type 1 Set in MPPS and images.

Attribute Name	Tag	Matching Key Usage	Return Key Usage
Referenced Study Sequence	(0008,1110)		Type 2 Set in MPPS and images.
> Referenced SOP Class UID	(0008,1150)		Type 1C Ignored.
> Referenced SOP Instance UID	(0008,1155)		Type 1C Set in MPPS and images.
Reason for the Requested Procedure	(0040,1002)		Type 3 May be used to set "Indication" field on the Patient Selection screen: 1st choice, configurable
Imaging Service Request			
Accession Number	(0008,0050)		Type 2 Displayed on Patient ID screen. Set in MPPS and images.
Referring Physician's Name	(0008,0090)		Type 2 Sets "Referring Physician" in the Patient ID screen and the 'Patient Selection' screen.
Reason for Imaging Service Request	(0040,2001)		Type 3 May be used to set "Indication" field on the Patient Selection screen: 2nd choice, configurable

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Attribute Name	Tag	Matching Key Usage	Return Key Usage
Visit Relationship			
Referenced Patient Sequence	(0008,1120)		Type 2 Set in MPPS.
> Referenced SOP Class UID	(0008,1150)		Type 2 Ignored.
> Referenced SOP Instance UID	(0008,1155)		Type 2 Set in MPPS.
Patient Identification			
Patient Name	(0010,0010)		Type 1 Displayed on 'Patient ID' screen and 'Patient Selection' screen. Set in MPPS and used as a tag in images.
Patient ID	(0010,0020)		Type 1 Displayed in "MRN" field of 'Patient ID' screen and 'Patient Selection' screen. Set in MPPS and used as a tag in images.
Patient Demographic			
Patient's Birth Date	(0010,0030)		Type 2 Sets the "DOB" field on the Patient ID and Patient Selection screen. Set in MPPS.

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Attribute Name	Tag	Matching Key Usage	Return Key Usage
Patient Sex	(0010,0040)		Type 2 Sets the "Gender" field on the 'Patient ID' screen and 'Patient Selection' screen. Set in MPPS.
Patient's Weight	(0010,1030)		Type 2 Sets the "Weight" field on the 'Patient ID' and 'Patient Selection' screens.
Patient's Size	(0010,1020)		Type 3 Sets the "Height" field on the 'Patient ID' and 'Patient Selection' screens.
Table 21: Modality Worklist Usage in the Worklist Management service			

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2.1.2.6 Updating the status of a scheduled procedure

Context: Expansion of Headings and sub-headings

- ➤ Application Entity Specifications
    - ➤ HD11 AE Specification
        - ➤ Association Initiation by Real-World Activity
            - ➤ Updating the status of a scheduled procedure

HD11 provides Standard Conformance to the following DICOM V3.0 Modality Performed Procedure Step (MPPS) SOP Class as an SCU.

SOP Class Name	SOP Class UID	Role
Modality Performed Procedure Step SOP Class	1.2.840.10008.3.1.2.3.3	SCU

Table 22: SOP Class Supported by MPPS service

The system uses N-CREATE and N-SET commands to notify the MPPS Server whenever the status of a patient's study has changed.

2.1.2.6.1 Associated Real-World Activity

Context: Expansion of Headings and sub-headings

➢ Application Entity Specifications

   ➢ HD11 AE Specification

      ➢ Association Initiation by Real-World Activity

         ➢ Updating the status of a scheduled procedure

            ➢ Associated Real-World Activity

The opening of a study marks the beginning of a new Modality Performed Procedure Step (MPPS). At this time, a MPPS record is created on the MPPS SCP through the use of the N-CREATE service. If the MPPS SCP is unavailable at the time the first image is stored, the request is queued and will be sent when the MPPS SCP is available.

When the user ends the scheduled procedure by closing the study and saving any changes, the MPPS status is "Completed". Alternatively, the user may choose to cancel acquisition, the study is saved in local storage and the MPPS status becomes "Discontinued". At this time, the Study Management AE attempts to modify the MPPS on the MPPS SCP through the use of the N-SET service. If the MPPS SCP is unavailable, the request is queued and will be sent when the MPPS SCP is available..

2.1.2.6.2 Proposed Presentation Contexts

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Updating the status of a scheduled procedure
        - ➢ Associated Real-World Activity
          - ➢ Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Performed Procedure Step	1.2.840.1000 8.3.1.2.3.3	Explicit VR Little Endian (Preferred, see Note)	1.2.840.10008.1. 2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1. 2		

Table 20: MPPS - Presentation Context

Note: If the SCP accepts both Explicit VR Little Endian and Implicit VR Little Endian then HD11 will use Explicit VR Little Endian.

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2.1.2.6.2.1 SOP Specific Conformance Statement for the MPPS SOP Class

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
  - ➢ HD11 AE Specification
    - ➢ Association Initiation by Real-World Activity
      - ➢ Updating the status of a scheduled procedure
        - ➢ Associated Real-World Activity
          - ➢ Proposed Presentation Contexts
            - ➢ SOP Specific Conformance Statement for the MPPS SOP Class

HD11 provides standard conformance to the DICOM MPPS Service Class.

The updated attributes are shown in Table 21. The "N_CREATE Usage" column shows the attributes transmitted when the status of the study changes to "IN_PROGRESS". The "N-SET Usage" column shows the attributes transmitted when the status of the study changes to "COMPLETED" or "DISCONTINUED".

Note: The following fields are copied from the selected MWL entry to the Patient ID screen:

Accession Number,
Patient's Name,
Patient's ID,
Patient's Birth Date
Patient's Sex
Referring Physician's Name
Study description

Usually, the performing physician will accept the information in the Patient ID Screen, as is, however the physician has the option of editing the information before starting the study. If the physician edits this information then the MPPS N-CREATE command that is sent to the MPPS server on study start will use the edited information and not the original MWL information.

Attribute Name	Tag	N-CREATE Usage	N-SET Usage
Specific Character Set	(0008,0005)	Not used, even though some attributes may	Not used, even though some attributes may

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Attribute Name	Tag	N-CREATE Usage	N-SET Usage
		contain characters from the Latin 1 character set	contain characters from the Latin 1 character set
Performed Procedure Step Relationship			
Scheduled Step Attribute Sequence	(0040,0270)	Present	Not allowed
> Study Instance UID	(0020,000D)	If available from the MWL; else synthesized by the host imaging system	Not allowed
> Referenced Study Sequence	(0008,1110)	If present in MWL else NULL	Not allowed
>> Referenced SOP Class UID	(0008,1150)	Detached Study Mgmt SOP Class: 1.2.840.10008.3.1.2.3.1	Not allowed
>> Referenced SOP Instance UID	(0008,1155)	From the MWL, if present; else the SOP Instance UID of this study.	Not allowed
> Accession Number	(0008,0050)	From the "Accession number" field of the Patient ID screen	Not allowed
> Requested Procedure ID	(0040,1001)	If available from the MWL; else NULL	Not allowed
> Requested Procedure Description	(0032,1060)	If available from the MWL; else NULL	Not allowed
> Scheduled Procedure Step ID	(0040,0009)	If available from the MWL; else NULL	Not allowed
> Scheduled Procedure Step Description	(0040,0007)	If available from the MWL; else NULL	Not allowed
> Scheduled Protocol Code Sequence	(0040,0008)	If available from the MWL; else NULL	Not allowed
>> Code Value	(0008,0100)	From the MWL	Not allowed
>> Coding Scheme Designator	(0008,0102)	From the MWL	Not allowed
>> Coding Scheme Version	(0008,0103)	From the MWL	Not allowed
>> Code Meaning	(0008,0104)	From the MWL	Not allowed

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Attribute Name	Tag	N-CREATE Usage	N-SET Usage
Patient Name	(0010,0010)	Generated from the "Name" fields of the Patient ID screen	Not allowed
Patient ID	(0010,0020)	From the "MRN" field of the Patient ID screen	Not allowed
Patient's Birth Date	(0010,0030)	From the "Birth Date" field of the Patient ID screen	Not allowed
Patient Sex	(0010,0040)	From the "Gender" field of the Patient ID screen	Not allowed
Referenced Patient Sequence	(0008,1120)	If available from the MWL; else NULL	Not allowed
> Referenced SOP Class UID	(0008,1150)	Detached Patient Mgmt SOP Class UID 1.2.840.10008.3.1.2.1.1	Not allowed
> Referenced SOP Instance UID	(0008,1155)	If available from the MWL; else NULL	Not allowed
Performed Procedure Step Information			
Performed Procedure Step ID	(0040,0253)	If available from the MWL, else generated by HD11	Not allowed
Performed Station AE Title	(0040,0241)	AE Title of HD11	Not allowed
Performed Station Name	(0040,0242)	Same as the 'Performed Station AE Title', tag (0040,0241)	Not allowed
Performed Location	(0040,0243)	If available from the MWL, else NULL	Not allowed
Performed Procedure Step Start Date	(0040,0244)	Date of the acquisition of the first image in the study	Not allowed
Performed Procedure Step Start Time	(0040,0245)	Time of the acquisition of the first image in the study	Not allowed

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Attribute Name	Tag	N-CREATE Usage	N-SET Usage
Performed Procedure Step Status	(0040,0252)	"IN PROGRESS"	"COMPLETED" or "DISCONTINUED"
Performed Procedure Step Description	(0040,0254)	If "Scheduled Procedure Description" available from MWL, else "Indication" field from Patient ID screen	Not used
Performed Procedure Type Description	(0040,0255)	If "Scheduled Procedure Description" available from MWL, else "Indication" field from Patient ID screen	Not used
Procedure Code Sequence	(0008,1032)	If "Requested Procedure Code Sequence" available from the MWL; else generated by HD11	If "Requested Procedure Code Sequence" available from the MWL; else NULL
> Code Value	(0008,0100)	From the MWL	From the MWL
> Coding Scheme Designator	(0008,0102)	From the MWL	From the MWL
> Coding Scheme Version	(0008,0103)	If available from the MWL; else omitted	If available from the MWL; else omitted
> Code Meaning	(0008,0104)	If available from the MWL; else omitted	If available from the MWL; else omitted
Performed Procedure Step End Date	(0040,0250)	NULL (empty string sent)	Date "End Study" is pressed.
Performed Procedure Step End Time	(0040,0251)	NULL (empty string sent)	Time "End Study" is pressed.
Image Acquisition Results			
Modality	(0008,0060)	"US"	Not allowed

Attribute Name	Tag	N-CREATE Usage	N-SET Usage
Study ID	(0020,0010)	If MWL is used, set to "Requested Procedure ID" if available from the MWL; else the empty string. This "DICOM Study ID" differs from the value of "Study ID" in DICOM images.	Not allowed
Performed Protocol Code Sequence	(0040,0260)	If "Scheduled Protocol Code Sequence" available from the MWL; else NULL	If "Scheduled Protocol Code Sequence" available from the MWL; else NULL
> Code Value	(0008,0100)	From the MWL	From the MWL
> Coding Scheme Designator	(0008,0102)	From the MWL	From the MWL
> Coding Scheme Version	(0008,0103)	If available from the MWL; else omitted	If available from the MWL; else omitted
> Code Meaning	(0008,0104)	If available from the MWL; else omitted	If available from the MWL; else omitted
Performed Series Sequence	(0040,0340)	One item representing the series used for this MPPS	One item representing the series used for this MPPS
> Performing Physician's Name	(0008,1050)	From the "Performed By" field of the Patient ID screen	From the "Performed By" field of the Patient ID screen
> Protocol Name	(0018,1030)	"CLR Standard" for all exams.	"CLR Standard" for all exams.
> Operator's Name	(0008,1070)	From the "Performed By" field of the Patient ID screen; else NULL	From the "Performed By" field of the Patient ID screen; else NULL
> Series Instance UID	(0020,000E)	Synthesized by HD11	Synthesized by HD11
> Series Description	(0008,103E)	NULL	NULL
> Retrieve AE Title	(0008,0054)	NULL	NULL

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Attribute Name	Tag	N-CREATE Usage	N-SET Usage
> Referenced Image Sequence	(0008,1140)	NULL	NULL
> Referenced Non-image Composite SOP Instance Sequence	(0040,0220)	NULL	NULL

Table 21: Modality Performed Procedure Step N-CREATE and N-SET Attributes

2.1.3 Association Acceptance Policy

2.1.3.1 Responding to a verification request from a remote DICOM server

Context: Expansion of Headings and sub-headings

➢ Application Entity Specifications

   ➢ HD11 AE Specification

      ➢ Association Acceptance Policy

         ➢ Responding to a verification request from a remote DICOM server

HD11 provides standard conformance to the DICOM V3.0 SOP Class as shown in the Table 22.

SOP Class Name	SOP Class UID	Role
Verification SOP Class	1.2.840.10008.1.1	SCP

Table 22: SOP Class Supported by Verification service

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2.1.3.1.1 Associated Real-World Activity

Context: Expansion of Headings and sub-headings

- ➢ Application Entity Specifications
    - ➢ HD11 AE Specification
        - ➢ Association Acceptance Policy
            - ➢ Responding to a verification request from a remote DICOM server
                - ➢ Associated Real-World Activity

The ultrasound system employs a Verification SCP to reply to verification requests sent by remote devices. This will allow the remote device to ensure the availability of HD11 on the network, within the constraints of the network topology, and timeout values.

HD11 employs a 'high security' paradigm and will only respond to C-Echo requests from DICOM Servers that it knows about. Specifically, the following steps must have been performed:

1. In DICOM Setup, add the DICOM server to the list of DICOM servers.

2. Assign the server to the appropriate role.

Accepted Presentation Contexts

Context: Expansion of Headings and sub-headings

➢ Application Entity Specifications

   ➢ HD11 AE Specification

      ➢ Association Acceptance Policy

         ➢ Responding to a verification request from a remote DICOM server

            ➢ Accepted Presentation Contexts

Only one association is established for each verification attempt. When the association is opened, the presentation contexts noted in Table 23 are accepted.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification SOP Class	1.2.840.10008.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR Little Endian	1.2.840.10008.1.2		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

Table 23: Accepted Presentation Contexts

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3. HD11 as a Media Storage Application

The implementation model, application data flow diagram, functional definition of the HD11 AE, sequencing of real world activities are the same as in section 2.

3.1 File Meta Information for the HD11 AE

Context: Expansion of Headings and sub-headings

- ➢ HD11 as a Media Storage Application
  - ➢ File Meta Information for the HD11 AE

Element	Implementation Value
Implementation Class UID	1.2.840.113543.6.6.4.0
Implementation Version Name	HD11_1.0

Table 24: Implementation Identifying Information

3.2 Real-World Activities

3.2.1 Saving a DICOM Study to removable media

Context: Expansion of Headings and sub-headings

> ➢ HD11 as a Media Storage Application
>> ➢ Real-World Activities
>>> ➢ Saving a DICOM Study to removable media

The HD11 AE conforms to the Application Profile for Ultrasound Media Storage applications. For all SOP Classes described in the Application Profile, this AE performs in the role of File Set Creator (FSC) and File Set Updater (FSU). The particular physical media available is 3.5″ MOD or CD-RW. For previously imported studies, HD11 will export the IODs using the transfer syntax and tags that were used when HD11 originally imported the study.

Supported Application Profile	Real-World Activity	Roles	Service Class Option
STD-US-SC-SF&MF	Export Study	FSC and FSU	Interchange
STD-US-ID-SF&MF	Export Study	FSC and FSU	Interchange

Table 25: Export study to DICOM media

The Export DICOM Objects Application Entity acts as FSC and FSU using the Interchange Option.

When saving a DICOM study to removable media, the user can specify the photometric interpretation and transfer syntax used to create DICOM files on the media. The options available to users are listed in Table 26.

Transfer Syntax and Photometric Interpretation options for removable media
Uncompressed (DICOM Implicit VR Little Endian) Palette Color
Uncompressed (DICOM Explicit VR Little Endian) Palette Color
Uncompressed (DICOM Implicit VR Little Endian) RGB
Uncompressed (DICOM Explicit VR Little Endian) RGB
RLE (lossless) Compression Palette Color
RLE (lossless) Compression RGB
JPEG (lossy) Compression YBR

Table 26: Photometric Interpretation and Transfer Syntax Options for Saving to Removable Media

HD11 creates special PanView internal files called 'dataset' files that are never exported to a PACS but may be optionally exported to media. These DICOM files are not exported in network storage since they are only of use to HD11's PanView application and HD11 does not support networked Query/Retrieve. However, these files may optionally be exported to media with the rest of the study for archival purposes. The study could later be imported into an HD11 system and the user would be able to click on the dataset file to enter into the PanView application

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3.2.2 Reading a DICOM study from removable media

Context: Expansion of Headings and sub-headings

- ➢ HD11 as a Media Storage Application
  - ➢ Real-World Activities
    - ➢ Reading a DICOM study from removable media

When requested to read the media directory, the Import DICOM Objects Application Entity acts as FSR using the Interchange Option,

The user choosing the Import operation from a menu initiates importing images. See the system user manuals for a description of the specific user interface capabilities.

3.2.2.1 Import DICOM Object Specifications

Context: Expansion of Headings and sub-headings

> HD11 as a Media Storage Application
>> Real-World Activities
>>> Reading a DICOM study from removable media
>>>> Import DICOM Object Specifications

The HD11 AE conforms to the Application Profile for Ultrasound Media Storage applications. For all SOP Classes described in the Application Profile, this AE performs in the role of File Set Reader (FSR). The particular physical media available is 3.5″ MOD or CD-RW. Image Display and Spatial Calibration of Single and Multi-Frame image objects on any media in the Ultrasound Application Profile is therefore supported.

Supported Application Profile	Real-World Activity	Roles	Service Class Option
STD-US-SC-SF&MF-FLOP	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD128	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD230	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD540	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD650	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD12	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-MOD23	Import Studies	FSR	Interchange
STD-US-SC-SF&MF-CDR	Import Studies	FSR	Interchange

Table 27: DICOM Objects Application Profiles

HD11's DICOM Study Import feature is designed for importing studies that *were originally exported from* **HD11**. The system will not allow the user to import ultrasound studies created by another manufacturers system.

3.2.2.2 Media Storage Application Profiles

Context: Expansion of Headings and sub-headings

- ➢ HD11 as a Media Storage Application
  - ➢ Real-World Activities
    - ➢ Reading a DICOM study from removable media
      - ➢ Media Storage Application Profiles

The supported Application Profiles are listed in Table 27 DICOM Objects Application Profiles.

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3.2.2.3 SOP Specific Conformance For "DICOM Directory" SOP Class

Context: Expansion of Headings and sub-headings

- ➢ HD11 as a Media Storage Application
  - ➢ Real-World Activities
    - ➢ Reading a DICOM study from removable media
      - ➢ SOP Specific Conformance For "DICOM Directory"

Type 1, 1C, 2, and 2C data elements present in the Basic Directory Object are supported as required in DICOM 3.0, Parts 3 and 10. They are used for properly navigating through the directory data structures, recognizing and conforming to the character set being used, and the Import Study user interface to aid in the selection of objects to import. Data elements that elicit behavior that is specific to the Application Entity are described in the sections below. If Type 2 data elements are null or if Type 3 data elements are absent, the data elements are ignored by the system and the corresponding display fields in the user interface screen(s) are left blank.

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3.2.2.4 File-Set Identification Module

Context: Expansion of Headings and sub-headings

> HD11 as a Media Storage Application
>> Real-World Activities
>>> Reading a DICOM study from removable media
>>>> File-Set Identification Module

Contents of the File-set Identification Module are not displayed or otherwise used in this version of HD11.

3.2.2.5 Directory Information Module

Context: Expansion of Headings and sub-headings

> ➢ HD11 as a Media Storage Application
>> ➢ Real-World Activities
>>> ➢ Reading a DICOM study from removable media
>>>> ➢ Directory Information Module

All data elements are used as described in DICOM 3.0 Part 3 for Basic Directory Object Definitions. As stated in the Ultrasound Application Profile, "The (DICOMDIR) Directory shall include Directory Records of PATIENT, STUDY, SERIES, and IMAGE corresponding to the information object files in the File-set". Given this requirement, HD11 uses these directory records to identify the study to import. If there are DICOM image files on the import media that do not appear in the DICOMDIR Directory Information Module (either because references to these files were omitted or because the Directory Information Module, optional in DICOM but required in the Ultrasound Application Profile, does not exist), these files are not recognized by the system.

HD11 ignores directory Record Types other than those above.

HD11 also ignores the "File-set consistency Flag" (0004, 1212).

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3.2.2.5.1 Patient Directory Record

Context: Expansion of Headings and sub-headings

- ➢ HD11 as a Media Storage Application
    - ➢ Real-World Activities
        - ➢ Reading a DICOM study from removable media
            - ➢ Directory Information Module
                - ➢ Patient Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008, 0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details.
Patient Name	(0010, 0010)	2	Displayed to help the user identify the patient folder in which to place the studies for this patient.
Patient ID	(0010, 0020)	1	Displayed to help the user identify the patient folder in which to place the studies for this patient.

Table 28: Specific Usage of Patient Directory Record Information

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3.2.2.5.2 Study Directory Record

Context: Expansion of Headings and sub-headings

- ➢ HD11 as a Media Storage Application
    - ➢ Real-World Activities
        - ➢ Reading a DICOM study from removable media
            - ➢ Directory Information Module
                - ➢ Study Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008, 0005)	1C	The Default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details.
Study Date	(0008, 0020)	1	Used in displaying list of studies to user
Study Time	(0008, 0030)	1	Used in displaying list of studies to user
Accession Number	(0008, 0050)	2	Stored in the system database
Study Description	(0008, 1030)	2	Generated
Study Instance UID	(0020, 000D)	1C	Stored in the system database
Study ID	(0020, 0010)	1	Stored in the system database

Table 29: Specific Usage of Study Directory Record Information

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3.2.2.5.2.1 Series Directory Record

Context: Expansion of Headings and sub-headings

- ➢ HD11 as a Media Storage Application
    - ➢ Real-World Activities
        - ➢ Reading a DICOM study from removable media
            - ➢ Directory Information Module
                - ➢ Series Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008, 0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details.
Modality	(0008, 0060)	1	Only US is supported. Other modalities are ignored.
Series Description	(0008, 103E)	3	Stored
Series Number	(0020, 0011)	1	Stored

Table 30: Specific Usage of Series Directory Record Information

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3.2.2.5.2.2 Image Directory Record

Context: Expansion of Headings and sub-headings

> HD11 as a Media Storage Application

>> Real-World Activities

>>> Reading a DICOM study from removable media

>>>> Directory Information Module

>>>>> Image Directory Record

Attribute Name	Tag	Type	Usage
Specific Character Set	(0008, 0005)	1C	The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details.
Referenced File ID	(0004, 1500)	1C	Used
Referenced SOP Class UID in File	(0004, 1510)	1C	Used
Referenced SOP UID in File	(0004, 1511)	1C	Used
Referenced Transfer Syntax UID in File	(0004, 1512)	1C	Used
Image Date	(0008, 0023)	3	Used for ordering the thumbnail display. On Export, comes from the image.
Image Time	(0008, 0033)	3	Used for ordering the thumbnail display. On Export, comes from the image.

Table 31: Specific Usage of Image Directory Record Information

4. Communications Profiles

HD11 provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

5. Extensions/Specializations/Privatizations

5.1 General

Context: Expansion of Headings and sub-headings

- ➢ Extensions/Specializations/Privatizations
  - ➢ General

The following private tag is used by HD11's display compensation application:

Tag	VR	Value
0031, 6030	UL	Private data

5.2 2D

Context: Expansion of Headings and sub-headings

- ➢ Extensions/Specializations/Privatizations
  - ➢ 2D

There are no extensions, specializations or privatizations specific to HD11's 2D application.

5.3 PanView

Context: Expansion of Headings and sub-headings

- ➢ Extensions/Specializations/Privatizations
  - ➢ PanView

PanView image files contain the following private tags for use by HD11's PanView application:

Tag	VR	Value
7777, 0010	LO	Private data
7777, 1001	DA	Private data
7777, 1002	CS	Private data

Tag	VR	Value
7777, 0010	LO	Private data
7777, 1003	LO	Private data
7777, 1014	LT	Private data

5.4 QLAB

QLAB is a stand-alone software product that provides advanced off-line ultrasound quantification capabilities. The user can use QLAB to review and quantify HD11 images. The HD11 user exports images in DICOM format to media in order to 'sneaker-net' those images to a PC running the QLAB software. QLAB 4.0 will be the first release to support all HD11 DICOM image formats.

Parts of QLAB require additional information that can only be encoded in DICOM private tags. The following private tags are used by HD11 to support the QLAB application:

Note: Not all private tags are used all the time,

DICOM Tag	VR	Value	DICOM Tag	VR	Value
0029,0060	LO	Private data	200d,0036	LO	Private data
0029,6050	CS	Private data	200d,0037	LO	Private data
0029,6051	UL	Private data	200d,0038	LO	Private data
0029,6052	UL	Private data	200d,0039	LO	Private data
0029,6053	DS	Private data	200d,003a	LO	Private data
0029,6030	UL	Private data	200d,3001	LO	Private data
0029,6031	UL	Private data	200d,300b	OB	Private data
0029,6032	UL	Private data	200d,3012	OB	Private data
0029,6033	DS	Private data	200d,3101	LO	Private data
0029,6034	DS	Private data	200d,3102	LO	Private data
0029,6036	SL	Private data	200d,3103	LO	Private data
200d,0030	LO	Private data	200d,3104	LO	Private data
200d,0031	LO	Private data	200d,3105	LO	Private data
200d,0032	LO	Private data	200d,3106	LO	Private data
200d,0033	LO	Private data	200d,3107	LO	Private data
200d,0034	LO	Private data	200d,3108	LO	Private data
200d,0035	LO	Private data	200d,3201	LO	Private data

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DICOM Tag	VR	Value		DICOM Tag	VR	Value
200d,3202	LO	Private data		200d,3404	UL	Private data
200d,3203	LO	Private data		200d,3405	UL	Private data
200d,3204	LO	Private data		200d,3406	UL	Private data
200d,3205	LO	Private data		200d,3407	UL	Private data
200d,3302	LO	Private data		200d,3408	UL	Private data
200d,3303	LO	Private data		200d,3409	UL	Private data
200d,3304	LO	Private data		200d,340a	UL	Private data
200d,3305	LO	Private data		200d,340b	UL	Private data
200d,3306	LO	Private data		200d,340c	UL	Private data
200d,3307	LO	Private data		200d,340d	UL	Private data
200d,3308	LO	Private data		200d,340e	UL	Private data
200d,3309	LO	Private data		200d,340f	UL	Private data
200d,330a	UL	Private data		200d,3a10	UL	Private data
200d,3401	CS	Private data		200d,3a11	UL	Private data
200d,3402	CS	Private data				
200d,3403	CS	Private data				

6. Configuration

The DICOM setup screen allows the user to configure a significant number of options including:

- For the HD11 system, it's AE Title and Port number.

- For DICOM servers, their AE Title, port number, IP address.

- For Storage SCP's and for media storage, the image format.

- For DICOM Printers, many DICOM configuration settings

- For a MWL server, the query parameters: scheduled procedure start range, modality, AE Title.

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7. Support for Extended Character Sets

HD11 will offer support for Japanese, Chinese, and Russian. This includes translating system text into these languages and allowing the user to input Japanese, Chinese, and Cyrillic characters into the system. One important aspect of this is that the user will be able to enter these special characters into the Patient ID screen.

The present DICOM standard allows Code Extension Techniques
for multi-byte characters.   Therefore, as well as the default character set (ISO-IR 6),
HD11 supports the following extended character sets:

- ISO-IR 100   Latin Alphabet No. 1

- ISO-IR 87   Japanese Kanji (ideographic), Hiragana (phonetic) and Katakana (phonetic)

- ISO-IR 13   Japanese Katakana (phonetic)

- ISO-IR 159   Supplementary Kanji (ideographic)

- ISO-IR 144   Russian Cyrillic

Important Note:

When an Application Entity which does not support Code Extension Techniques receives a Data Set which includes multi-byte characters from an HD11 system, misrepresentation of characters may occur.

The DICOM standard states that it is the responsibility of the Application Entity which receives the Data Sets to take whatever action is considered necessary to minimize the effect of misrepresented characters. It is not the responsibility of the HD11 system to take such action.

7.1 Support for Russian and Japanese Markets

HD11 uses "Code-extension techniques" to encode Japanese stroke based characters and Russian Cyrillic characters in DICOM tags with value representations of SH, LO, ST, LT, UT, and PN.

The technique requires two things in a DICOM file that contains these characters:

1. Add the Optional Specific Character Set TAG (0008,0005) and set the value to the list of identifiers for all the non-standard character sets that will appear in any string in the file separated by backslashes. For example:

   For Japanese systems:
   (0008,0005) = "ISO 2022 IR 13\ISO 2022 IR 87\ISO 2022 IR 159\ISO 2022 IR 100"

   For Russian systems:
   (0008,0005) = "ISO 2022 IR 144\ISO 2022 IR 100"

   For English systems:
   (0008,0005) = "ISO 2022 IR 100"

2. Embed escape sequences in the strings that contain Asian or Cyrillic characters to cause the DICOM interpreting code to switch from one character set to another.

The escape sequences to be used are defined as:

"<ESC>$B"   ISO - IR 87 Japanese Kanji (ideographic), Hiragana (phonetic), Katakana (phonetic)

"<ESC>(B"   ISO - IR 6 ASCII - DICOM default character set

"<ESC>$(D"   ISO - IR 159 Supplementary Kanji (ideographic)

"<ESC>(J"   ISO - IR 144 Russian Cyrillic

7.2 Additional Support for Japanese Markets

Japanese markets will have additional fields to the Patient ID screen so that the user can enter the Roman, Ideographic, and Phonetic representations of a patient's name.
The DICOM patient name field, tag (0010,0010) of type PN, is a single string field that contains up to five components (last, first, middle, title, honorific) in up to three language variants (Roman, Idiographic, and Phonetic.) The format of the patient name field is:

"Roman-last^Roman-first^Roman-middle^Roman-prefix^Roman-suffix=
Ideographic-last^Ideographic-first^Ideographic-middle^Ideographic-prefix^Ideographic-suffix=
Phonetic-last^Phonetic-first^Phonetic-middle^Phonetic-prefix^Phonetic-suffix"

In the above string the five components are separated with the '^' Ascii character and the three language variants are separated by the '=' Ascii character. The only required

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component is the Roman Last name. All other components are optional. Trailing '^' and '=' characters can be excluded.

When this string is encoded in a DICOM image file or DICOMDIR directory file, the escape sequences appropriate for the character sets used are inserted into the string for storage as a single-byte string. On media import the escape sequences are removed.

7.3 Support for Chinese Markets

The current DICOM standard as of this release of HD11 does not support Chinese character sets. HD11 however provides support for Chinese customers so that they can enter text using Chinese characters.

If the system is set up for Chinese, then (unlike for Japanese markets) the user can enter just one version of the patient name. This would make Chinese systems work in the same way as Russian, English, French, Italian, and Spanish systems. The Chinese user will be able to enter the patient name using a combination of Chinese and Roman characters – all of the characters will appear wherever the system displays the patient name (image, report, Search for Study window, etc.).

Since the DICOM Standard does not offer support for Chinese characters, all Chinese characters entered into the Patient ID screen will be lost if a user exports or backs up a study to media. This will be noticed when the study is imported back into the system; upon import, each Chinese character will be replaced with a question mark ("?") character. The question marks will make it obvious to the user that the characters were lost.

If the user enters a patient name that consists entirely of Chinese characters, then the name will come back as "??????". In this case, the user will have to identify the study in the "Import Study" and "Search for Study" windows by the MRN. If the user enters a patient name that consists of a combination of Roman and Chinese characters, then Roman characters will be preserved, and the name will come back as something like "Lee ????????". This will give users who like to back up their studies the flexibility of entering a patient name with a combination of Roman and Chinese characters, and have at least part of the name come back during import.

Note that the original Chinese name will be "burned into" study images that are exported to media. These Chinese characters will remain on the images when the studies are imported back into the system.

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