GE Medical Systems

Technical Publications

Direction 2204609-100
Revision 2

Advantage™ CR Quality Assurance (ACRQA) Workstation V2.0

CONFORMANCE STATEMENT for DICOM V3.0

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REVISION HISTORY

REV	DATE	REASON
Draft A	Dec 03 1997	Initial draft
Draft B	Dec 04 1997	Updated after initial review
Official Draft C	Dec 05 1997	Updated after engineering review
Official Draft D (Rev 0)	Dec 09 1997	Updated after review
Official Draft E	Dec 12 1997	Updated after GSCP review
Rev 1	Jan 11 1998	Updated for rev 1.
Rev 2	Jan 29 1998	Update section 3.5.5.2 to show “Photometric Interpretation” as configurable (MONOCHROME1 or MONOCHROME2 or both)

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1. INTRODUCTION

1.1 OVERVIEW

This DICOM Conformance Statement is divided into Sections as described below:

Section 1 (Introduction), which describes the overall structure, intent, and references for this Conformance Statement

Section 2 (Network Conformance Statement), which specifies the GEMS equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 3 (Computed Radiography Information Object Implementation), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a Computed Radiography Information Object

Section 4 (Patient Root Query/Retrieve Information Model), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a Patient Root Query/Retrieve service.

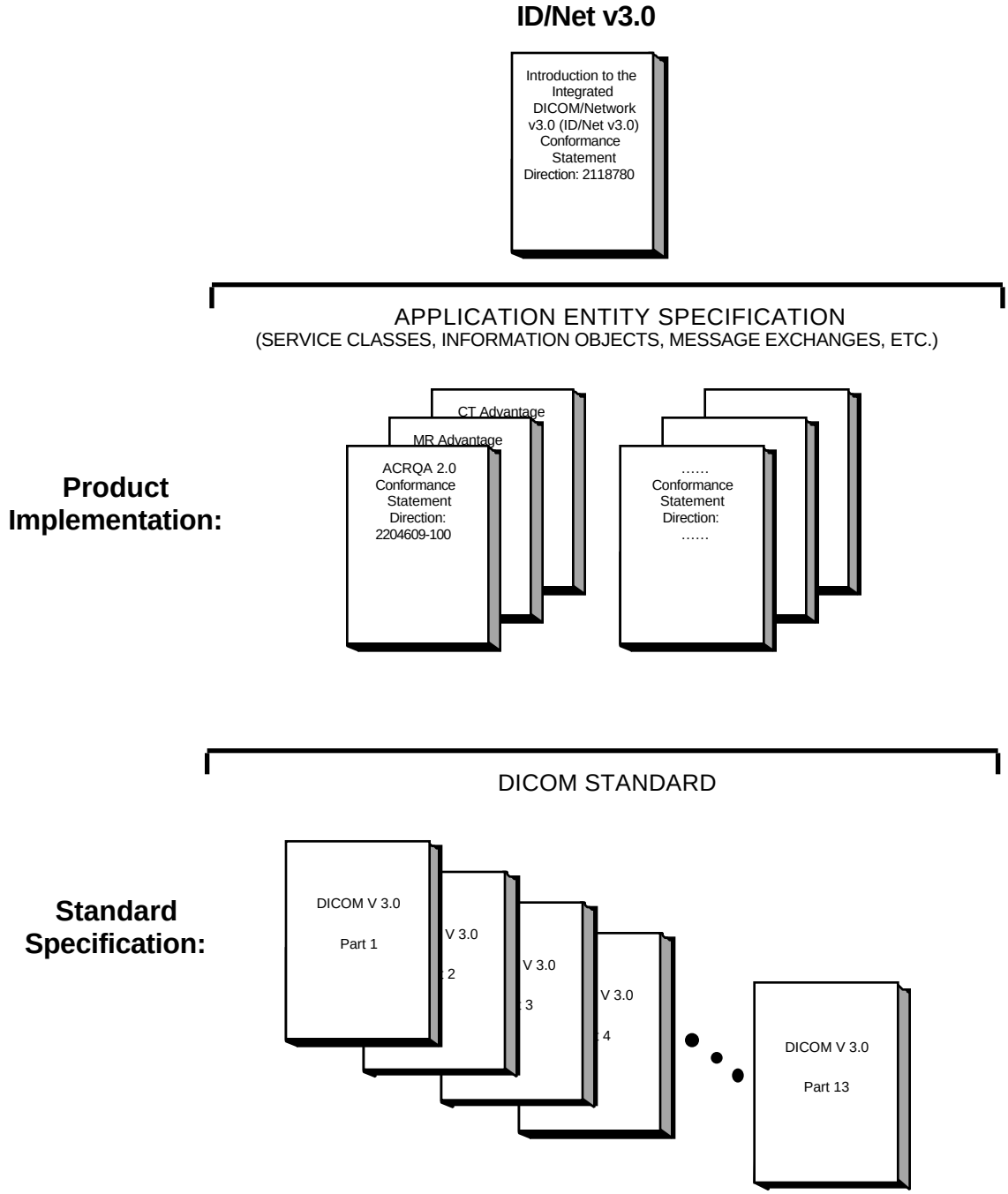
Section 5 (Study Root Query/Retrieve Information Model), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of a Study Root Query/Retrieve service.

Section 6 (Modality Worklist Information Model), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of the Modality Worklist service.

Section 7 (Print Management SOP Class), which specifies the GEMS equipment compliance to DICOM requirements for the implementation of the Print Management SOP Class.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEMS Conformance Statements and their relationship with the DICOM v3.0 Conformance Statements is shown in the following Illustration.



This document specifies the DICOM v3.0 implementation. It is entitled:

> ***Advantage CR Quality Assurance (ACRQA) Workstation 2.0***
> *Conformance Statement for DICOM v3.0*
> *Direction **2204609-100***

This DICOM Conformance Statement documents the DICOM v3.0 Conformance Statement and Technical Specification required to interoperate with the GEMS network interface. Introductory information, which is applicable to all GEMS Conformance Statements, is described in the document:

> *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0)*
> *Conformance Statement*
> *Direction: 2118780.*

This Introduction familiarizes the reader with DICOM terminology and general concepts. It should be read prior to reading the individual products' GEMS Conformance Statements.

The GEMS Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM v3.0 Part 8 standard.

For more information including Network Architecture and basic DICOM concepts, please refer to the Introduction.

For the convenience of software developers, there is "collector" Direction available. By ordering the collector, the Introduction described above and all of the currently published GEMS Product Conformance Statements will be received. The collector Direction is:

> *ID/Net v3.0 Conformance Statements*
> *Direction: 2117016*

For more information regarding DICOM v3.0, copies of the Standard may be obtained by written request or phone by contacting:

> NEMA Publication
> 1300 North 17th Street
> Suite 1847
> Rosslyn, VA 22209
> USA
> Phone: (703) 841-3200

1.3 INTENDED AUDIENCE

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM v3.0 Standards and with the terminology and concepts which are used in those Standards.

If readers are unfamiliar with DICOM v3.0 terminology they should first refer to the document listed below, then read the DICOM v3.0 Standard itself, prior to reading this DICOM Conformance Statement document.

> *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0)*
> *Conformance Statement*
> *Direction: 2118780*

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document, in conjunction with the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780,* to provide an unambiguous specification for GEMS implementations. This specification, called a Conformance Statement, includes a DICOM v3.0 Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical data exchanged using DICOM v3.0. The GEMS Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEMS devices are capable of using different Information Object Definitions. For example, a GEMS CT Scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this DICOM Conformance Statement are the Module Definitions which define all data elements used by this GEMS implementation. If the user encounters unspecified private data elements while parsing a GEMS Data Set, the user is well advised to ignore those data elements (per the DICOM v3.0 standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements which are sent by GEMS devices.

1.5 IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM v3.0 Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.
- **Validation** - Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications.

  Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM v3.0 Standard. DICOM v3.0 will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEMS protocol is based on DICOM v3.0 as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM v3.0. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) reflected on by these DICOM Conformance Statements**. The **user** should ensure that any non–GE provider,

which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

- **To be informed of the evolution of the implementation described in this document, the User is advised to regularly check the GE Internet Server, accessible via anonymous ftp (GE Internet Server Address: ftp.med.ge.com, 192.88.230.11).**
- **Interaction** - It is the sole responsibility of the **non–GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1.6 REFERENCES

A list of references which is applicable to all GEMS Conformance Statements is included in the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*.

The information object implementation refers to DICOM PS 3.3 (Information Object Definition).

1.7 DEFINITIONS

A set of definitions which is applicable to all GEMS Conformance Statements is included in *the Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*.

1.8 SYMBOLS AND ABBREVIATIONS

A list of symbols and abbreviations which is applicable to all GEMS Conformance Statements is included in the *Introduction to the Integrated DICOM/Network v3.0 (ID/Net v3.0) Conformance Statement, Direction: 2118780*.

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the compliance to DICOM conformance requirements for the relevant **Networking** features on this GEMS product. Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section.

Please also note that the details of the DICOM conformance related to Information Models supported by this product are included in subsequent sections of this DICOM Conformance Statement.

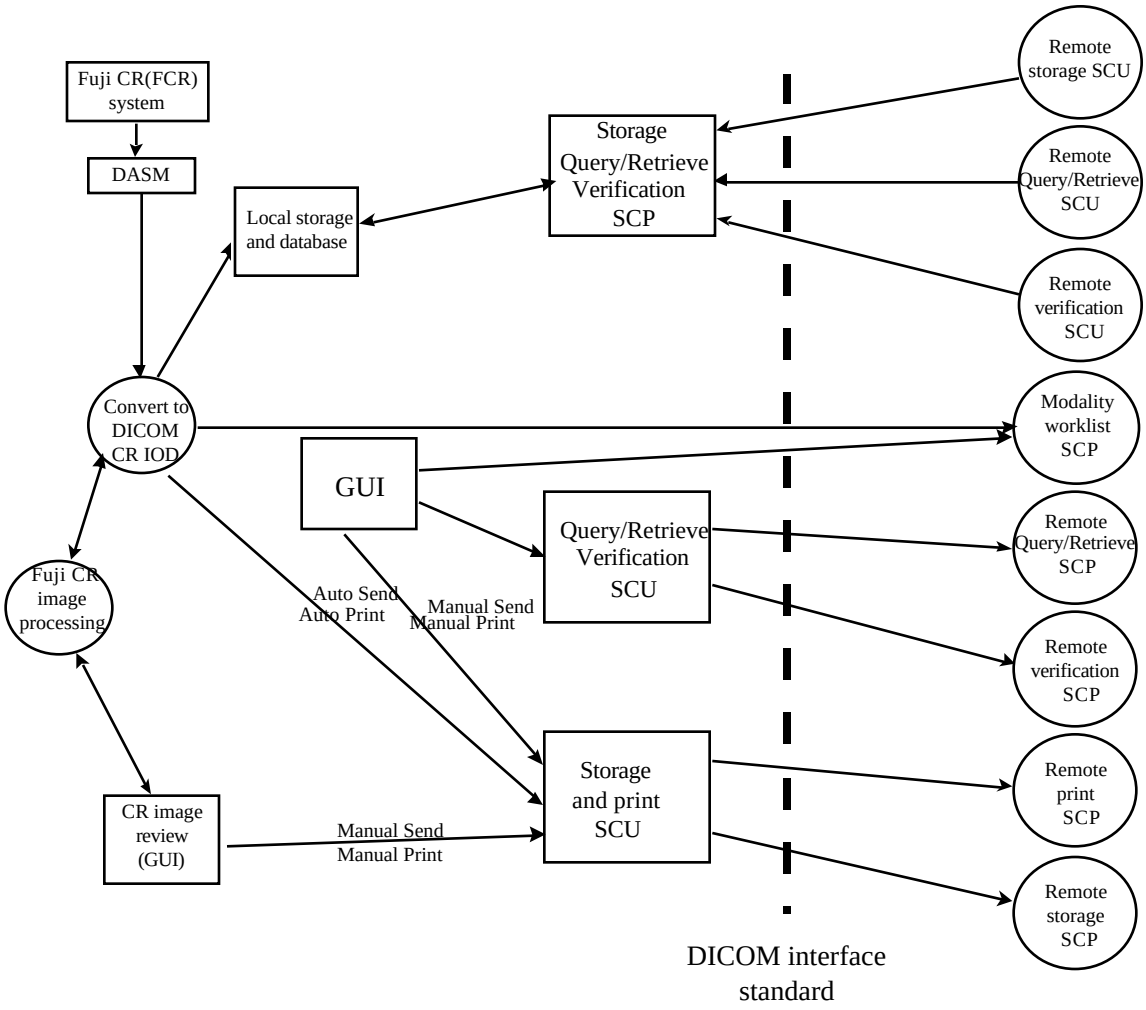
The ACRQA 2.0 workstation is an image database, storage, communication, display and image processing facility for CR images. It is a single application entity that stores CR images sent to it by SCU's, queries remote SCP's for CR images based on several standard query models and retrieves requested images. It sends CR images to DICOM print SCP's and to CR image store SCP's. In its primary mode it receives images over the DASM from Fuji CR systems in Fuji proprietary format and converts them to DICOM CR IOD's. Once the Fuji images get converted to DICOM CR IOD's they are available on the DICOM network.

The ACRQA 2.0 workstation is configured by modifying several configuration files which are created during installation.

2.2 IMPLEMENTATION MODEL

2.2.1 Application Data Flow Diagram

The Basic and Specific Application models for this device are shown in the following Illustration. The ACRQA 2.0 workstation implements a single AE title through different UNIX processes as shown.



2.2.2 Functional Definition of AE's

An ACRQA 2.0 AE provides the following functions:

- Initiates association for verification (C-ECHO).
- Initiates association for query and retrieve.
- Initiates association for CR image store.
- Initiates association for CR image print.

- Responds to association requests for verification.
- Responds to associations requests for CR image store.
- Responds to association request for local image database query and retrieve.

2.2.3 Sequencing of Real-World Activities

Auto-send and auto-print functions are applicable for images received by the DASM manager from a Fuji CR system only. Images received by the storage-scp are not auto routed.

2.2.3.1 Fuji Image processing

The pixel data received by the ACRQA 2.0 over the DASM from a Fuji CR systems is termed **unprocessed** data. **Processed** data is obtained by passing the unprocessed data through the Fuji CR image processing module. The Fuji CR image processing algorithms transform the unprocessed data non-linearly and hence it is not possible to restore unprocessed data from processed data. Transmission of processed or unprocessed data may be configured for each destination Application Entity.

2.2.3.2 Auto/Manual Print

1. If the processed data is available, it is copied to the DICOM-out directory and an entry is made in the DICOM-out database.
2. If only unprocessed data is available then the image is first passed through the CR image processing chain to produce processed data. The processed data is then copied to the DICOM-out directory and an entry is made in the DICOM-out database.
3. The DICOM print process picks up the image and sends it to the printer.

Note: Only processed data can be printed from the ACRQA 2.0.

2.2.3.3 Auto/Manual Send

1. If the destination AE title is marked to receive unprocessed data, then unprocessed data (if it exists) is copied to the to the DICOM-out directory and an entry is made in the DICOM-out database. If unprocessed data does not exist for the selected image (e.g. images received by the storage SCP normally have only the processed data) then an error message is displayed.
2. If the destination AE is marked to receive processed data, then the processed data is copied to the DICOM-out directory. If processed data does not exist, then the unprocessed data is first passed through the image processing chain to produce the processed data and this processed data is copied to the DICOM-out directory. An entry is made in the DICOM-out database.
3. The DICOM send process picks up the image and sends it to the remote storage SCP.

Note: Both processed and unprocessed image data can be sent out from the ACRQA 2.0.

2.3 AE SPECIFICATIONS

2.3.1 AE Specification

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCU**:

SOP Class Name	SOP Class UID
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9
Verification SOP Class	1.2.840.10008.1.1

This Application Entity provides Standard Conformance to the following DICOM V3.0 SOP Classes as an **SCP** :

SOP Class Name	SOP Class UID
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Verification SOP Class	1.2.840.10008.1.1

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

Application Context Name	1.2.840.10008.3.1.1.1

The Maximum Length PDU negotiation is included in all association establishment requests.

The maximum length PDU for an association is:

Maximum Length PDU	100KB

The SOP Class Extended Negotiation is not supported.

The maximum number of Presentation Context Items that will be proposed is 2.

The user information Items sent by this product are :

- Maximum PDU Length
- Implementation UID
- Implementation Version Name

Maximum PDU length is configurable.

2.3.1.1.2 Number of Associations

The maximum number of simultaneous associations accepted by ACRQA 2.0 for image store, query and retrieve, of local images or to service an verification request is **two**. Additionally an association may be in progress for printing to remote DICOM printer, an association may be open for querying remote SCP's and up to **four** associations may be open for sending images to remote storage SCP's.

Note: For sending images a maximum of one association is open per remote AE title. ACRQA 2.0 can simultaneously send to four distinct remote AE's. Each association is handled by a thread of the DICOM send process. For example if there are 3 jobs all destined to same AE, then a single thread will be active and hence a single association for sending is open at a given time. If there are 5 jobs in the queue all going to 5 different AE titles, then there will be 4 threads active sending to 4 AE's while one job is still waiting in the queue until one of the first threads completes.

2.3.1.1.3 Asynchronous Nature

Asynchronous mode is not supported. All operations will be performed synchronously.

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM v3.0 Implementation is:

Implementation UID	1.2.840.113619.6.62

The Implementation Version Name for this DICOM v3.0 Implementation is:

Implementation Version Name	GE-ACRQADCM1197

2.3.1.2 Association Initiation Policy

2.3.1.2.1 Real-World Activity Auto/Manual Send

2.3.1.2.1.1 Associated Real-World Activity

Two distinct real world activities initiate an image send process. The DICOM association initiation and data transfer process are identical in both cases. In either case a DICOM C-STORE is initiated. There is one association per image (multiple images in a study are sent in multiple associations). The two real world activities are auto send and manual send as described below.

When an image is received by ACRQA 2.0 from a Fuji CR system via DASM and auto send destinations (up to four destinations can be enabled) are enabled (either directly via the GUI or through the Fuji distribution code) the newly arrived image is put in the DICOM send queue which then initiates the DICOM C-STORE.

Alternatively, requests to send images to remote destinations can be entered through the GUI in three ways:

1. select multiple images, multiple series, multiple studies or multiple patients (limited only by the space allocated to the DICOM out directory) on the patient list and push the selection to any or all configured destinations,
2. select from the viewer after image manipulation the displayed image to be sent to up to any or all configured destinations, and
3. select from the Fuji image re-processing screen the loaded image after image processing to be sent to any or all configured destinations.

2.3.1.2.1.2 Proposed Presentation Context Table

Presentation Context Table - Proposed					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1	SCU	None

2.3.1.2.1.2.1 SOP Specific DICOM Conformance Statement for Image Storage SOP Classes

This implementation performs single C-STORE operation per association. Each image is sent on a separate association.

Upon receiving a C-STORE confirmation containing an error or refused status, the association is aborted. After three tries (number of tries is 3 by default but can be

configured to be any value), if the store is not successful, a warning message is displayed and the image is removed from the queue.

Upon receiving a successful C-STORE confirmation , the GUI and the database are updated to reflect the fact that the image has been stored. No record of where it has been sent is maintained.

This implementation also supports configurable timers, an "Association establishment timer", a "Store timer" and an "Inactivity timer."

2.3.1.2.2 Real-World Activity Auto/Manual Print

2.3.1.2.2.1 Associated Real-World Activity

Two distinct real world activities initiate an image print process. The DICOM association initiation and data transfer process are identical in both cases. The two real world activities are auto print and manual print as described below.

When an image is received by ACRQA 2.0 from a Fuji CR system via the DASM, and auto print destinations (up to four) are enabled (either directly via the GUI or through the Fuji distribution code), the newly arrived image is put in the DICOM print queue for printing to the print SCP.

Alternatively, images can be selected from the GUI for printing by a remote print SCP. There are 3 ways to select images for printing from the GUI:

1. select multiple images, multiple series, multiple studies or multiple patients (only limited by the space allocated to the DICOM out directory) on the patient list and push the selection to any or all configured destinations,
2. select from the viewer after image manipulation the displayed image to be printed by any or all configured destinations, and
3. select from the Fuji image re-processing screen the loaded image after image processing to be printed any or all configured destinations.

2.3.1.2.2.2 Proposed Presentation Context Table

Presentation Context Table - Proposed					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended**
Name	**UID**	**Name List**	**UID List**		**Negotiation**
Basic Grayscale Print Management	1.2.840.10008.5.1.1.9	Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

2.3.1.2.2.2.1 SOP Specific DICOM Conformance Statement for Basic Gray scale Print Management Meta SOP Class

Please refer to Section 7 for details.

2.3.1.2.3 Real-World Activity DICOM Echo/Verification

2.3.1.2.3.1 Associated Real-World Activity

Upon manual request ACRQA 2.0 AE requests verification of communication to the DICOM verification SCP on the destination system. The activity is invoked in two ways:

1. from the service tool which is menu driven (this also does an IP level ping before a C-ECHO is performed), or
2. from the GUI.

2.3.1.2.3.2 Proposed Presentation Context Table

Presentation Context Table - Proposed					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.3.1.2.4 Real-World Activity Query/Retrieve

2.3.1.2.4.1 Associated Real-World Activity

This activity is invoked from the GUI. Operator selects a remote Query/Retrieve SCP from a list and initiates a Query request. The results of the Query are displayed on the GUI. The operator then can select multiple series or multiple images to be retrieved.

In case of a failure the SCU extracts the status code and error comment from the response and displays it in a dialog box and terminates the activity.

2.3.1.2.4.2 Proposed Presentation Context Table

Presentation Context Table - Proposed					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	See NOTE 1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	See NOTE 2

Note: **1. Find Extended Negotiation** is supported. The ACRQA 2.0 negotiates with the following information :

Field Name	Value	Description of Field
Relational Queries	0	Relational Query not supported
	1	Relational Query supported

Note: **2. Move Extended Negotiation** is supported. The ACRQA 2.0 negotiates with the following information:

Field Name	Value	Description of Field
Relational Retrieval	0	Relational Retrieval not supported
	1	Relational Retrieval supported

2.3.1.2.5 Real-World Activity Modality Worklist Query

2.3.1.2.5.1 Associated Real-World Activity

This activity is invoked when an image is received via the DASM from the Fuji CR device. There is no GUI provided for any interaction. The results of the Query are used to complete attributes in the DICOM image.

2.3.1.2.5.2 Proposed Presentation Context Table

Presentation Context Table - Proposed					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.3.1.2.5.2.1 SOP Specific DICOM Conformance Statement Modality Worklist FIND SOP Class

Please refer to Section 6 for details.

2.3.1.2.6 Real-World Activity Store Received Images

2.3.1.2.6.1 Associated Real-World Activity

The Storage SCP that responds to requests to store images is implemented as a threaded UNIX process which runs indefinitely waiting for association requests. There is no GUI provided for any interaction. It communicates with the GUI through UNIX named pipes for status updates.

The storage scp is a "full fidelity" scp, i.e., all attributes of a received image are stored and regurgitated unchanged, including foreign private elements.

2.3.1.2.6.2 Accepted Presentation Context Table

Presentation Context Table - Accepted					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCP	
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

2.3.1.2.6.2.1 SOP Specific DICOM Conformance Statement for all Storage SOP Classes

Following are the status codes the Application may send back to the SCU Equipment after performing the requested image Storage:

Service Status	Status Codes	Further Meaning	Status Code sending explanation	Related Fields sent back to the SCU
Refused	A7xx	Out of resources	A701 - Out of Disk space	(0000,0902)
	0122	SOP Class not Supported		(0000,0902)
Error	Cxxx	Cannot Understand	C700 - access denied to remote SCU C702 - internal parsing error C703 - memory allocation error C708 - error parsing out the pixel data. C704 - data compression error	(0000,0901) (0000,0902)

			C707 - file write error C706 - file open error while writing. C70B - database error	
Success	0000			None

Note that a CR image received from a SCU (as result of a retrieve operation or otherwise) might have the modality attribute set to other than CR (ex. SC). ACRQA 2.0 will assume the the image is a CR image for all its activities (including q/r operations).

2.3.1.2.7 Real-World Activity Respond to Remote Query

2.3.1.2.7.1 Associated Real-World Activity

The Storage SCP that responds to remote queries is implemented as a threaded UNIX process which runs indefinitely waiting for association requests. There is no GUI provided for any interaction. It communicates with the GUI through UNIX named pipes for status updates.

2.3.1.2.7.2 Accepted Presentation Context Table

Presentation Context Table - Accepted					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name List**	**UID List**		
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	See NOTE 1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	See NOTE 2
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	See NOTE 1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	See NOTE 2

Note: **1. Find Extended Negotiation** is supported. ACRQA 2.0 negotiates with the following information :

Field Name	Value	Description of Field
Relational Queries	0	Relational Query not supported
	1	Relational Query supported

Note: **2. Move Extended Negotiation** is supported. ACRQA 2.0 negotiates with the following information :

Field Name	Value	Description of Field
Relational Retrieval	0	Relational Retrieval not supported
	1	Relational Retrieval supported

2.3.1.2.7.2.1 SOP Specific DICOM Conformance Statement for the Patient Root Query/Retrieve Information Model - FIND and Study Root Query/Retrieve Information Model - FIND SOP Classes

Following are the status codes the Application may send back to the SCU Equipment after performing the requested **Query** :

Service Status	Status Codes	Further Meaning	Related Fields Processed if received
Failed	A900	Identifier does not match SOP Class	(0000,0901) (0000,0902)
	C700	access denied to the remote SCU	(0000,0901) (0000,0902)
Cancel	FE00	Matching terminated due to cancel	None
Success	0000	Matching is complete - No final identifier is supplied	None
Pending	FF00	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys.	Identifier

2.3.1.2.7.2.2 SOP Specific DICOM Conformance Statement for the Patient Root Query/Retrieve Information Model - MOVE, and Study Root Query/Retrieve Information Model - MOVE SOP Classes

Following are the status codes the Application may send back to the SCU Equipment after performing the requested **Retrieve** :

Service Status	Status Codes	Further Meaning	Application Behavior When sending Status Codes	Related Fields Processed if received
Failed	A801	Move Destination Unknown		(0000,0902)
	0122	SOP Class not Supported		(0000,0902)
	A900	Identifier does not match SOP Class	Match failed	(0000,0901) (0000,0902)
	Cxxx	Unable to process	C702 - object parsing error C802 - invalid chars in patient id or uid	(0000,0901) (0000,0902)
Cancel	FE00	Sub-operations terminated due to a Cancel indication		(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	B000	Sub-operations Complete - One or more Failures.	If one or more of the requested images has not been Q/C'd then these images will not be moved, and this error code will be generated. See note below.	(0000,1021) (0000,1022) (0000,1023)
Success	0000	Sub-operations Complete - No Failure.		(0000,1021) (0000,1022) (0000,1023)
Pending	FF00	Sub-operations are continuing -		(0000,1020) (0000,1021) (0000,1022) (0000,1023)

The ACRQA 2.0 supports the notion of "Quality Control" of each image. If the device is so configured, each image that is received from the Fuji CR system is held at the workstation for Q/C. After the operator has Q/C'd the image, it is marked so and is available for retrieval. Optionally, the ACRQA 2.0 can be put in a auto Q/C mode where all the images are marked as Q/C'd without operator intervention as they are received. If an image is not marked as Q/C'd, then that image will not be moved if a MOVE request is received for such an image. This implies that an image might appear in a Query list, but the image cannot actually be retrieved. In such situations, the ACRQA 2.0 SCP sends an warning status of 0xB000 with a warning string "Some images did not get moved (non-qc'd image(s))".

2.4 COMMUNICATION PROFILES

2.4.1 Supported Communication Stacks

DICOM Upper Layer (PS 3.8) is supported using TCP/IP.

2.4.2 OSI Stack

OSI stack not supported.

2.4.3 TCP/IP Stack

The TCP/IP stack is inherited from a SUN OS 5.5.2 Operating System.

2.4.3.1 API

Not applicable to this product.

2.4.3.2 Physical Medium Support

DICOM is indifferent to the Physical medium over which TCP/IP executes (e.g. Ethernet V2.0,IEEE 802.3, ATM, FDDI)

Note: For more information about the Physical Media available on the ACRQA 2.0, please refer to the Product Data Sheet.

2.4.4 Point-to-Point Stack

A 50-pin ACR-NEMA connection is not applicable to this product.

2.5 CONFIGURATION

2.5.1 Configurable Parameters

The following fields are configurable for this AE (local):

- Local AE Title
- Local IP Address
- Local Listening Port Number
- Local IP Netmask

The following fields are configurable for each remote DICOM AE:

- Remote AE Title
- Remote IP Address
- RemoteListening TCP/IP Port Number

The default router configured for the operating system is used for communicating with any node that is not on the same sub net.

The following fields are configurable:

- Association Establishment Timer
- Maximum Length PDU

2.6 SUPPORT OF EXTENDED CHARACTER SETS

ISO_IR 100 = Latin Alphabet No. 1

ISO_IR 13 = Katakana (JIS X 0201)

ISO_2022 IR_13 \ ISO 2022_IR_87 = Katakana+Kanji (JIS X 0208)

ACRQA 2.0 will store and display these characters correctly. If an image is received with any other character set then it is interpreted as the default character set (ISO_IR 100) and hence will result in incorrect display of information on the screen.

3. CR INFORMATION OBJECT IMPLEMENTATION

3.1 INTRODUCTION

This section specifies the use of the DICOM CR Image IOD to represent the information included in CR images produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

3.2 - IOD Description

3.3 - IOD Entity-Relationship Model

3.4 - IOD Module Table

3.5 - IOD Module Definition

3.2 CR IOD IMPLEMENTATION

This section specifies the subset of the DICOM CR image information object definition used to represent the information included in the images produced by this implementation.

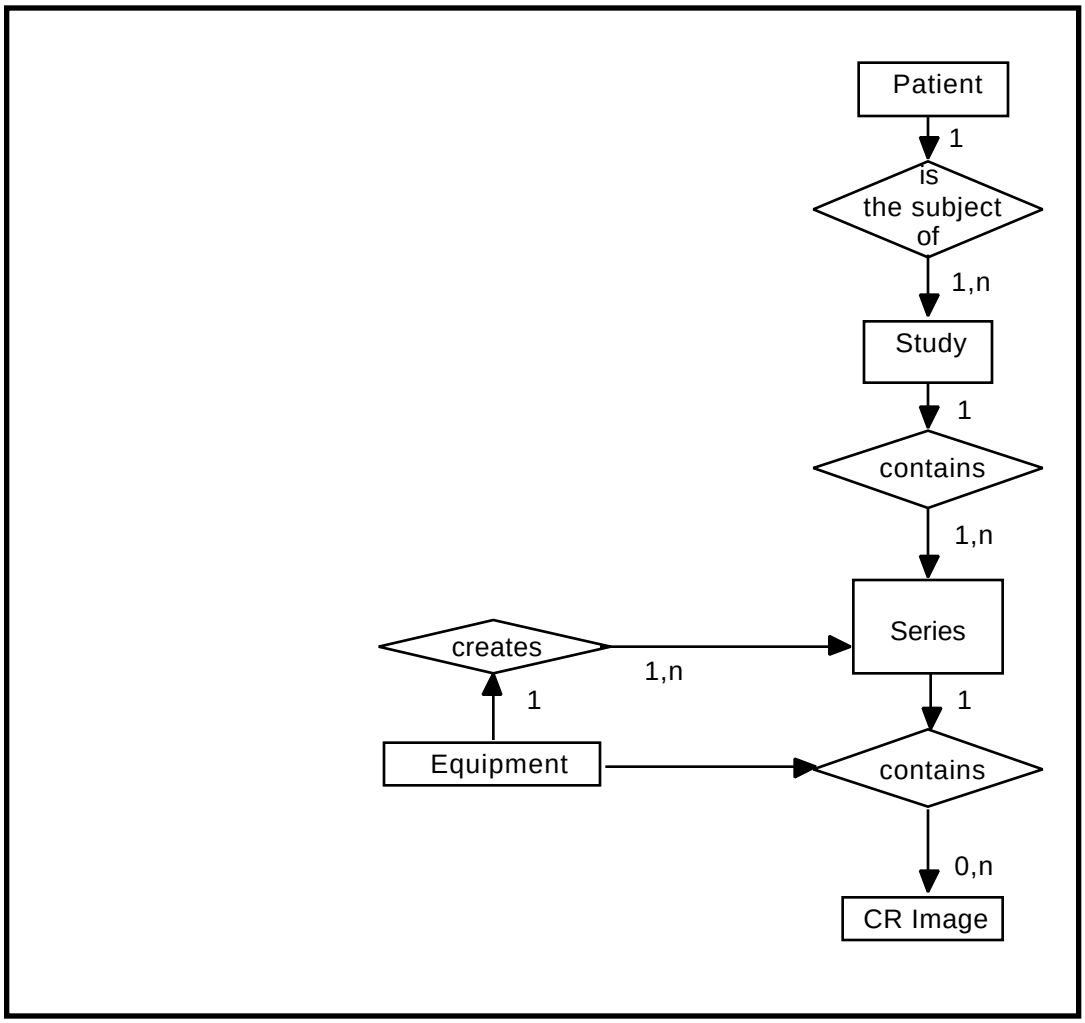
3.3 CR ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the CR Image interoperability schema is shown in Illustration 3.3-1. In this figure, the following diagrammatic convention is established to represent the information organization :

- each entity is represented by a rectangular box.
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

ACRQA 2.0 operates in two different modes (GROUP and NO-GROUP mode which is configurable). When in GROUP mode there is no limit to the number of images per series and number of series per study. When operating in NO-GROUP mode each image belongs to its own series and study, i.e., one image per series and one series per study.

ILLUSTRATION 3.3-1
CR IMAGE ENTITY RELATIONSHIP DIAGRAM



3.3.1 ENTITY DESCRIPTIONS

Please refer to DICOM Standard Part 3 (Information Object Definitions) for a description of each of the entities contained within the CR Information Object.

3.3.2 ACRQA 2.0 Mapping of DICOM entities

TABLE 3.3-1
MAPPING OF DICOM ENTITIES TO ACRQA 2.0 ENTITIES

DICOM	ACRQA 2.0 Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image

3.4 IOD MODULE TABLE

Within an entity of the DICOM v3.0 CR IOD, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into data sets.

Table 3.4-1 identifies the defined modules within the entities which comprise the DICOM v3.0 CR IOD. Modules are identified by Module Name.

See DICOM v3.0 Part 3 for a complete definition of the entities, modules, and attributes.

TABLE 3.4-1
CR IMAGE IOD MODULES

Entity Name	Module Name	Reference
Patient	Patient	3.5.1.1
Study	General Study	3.5.2.1
	Patient Study	3.5.2.2
Series	General Series	3.5.3.1
	CR Series	3.5.7.1
Equipment	General Equipment	3.5.4.1
Image	General Image	3.5.5.1
	Image Pixel	3.5.5.2
	Contrast/Bolus	Not supported
	CR Image	3.5.7.2
	Overlay Plane	Not supported
	Curve	Not supported
	Modality LUT	Not supported
	VOI LUT	3.5.7.3
	CR Image Private Attributes	3.2.12
	SOP Common	3.5.6.1

3.5 INFORMATION MODULE DEFINITIONS

Please refer to DICOM v3.0 Standard Part 3 (Information Object Definitions) for a description of each of the entities and modules contained within the CR Information Object.

The following modules are included to convey Enumerated Values, Defined Terms, and Optional Attributes supported. Type 1 & Type 2 Attributes are also included for completeness and to define what values they may take and where these values are obtained from. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard Part 3 (Information Object Definitions).

Most of the attribute values are received from the Fuji CR system. Optionally ACRQA 2.0 can connect to DICOM modality worklist SCP to obtain additional demographic information to populate the CR IOD. Optionally ACRQA 2.0 can be configured to

operate in conjunction with Fuji ID gateway to obtain additional information not sent out by standard Fuji CR ID terminal (like accession number).

3.5.1 Common Patient Entity Modules

3.5.1.1 Patient Module

This section specifies the Attributes of the Patient that describe and identify the Patient who is the subject of a diagnostic Study. This Module contains Attributes of the patient that are needed for diagnostic interpretation of the Image and are common for all studies performed on the patient.

TABLE 3.5-1
PATIENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Fuji CR System Patient Name, see note.
Patient ID	(0010,0020)	2	Fuji CR System Patient ID, see note
Patient's Birth Date	(0010,0030)	2	Fuji CR System birth date, see note
Patient's Sex	(0010,0040)	2	Fuji CR System sex, see note
Patient's Size	(0010,1020)	2	Value returned from MWL SCP, see note
Patient's Weight	(0010,1030)	2	Value returned from MWL SCP, see note
Patient's Address	(0010,1040)	2	Value returned from MWL SCP, see note
Patient's Telephone No.	(0010,2154)	2	Value returned from MWL SCP, see note

Note: These values might change if the image is edited on the ACRQA 2.0

3.5.2 Common Study Entity Modules

The following Study IE Modules are common to all Composite Image IODs which reference the Study IE. These Module contain Attributes of the patient and study that are needed for diagnostic interpretation of the image.

3.5.2.1 General Study Module

This section specifies the Attributes which describe and identify the Study performed upon the Patient.

TABLE 3.5-2
GENERAL STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	See Note 1 and Note 2
Study Date	(0008,0020)	2	Fuji CR System exposure date.
Study Time	(0008,0030)	2	Fuji CR system exposure time.
Referring Physician's Name	(0008,0090)	2	If available from MWL SCP, that value is sent
Requesting Physician	(0032,1032)	2	If available from MWL SCP, that value is sent
Study ID	(0020,0010)	2	Fuji CR System exam number else exposure date. See Note 2.
Accession Number	(0008,0050)	2	Fuji CR system exam number else exposure date. See Note 2.
Study Description	(0008,1030)	3	Fuji CR system menu code string

Note: 1. The Study Instance UID is created by the system. However, if modality work list (MWL) is enabled on the system and a modality worklist SCP exists which supplies a Study Instance UID, then that UID is used.

Note: 2. May change if the image is edited.

3.5.2.2 Patient Study Module

This section defines Attributes that provide information about the Patient at the time the Study was performed.

TABLE 3.5-3
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient's Size	(0010,1020)	3	If available from MWL SCP, that value is sent
Patient's Weight	(0010,1030)	3	If available from MWL SCP, that value is sent

3.5.3 Common Series Entity Modules

The following Series IE Modules are common to all Composite Image IODs which reference the Series IE.

3.5.3.1 General Series Module

This section specifies the Attributes which identify and describe general information about the Series within a Study.

TABLE 3.5-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	CR = Computed Radiography
Series Instance UID	(0020,000E)	1	Created, may change if image is edited
Series Number	(0020,0011)	2	Fuji CR System menu code
Series Date	(0008,0021)	3	Fuji CR System exposure date
Series Time	(0008,0031)	3	Fuji CR System exposure time
Body Part Examined	(0018,0015)	3	Fuji CR System menu code string.

3.5.4 Common Equipment Entity Modules

The following Equipment IE Module is common to all Composite Image IODs which reference the Equipment IE.

3.5.4.1 General Equipment Module

This section specifies the Attributes which identify and describe the piece of equipment which produced a Series of Images.

TABLE 3.5-5
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	"Fuji Photo Film Co. Ltd. And GE Medical Systems"
Institution Name	(0008,0080)	3	Fuji CR System supplied institution name
Station Name	(0008,1010)	3	System UNIX hostname-Fuji CR System ID
Software Versions	(0018,1020)	3	"GEMS ACRQA 2.0"

3.5.5 Common Image Entity Modules

The following Image IE Modules are common to all Composite Image IODs which reference the Image IE.

3.5.5.1 General Image Module

This section specifies the Attributes which identify and describe an image within a particular series.

TABLE 3.5-6
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Fuji CR System supplied film number
Patient Orientation	(0020,0020)	2C	Sent zero length.
Image Date	(0008,0023)	2C	Date image is received from Fuji CR System
Image Time	(0008,0033)	2C	Time image is received from Fuji CR System
Image Type	(0008,0008)	3	See 3.5.5.1.1.2
Acquisition Date	(0008,0022)	3	Fuji CR System exposure date
Acquisition Time	(0008,0032)	3	Fuji CR System exposure date
Image comments	(0020, 4000)	3	Fuji CR System menu code

3.5.5.1.1 General Image Attribute Descriptions

3.5.5.1.1.1 Patient Orientation

This attribute is always sent with zero length.

3.5.5.1.1.2 Image Type

Value 1 shall have the following Enumerated Values:

- ORIGINAL identifies an Original Image as received from the Fuji CR system
- DERIVED identifies a Derived Image which is derived from the ORIGINAL image after Fuji CR image processing is applied

Value 2 shall have the following Enumerated Values:

- PRIMARY identifies a Primary Image
- SECONDARY identifies a Secondary Image which has undergone some type of image manipulation, ex. Rotation etc.

3.5.5.2 Image Pixel Module

This section specifies the Attributes that describe the pixel data of the image.

TABLE 3.5-7
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	1

Photometric Interpretation	(0028,0004)	1	MONOCHROME1 MONOCHROME2 See Note 1
Rows	(0028,0010)	1	Fuji CR System sent ROWS.
Columns	(0028,0011)	1	Fuji CR System sent COLUMNS.
Bits Allocated	(0028,0100)	1	16
Bits Stored	(0028,0101)	1	10
High Bit	(0028,0102)	1	9
Pixel Representation	(0028,0103)	1	0 (unsigned)
Pixel Aspect Ratio	(0028,0034)	1C	"1/1"
Pixel Data	(7FE0,0010)	1	

Note 1: If the photometric interpretation on the image is MONOCHROME1 and the Storage SCP supports only MONOCHROME2 (or vice versa), then the image is first inverted before sending. This is configurable per AE Title for Storage SCPs via the DICOM configuration service tool. Configurable options are MONOCHROME1, MONOCHROME2, or both.

3.5.6 General Modules

The SOP Common Module is mandatory for all DICOM IODs.

3.5.6.1 SOP Common Module

This section defines the Attributes which are required for proper functioning and identification of the associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD.

TABLE 3.5-8
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	1.2.840.10008.5.1.4.1.1.1
SOP Instance UID	(0008,0018)	1	Created.
Specific Character Set	(0008,0005)	1C	ISO_IR 100 = Latin Alphabet No. 1 ISO_IR 13 = Katakana (JIS X 0201) ISO_2022 IR_13 \ ISO_2022_IR_87 = Katakana+Kanji (JIS X 0208)

3.5.7 CR Modules

This Section describes CR Equipment, and Image Modules. These Modules contain Attributes that are specific to CR Image IOD.

3.5.7.1 CR Series Module

This Module contains IOD Attributes that describe a computed radiography series performed on the patient.

TABLE 3.5-9
CR SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Body Part Examined	(0018,0015)	2	Fuji CR System sent Body Part.
View Position	(0018,5101)	2	Fuji CR System sent View Position

3.5.7.2 CR Image Module

The table in this Section contains IOD Attributes that describe CR images.

TABLE 3.5-10
CR IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Imager Pixel Spacing	(0018,1164)	3	Fuji CR System pixel spacing
Pixel Spacing	(0028,0030)	3	Fuji CR System pixel spacing
Sensitivity	(0018,6000)	3	Fuji CR Sensitivity
Acquisition Device Processing Code	(0018. 1400)	3	Fuji CR Menu Code
Acquisition Device Processing Description	(0018, 1401)	3	Fuji CR Menu Code String
CR Exposure Menu Code	(0023, 1000)	3	Fuji CR Exposure Menu Code
CR Exposure Menu String	(0023, 1010)	3	Fuji CR Exposure Menu String
CR EDR Mode	(0023, 1020)	3	Fuji CR EDR Mode
CR Latitude	(0023, 1030)	3	Fuji CR Latitude
CR Group Number	(0023, 1040)	3	Fuji CR Group Number
CR Image Serial Number	(0023, 1050)	3	Fuji CR Image Serial Number
CR Bar Code Number	(0023, 1060)	3	Fuji CR Bar Code Number
CR Film Output Exposure	(0023, 1070)	3	Fuji CR Film Output Exposure
CR Film Format	(0023, 1080)	3	Fuji CR Film Format
CR S-Shift String*	(0023, 1090)	3	Fuji CR S-Shift String*
CR S-Shift *	(0023, 2000)	3	Fuji CR S-Shift
CR C-Shift*	(0023, 2010)	3	Fuji CR C-Shift*
CR GT*	(0023, 2020)	3	Fuji CR GT*
CR GA*	(0023, 2030)	3	Fuji CR GA*
CR GC*	(0023, 2040)	3	Fuji CR GC*
CR GS*	(0023, 2050)	3	Fuji CR GS*

CR RT*	(0023, 2060)	3	Fuji CR RT*
CR RE*	(0023, 2070)	3	Fuji CR RE*
CR RN*	(0023, 2080)	3	Fuji CR RN*
CR DRT*	(0023, 2090)	3	Fuji CR DRT*
CR DRE*	(0023, 3000)	3	Fuji CR DRE*
CR DRN*	(0023, 3010)	3	Fuji CR DRN*
CR ORE	(0023, 3020)	3	Fuji CR ORE
CR ORN	(0023, 3030)	3	Fuji CR ORN
CR ORD	(0023, 3040)	3	Fuji CR ORD
CR Cassette Size	(0023, 3050)	3	Fuji CR Cassette Size
CR Machine ID	(0023, 3060)	3	Fuji CR Machine ID
CR Machine Type	(0023, 3070)	3	Fuji CR Machine Type
CR Technician Code	(0023, 3080)	3	Fuji CR Technician Code
CR Energy Subtraction value	(0023, 3090)	3	Fuji CR Energy Subtraction value
CR Distribution Code	(0023, 30F0)	3	Fuji CR Distribution Code
CR Shutters Applied	(0023, 30FF)	3	Fuji CR Shutters Applied

3.5.7.3 VOI LUT Module

This section specifies the Attributes that describe the VOI LUT.

TABLE 3.5-11
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Window Center	(0028,1050)	3	Single value set according to body part
Window Width	(0028,1051)	1C	Single value set according to body part
Window Center & Width Explanation	(0028,1055)	3	Not used

3.5.8 Private data dictionary

TABLE 3.8-1
PRIVATE CREATOR IDENTIFICATION (GEMS_ACRQA_2.0_BLOCK1)

Attribute Name	Tag	VR	VM
Private Creator	(0023, 0010)	LO	1
CR Exposure Menu Code	(0023, 1000)	LO	1
CR Exposure Menu String	(0023, 1010)	LO	1
CR EDR Mode	(0023, 1020)	LO	1
CR Latitude	(0023, 1030)	LO	1
CR Group Number	(0023, 1040)	LO	1
CR Image Serial Number	(0023, 1050)	LO	1
CR Bar Code Number	(0023, 1060)	LO	1
CR Film Output Exposure	(0023, 1070)	LO	1
CR Film Format	(0023, 1080)	LO	1

CR S-Shift String*	(0023, 1090)	LO	1
CR S-Shift *	(0023, 2000)	SS	1
CR C-Shift*	(0023, 2010)	LO	1
CR GT*	(0023, 2020)	LO	1
CR GA*	(0023, 2030)	LO	1
CR GC*	(0023, 2040)	LO	1
CR GS*	(0023, 2050)	LO	1
CR RT*	(0023, 2060)	LO	1
CR RE*	(0023, 2070)	LO	1
CR RN*	(0023, 2080)	US	1
CR DRT*	(0023, 2090)	LO	1
CR DRE*	(0023, 3000)	LO	1
CR DRN*	(0023, 3010)	US	1
CR ORE	(0023, 3020)	LO	1
CR ORN	(0023, 3030)	SS	1
CR ORD	(0023, 3040)	SS	1
CR Cassette Size	(0023, 3050)	LO	1
CR Machine ID	(0023, 3060)	LO	1
CR Machine Type	(0023, 3070)	LO	1
CR Technician Code	(0023, 3080)	LO	1
CR Energy Subtraction value	(0023, 3090)	LO	1
CR Distribution Code	(0023, 30F0)	LO	1
CR Shutters Applied*	(0023, 30FF)	US	1

Note: * These values may change if the user re-processes the image on the system

4. PATIENT ROOT QUERY/RETRIEVE INFORMATION MODEL DEFINITION

4.1 INTRODUCTION

This section specifies the use of the DICOM Patient Root Query/Retrieve Model used to organize data and against which a Query/Retrieve will be performed. The contents of this section are:

4.2 - Information Model Description

4.3 - Information Model Entity-Relationship Model

4.4 - Information Model Keys

4.2 PATIENT ROOT INFORMATION MODEL DESCRIPTION

Patient root information model is supported by the ACRQA 2.0 SCP. The SCU does not support this information model.

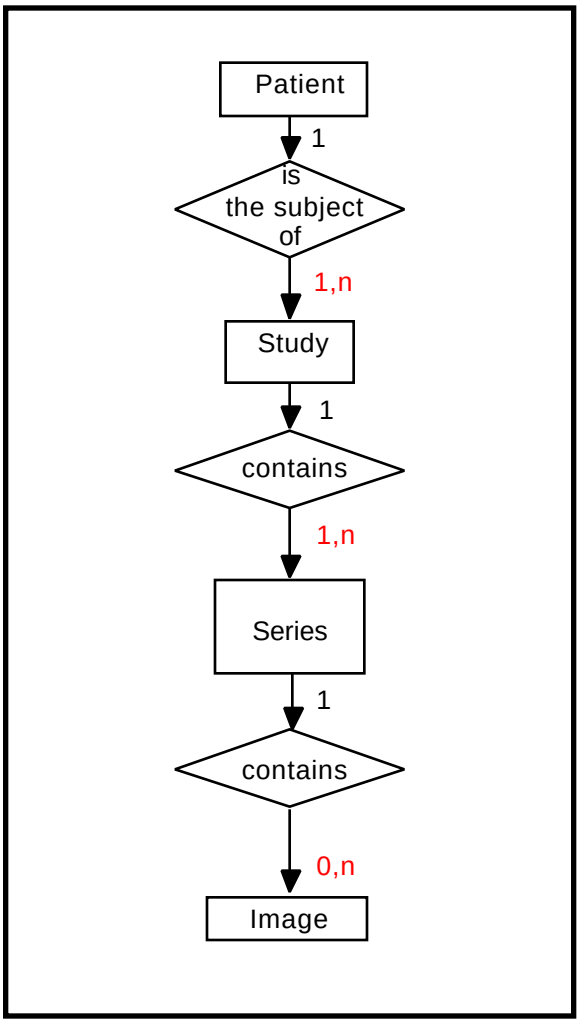
4.3 PATIENT ROOT INFORMATION MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the Patient Root Information Model schema is shown in Illustration 4.3-1**.** In this figure, the following diagrammatic convention is established to represent the information organization :

- each entity is represented by a rectangular box.
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. In other words, the relationship between Series and Image can have up to n Images per Series, but the Patient to Study relationship has 1 Study for each Patient (a Patient can have more than one Study on the system, however each Study will contain all of the information pertaining to that Patient).

ILLUSTRATION 4.3-1
PATIENT ROOT QUERY/RETRIEVE INFORMATION MODEL E/R DIAGRAM



4.3.1 ENTITY DESCRIPTIONS

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of each of the levels contained within the Patient Root Query/Retrieve Information Model.

4.3.2 ACRQA 2.0 Mapping of DICOM entities

TABLE 4.3-1
MAPPING OF DICOM ENTITIES TO ACRQA 2.0 ENTITIES

DICOM	ACRQA 2.0 Entity
Patient	Patient
Study	Exam
Series	Series
Image	Image

4.4 INFORMATION MODEL KEYS

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of each of the levels contained within the Patient Root Query/Retrieve Information Model.

The following Level descriptions are included to specify what data elements are supported and what type of matching can be applied. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard PS 3.4 (Service Class Specifications).

4.4.1 Supported Matching

Following are the types of matching that are supported by the implementation :

- Single Value matching
- Universal Matching
- Wild Card Matching
- Range of Date, Range of Time

4.4.2 Patient Level

This section defines the keys at the Patient Level of the Patient Root Query/Retrieve Information Model that are supported by this implementation.

TABLE 4.4-1
PATIENT LEVEL ATTRIBUTES FOR THE PATIENT ROOT QUERY/RETRIEVE INFORMATION MODEL

Attribute Name	Tag	Type	Note
Patient's Name	(0010,0010)	R	
Patient ID	(0010,0020)	U	

TABLE 4.4-2
Q/R PATIENT LEVEL AND LOCATION FOR RETRIEVE ATTRIBUTES

Attribute Name	Tag	Type	Note
Query Retrieve Level	(0008,0052)	-	Value = PATIENT
Retrieve AE Title	(0008,0054)	-	This value is the local AE title

4.4.3 Study Level

This section defines the keys at the Study Level of the Patient Root Query/Retrieve Information Model that are supported by this implementation.

TABLE 4.4-3
STUDY LEVEL ATTRIBUTES FOR THE PATIENT ROOT QUERY/RETRIEVE INFORMATION MODEL

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008,0020)	R	Requested by SCU, matched by SCP

Study Time	(0008,0030)	R	Requested by SCU, matched by SCP
Accession Number	(0008,0050)	R	Requested by SCU, matched by SCP
Study ID	(0020,0010)	R	Requested by SCU, matched by SCP
Study Instance UID	(0020,000D)	U	Requested by SCU, matched by SCP
Study Description	(0008,1030)	O	Requested by SCU, matched by SCP

TABLE 4.4-4
Q/R STUDY LEVEL AND LOCATION FOR RETRIEVE ATTRIBUTES

Attribute Name	Tag	Type	Note
Query Retrieve Level	(0008,0052)	-	Value = STUDY
Retrieve AE Title	(0008,0054)	-	Local AE title

4.4.4 Series Level

This section defines the keys at the Series Level of the Patient Root Query/Retrieve Information Model that are supported by this implementation.

TABLE 4.4-5
SERIES LEVEL ATTRIBUTES FOR THE PATIENT ROOT QUERY/RETRIEVE INFORMATION MODEL

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	R	Requested by SCU, matched by SCP SCU requests only CR modality SCP supports only CR modality
Series Number	(0020, 0011)	R	Requested by SCU, matched by SCP
Series Instance UID	(0020,000E)	U	Requested by SCU, matched by SCP

TABLE 4.4-6
Q/R SERIES LEVEL AND LOCATION FOR RETRIEVE ATTRIBUTES

Attribute Name	Tag	Type	Note
Query Retrieve Level	(0008,0052)	-	Value = SERIES
Retrieve AE Title	(0008,0054)	-	Local AE title

4.4.5 Image Level

This section defines the keys at the Image Level of the Patient Root Query/Retrieve Information Model that are supported by this implementation.

TABLE 4.4-7
IMAGE LEVEL ATTRIBUTES FOR THE PATIENT ROOT QUERY/RETRIEVE INFORMATION MODEL

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	R	Requested by SCU, matched by SCP
SOP Instance UID	(0008,0018)	U	Requested by SCU, matched by SCP

TABLE 4.4-8
Q/R IMAGE LEVEL AND LOCATION FOR RETRIEVE ATTRIBUTES

Attribute Name	Tag	Type	Note
Query Retrieve Level	(0008,0052)	-	Value = IMAGE
Retrieve AE Title	(0008,0054)	-	Local AE

5. STUDY ROOT QUERY/RETRIEVE INFORMATION MODEL DEFINITION

5.1 INTRODUCTION

This section specifies the use of the DICOM Study Root Query/Retrieve Model used to organize data and against which a Query/Retrieve will be performed. The contents of this section are:

5.2 - Information Model Description.

5.3 - Information Model Entity-Relationship Model

5.4 - Information Model Keys

5.2 STUDY ROOT INFORMATION MODEL DESCRIPTION

This information model is supported by both the SCU and the SCP of ACRQA 2.0.

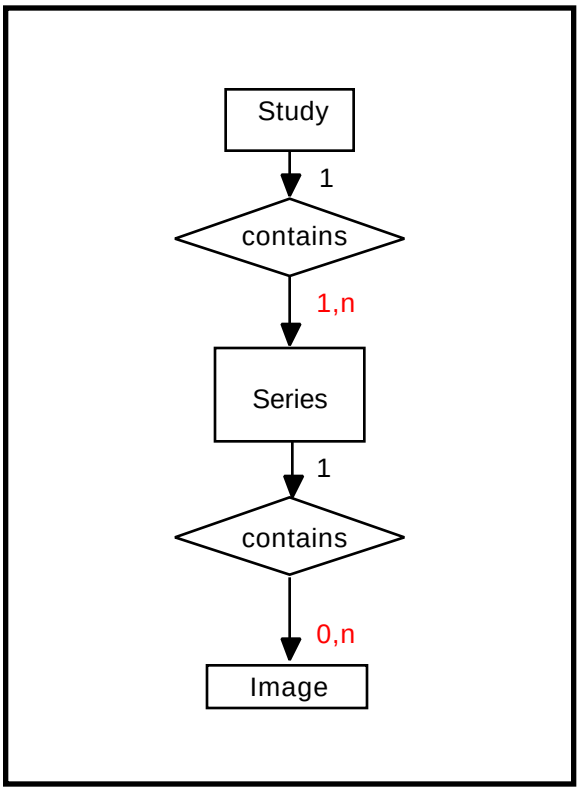
5.3 STUDY ROOT INFORMATION MODEL ENTITY-RELATIONSHIP MODEL

The Entity-Relationship diagram for the Study Root Information Model schema is shown in Illustration 5.3-1**.** In this figure, the following diagrammatic convention is established to represent the information organization :

- each entity is represented by a rectangular box.
- each relationship is represented by a diamond shaped box.
- the fact that a relationship exists between two entities is depicted by lines connecting the corresponding entity boxes to the relationship boxes.

The relationships are fully defined with the maximum number of possible entities in the relationship shown. In other words, the relationship between Series and Image can have up to n Images per Series.

ILLUSTRATION 5.3-1
STUDY ROOT QUERY/RETRIEVE INFORMATION MODEL E/R DIAGRAM



5.3.1 Entity Descriptions

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of each of the levels contained within the Study Root Query/Retrieve Information Model.

5.3.2 ACRQA 2.0 Mapping of DICOM entities

TABLE 5.3-1
MAPPING OF DICOM ENTITIES TO ACRQA 2.0 ENTITIES

DICOM	ACRQA 2.0 Entity
Study	Exam
Series	Series
Image	Image

5.4 INFORMATION MODEL KEYS

Please refer to DICOM Standard PS 3.4 (Service Class Specifications) for a description of each of the levels contained within the Study Root Query/Retrieve Information Model.

The following Level descriptions are included to specify what data elements are supported and what type of matching can be applied. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard PS 3.4 (Service Class Specifications).

5.4.1 Supported Matching

Following are the types of matching that can be request by the implementation :

- Single Value matching
- Universal Matching
- Wild Card Matching
- Range of date, Range of Time

Following are the types of matching that are supported by the implementation :

- Single Value matching
- Universal Matching
- Wild Card Matching
- Range of date, Range of Time

5.4.2 Study Level

This section defines the keys at the Study Level of the Study Root Query/Retrieve Information Model that are supported by this implementation.

TABLE 5.4-2
STUDY LEVEL ATTRIBUTES FOR THE STUDY ROOT QUERY/RETRIEVE INFORMATION MODEL

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008,0020)	R	Requested by SCU, matched by SCP
Study Time	(0008,0030)	R	Requested by SCU, matched by SCP
Accession Number	(0008,0050)	R	Requested by SCU, matched by SCP
Patient's Name	(0010,0010)	R	Requested by SCU, matched by SCP
Patient ID	(0010,0020)	U	Requested by SCU, matched by SCP
Study ID	(0020,0010)	R	Requested by SCU, matched by SCP
Study Instance UID	(0020,000D)	U	Requested by SCU, matched by SCP
Study Description	(0008,1030)	O	Requested by SCU, matched by SCP

TABLE 5.4-3
Q/R STUDY LEVEL AND LOCATION FOR RETRIEVE ATTRIBUTES

Attribute Name	Tag	Type	Note
Query Retrieve Level	(0008,0052)	-	Value = STUDY
Retrieve AE Title	(0008,0054)	-	Local AE title

5.4.3 Series Level

This section defines the keys at the Series Level of the Study Root Query/Retrieve Information Model that are supported by this implementation.

TABLE 5.4-4
SERIES LEVEL ATTRIBUTES FOR THE STUDY ROOT QUERY/RETRIEVE INFORMATION MODEL

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	R	Requested by SCU, matched by SCP SCU requests only CR modality SCP supports only CR modality
Series Number	(0020,0011)	R	Requested by SCU, matched by SCP
Series Instance UID	(0020,000E)	U	Requested by SCU, matched by SCP

TABLE 5.4-5
Q/R SERIES LEVEL AND LOCATION FOR RETRIEVE ATTRIBUTES

Attribute Name	Tag	Type	Note
Query Retrieve Level	(0008,0052)	-	Value = SERIES
Retrieve AE Title	(0008,0054)	-	For SCP : Local AE Title.

5.4.4 Image Level

This section defines the keys at the Image Level of the Study Root Query/Retrieve Information Model that are supported by this implementation.

TABLE 5.4-6
IMAGE LEVEL ATTRIBUTES FOR THE STUDY ROOT QUERY/RETRIEVE INFORMATION MODEL

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	R	Not requested by SCU, matched by SCP
SOP Instance UID	(0008,0018)	U	Requested by SCU, matched by SCP

TABLE 5.4-7
Q/R IMAGE LEVEL AND LOCATION FOR RETRIEVE ATTRIBUTES

Attribute Name	Tag	Type	Note
Query Retrieve Level	(0008,0052)	-	Value = IMAGE
Retrieve AE Title	(0008,0054)	-	For SCP: Local AE title.

6. MODALITY WORKLIST INFORMATION MODEL DEFINITION

6.1 INTRODUCTION

This section specifies the use of the DICOM Modality Worklist Information Model used to organize data and against which a Modality Worklist Query will be performed. The contents of this section are:

6.2 - Information Model Description

6.3 - Information Model Module Table

6.4 - Information Model Keys

6.2 MODALITY WORKLIST INFORMATION MODEL DESCRIPTION

ACRQA 2.0 supports a limited modality worklist. The purpose of this implementation is to just obtain the patient demographics. There is no GUI provided on ACRQA 2.0 for MWL. ACRQA 2.0 provides a switch in the configuration file for turning ON or OFF the MWL matching functionality. If this switch is OFF then ACRQA 2.0 will never contact the MWL SCP. If the switch is turned on then as each image is received from the Fuji CR system, a request is sent (containing the fields as described below) for matching. The fields that are sent out in the query are also configurable on ACRQA 2.0. The results of the query are mapped into the CR IOD. Behavior of the ACRQA 2.0 for a failed query is configurable (see Section 6.4).

6.2.1 ACRQA 2.0 Mapping of DICOM entities

TABLE 6.2-1
MAPPING OF DICOM ENTITIES TO ACRQA 2.0 ENTITIES

DICOM	ACRQA 2.0 Entity
Requested Procedure	Exam
Patient	Patient

Note that the other DICOM entities are not supported.

6.3 INFORMATION MODEL MODULE TABLE

Within an entity of the DICOM v3.0 Modality Worklist Information Model, attributes are grouped into related set of attributes. A set of related attributes is termed a module. A module facilitates the understanding of the semantics concerning the attributes and how the attributes are related with each other. A module grouping does not infer any encoding of information into datasets.

Table 6.3-1 identifies the defined modules within the entities which comprise the DICOM v3.0 Modality Worklist Information Model. Modules are identified by Module Name.

See DICOM v3.0 PS 3.3 and PS 3.4 for a complete definition of the entities, modules, and attributes.

TABLE 6.3-1
MODALITY WORKLIST INFORMATION MODEL MODULES

Entity Name	Module Name	Reference
Requested Procedure	Requested Procedure	6.5.2.1
Imaging Service Request	Imaging Service Request	6.5.3.1
Patient	Patient Identification	6.5.4.1
	Patient Demographic	6.5.4.2

6.4 INFORMATION MODEL KEYS

Please refer to DICOM Standard PS 3.3. (Information Object Definitions) and PS 3.4 (Service Class Specifications) for a description of each of the Entities contained within the Modality Worklist Information Model.

The following Module descriptions are included to specify what data elements are supported and what type of matching can be applied. It should be noted that they are the same ones as defined in the DICOM v3.0 Standard PS 3.4 (Service Class Specifications).

For each data element described here there is a switch in the ACRQA 2.0 config file which can either be set to ON or OFF. If the switch is turned OFF for a particular data element that data element is not used in the query. If turned ON then that data element is used in query. Note that patient ID and patient name are the only two patient identification fields that a Fuji CR system supplies to ACRQA 2.0 (without a Fuji ID gateway). Hence based on the switch settings ACRQA 2.0 can request a match based on only Patient ID, only patient name or both. If the query returns multiple matches then the first match is used. The results of the query are mapped into the CR IOD. The behavior of ACRQA 2.0 after a failed query is also configurable. In the first configuration ACRQA 2.0 will indicate on GUI that the match failed and continues. In the alternate configuration the image for which the match has failed is blocked at the ACRQA2.0 i.e., it is not auto routed anywhere and the GUI indicates a match fail. After editing the image for correct information ACRQA2.0 will again try to match the image info by contacting the MWL SCP. If successful the image is auto routed. This way images having erroneous information never get out into the network.

6.4.1 Supported Matching

Following are the types of matching that can be request by the implementation :

- Single Value matching

6.4.2 Requested Procedure Entity

6.4.2.1 Requested Procedure Module

TABLE 6.4-2
REQUESTED PROCEDURE MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Study Instance UID	(0020,000D)	O	1	Yes	Based on the configuration either requested or not requested by SCU

6.4.3 Imaging Service Request Entity

6.4.3.1 Imaging Service Request Module

TABLE 6.4-3
IMAGING SERVICE REQUEST MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Accession Number	(0008,0050)	O	2	Yes	Based on the configuration either requested or not requested by SCU
Referring Physician's Name	(0008,0090)	O	2	Yes	Based on the configuration either requested or not requested by SCU
Requesting Physician	(0032,1032)	O	2	Yes	Based on the configuration either requested or not requested by SCU

6.4.4 Patient Entity

6.4.4.1 Patient Identification

TABLE 6.4-4
PATIENT IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patient's Name	(0010,0010)	R	1	Yes	Based on the configuration either requested or not requested by SCU
Patient ID	(0010,0020)	R	1	Yes	Based on the configuration either requested or not requested by SCU

6.4.4.2 Patient Demographic

TABLE 6.4-5
PATIENT DEMOGRAPHIC MODULE ATTRIBUTES

Attribute Name	Tag	Expected Matching Key Type	Expected Returned Key Type	Mapped into the Image	Note
Patients Birth Date	(0010,0030)	O	2	Yes	Based on the configuration either requested or not requested by SCU
Patient's Sex	(0010,0040)	O	2	Yes	Based on the configuration either requested or not requested by SCU
Patient's Weight	(0010,1030)	O	2	Yes	Based on the configuration either requested or not requested by SCU
Patient's Size	(0010,1020)	O	3	Yes	Based on the configuration either requested or not requested by SCU
Patient's Address	(0010,1040)	O	3	Yes	Based on the configuration either requested or not requested by SCU
Patient's Telephone Numbers	(0010,2154)	O	3	Yes	Based on the configuration either requested or not requested by SCU

7. PRINT MANAGEMENT SOP CLASS DEFINITION

7.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the supported Print Management SOP and Meta SOP Classes, the optional attributes and service elements supported, the valid range of values for mandatory and optional attributes, and the status code behavior.

On ACRQA 2.0 there is a configuration file per AE title. This file can be edited by tools provided on the system to have the desired values for the configurable parameters.

This section contains:

7.2.1 - Basic Film Session SOP Class

7.2.2 - Basic Film Box SOP Class

7.2.3 - Image Box SOP Classes

7.2.4 - Printer SOP Class

7.2 PRINT MANAGEMENT SOP CLASS DEFINITIONS

7.2.1 Basic Film Session SOP Class

7.2.1.1 IOD Description

7.2.1.1.1 IOD modules

Module	Reference	Module Description
SOP Common		Contains SOP Common information
Basic Film Session Presentation Module	7.2.1.1.2	Contains Film Session presentations information

7.2.1.1.2 Basic Film Session Presentation Module

Attribute name	Tag	Attribute Description
Number of Copies	(2000,0010)	1-99, defaults to 1
Print Priority	(2000,0020)	HIGH or MED or LOW
Medium Type	(2000,0030)	CLEAR FILM or BLUE FILM
Film Destination	(2000,0040)	MAGAZINE or PROCESSOR
Film Session Label	(2000,0050)	"ACRQA DICOM PRINT"
Memory Allocation	(2000,0060)	Configurable(value in KB), defults to 0

7.2.1.2 DIMSE Service Group

DIMSE Service Element	Usage SCU
N-CREATE	M
N-ACTION	Not Used

7.2.1.2.1 N-CREATE

7.2.1.2.1.1 Attributes

Attribute Name	Tag	Usage SCU
Number of Copies	(2000,0010)	Used
Print Priority	(2000,0020)	Used
Medium Type	(2000,0030)	Used
Film Destination	(2000,0040)	Used
Film Session Label	(2000,0050)	Used
Memory Allocation	(2000,0060)	Configurable

Note that values for all these attributes are configurable through the per AE title configuration file.

The memory allocation Attribute is configured either to be sent or not. The value is also configurable.

7.2.1.2.1.2 Behavior

All the attributes on ACRQA 2.0 are individually configurable, either to be sent or not. If the printer does not support an attribute it can be turned off so it is not sent to the printer.

7.2.2 Basic Film Box SOP Class

7.2.2.1 IOD Description

7.2.2.1.1 IOD modules

Module	Reference	Module Descripion
SOP Common		Contains SOP Common information
Basic Film Box Presentation Module	7.2.2.1.2	Contains Film Box presentation information
Basic Film Box Relationship	7.2.2.1.3	References to related SOPs

7.2.2.1.2 Basic Film Box Presentation Module

Attribute Name	Tag	Attribute Description
Image Display Format	(2010,0010)	SCU sends: STANDARD\1,1 STANDARD\1,2 STANDARD\2,2 See Note 1
Film Orientation	(2010,0040)	SCU sends: PORTRAIT LANDSCAPE See Note 2
Film Size ID	(2010,0050)	SCU sends: 8INX10IN 10INX12IN 10INX14IN 11INX14IN 14INX14IN 14INX17IN 24CMX24CM 24CMX30CM See Note 3
Magnification Type	(2010,0060)	SCU sends: REPLICATE BILINEAR CUBIC NONE See Note 2
Smoothing Type	(2010,0080)	Printer dependent, configurable See Note 2

Border Density	(2010,0100)	SCU sends: BLACK or WHITE or I See Note 2
Empty Image Density	(2010,0110)	SCU sends: BLACK or WHITE or I See Note 2
Min Density	(2010,0120)	Printer dependent, configurable See Note 2
Max Density	(2010,0130)	Printer dependent, configurable See Note 2
Trim	(2010,0140)	SCU sends: YES or NO See Note 2
Configuration Information	(2010,0150)	Printer Dependent, configurable See Note 2

Note 1: The value of this attribute depends on the format chosen for printing (1on1, 2on1 or 4on1). In auto print mode only STANDARD\1,1 is used. While printing from GUI user has the ability to select different format which affect the value of this attribute.

Note 2: The value for this attribute is configured via the per AE title configuration file residing on ACRQA 2.0

Note 3: If the user prints from the GUI he/she can force ACRQA 2.0 to send a particular value to the printer. If the user selected value is not configured in the per AE title config file then it defaults to best fit size as described later. During auto print or if user select default size or if the selected film ID is not in the config file then ACRQA 2.0 selects the smallest film size which can accommodate the image/images among the film Ids configured in the per AE title config file.

7.2.2.1.3 Basic Film Box Relationship Module

Attribute Name	Tag	Attribute Description
Referenced Film Session Sequence	(2010,0500)	Used
>Referenced SOP Class UID	(0008,1150)	Used
>Referenced SOP Instance UID	(0008,1155)	Used
Referenced Image Box Sequence	(2010,0510)	Not Used
>Referenced SOP Class UID	(0008,1150)	Not Used
>Referenced SOP Instance UID	(0008,1155)	Not Used
Referenced Basic Annotation Box Sequence	(2010,0520)	Not Used
>Referenced SOP Class UID	(0008,1150)	Not Used

>Referenced SOP Instance UID	(0008,1155)	Not Used

7.2.2.2 DIMSE Service Group

DIMSE Service Element	Usage SCU
N-CREATE	M
N-ACTION	M
N-DELETE	Not Used
N-SET	Not Used

7.2.2.2.1 N-CREATE

7.2.2.2.1.1 Attributes

Attribute Name	Tag	Usage SCU
Image Display Format	(2010,0010)	M
Referenced Film Session Sequence	(2010,0500)	M
>Referenced SOP Class UID	(0008,1150)	M
>Referenced SOP Instance UID	(0008,1155)	M
Referenced Basic Annotation Box Sequence	(2010,0520)	Not Used
Film Orientation	(2010,0040)	Used
Film Size ID	(2010,0050)	Used
Magnification Type	(2010,0060)	Used
Max Density	(2010,0130)	Used
Configuration Information	(2010,0150)	Used
Annotation Display Format ID	(2010,0030)	Not Used
Smoothing Type	(2010,0080)	Used
Border Density	(2010,0100)	Used
Empty Image Density	(2010,0110)	Used
Min Density	(2010,0120)	Used
Trim	(2010,0140)	Used

7.2.2.2.1.2 Status

There are no specific status codes.

7.2.2.2.2 N-ACTION

Prints the film on the printer.

7.2.2.2.2.1 Status

Service Status	Status Codes	Further Meaning	Application Behavior When receiving Status Codes
Success	0000	Film accepted for printing; if supported, the Print Job SOP Instance is created	Updates the GUI and database to reflect the fact that the image has been printed
Warning	B603	Film Box SOP Instance hierarchy does not contain Image Box SOP Instances (empty page)	Job is retried (number of retries is configurable).
Failure	C602	Unable to create Print Job SOP Instance; print queue is full	Job is retried (number of retries is configurable).
	C604	Image position collision : multiple images assigned to single image position	Job is retried (number of retries is configurable).
	C603	Image size is larger than image box size (by using the specified magnification value)	Job is retried (number of retries is configurable).

7.2.2.2.2.2 Behavior

Depending upon the configuration on ACRQA 2.0 the failed job is retried multiple times. If the job does not succeed a warning message is displayed on the screen to that effect and a message is entered in the log.

7.2.3 Image Box SOP Classes

7.2.3.1 Basic Grayscale Image Box SOP Class

7.2.3.1.1 IOD description

####### 7.2.3.1.1.1 IOD modules

Module	Reference	Module Description
SOP Common		Contains SOP Common information
Image Box Presentation Module	7.2.3.1.1.2	Contains Image Box presentation information

####### 7.2.3.1.1.2 Image Box Pixel Presentation Module

Attribute Name	Tag	Attribute Description
Image Position	(2020,0010)	1, 2,, 3, 4, See Note 1
Polarity	(2020,0020)	Enumerated Values: NORMAL = pixels shall be printed as specified by the Photometric Interpretation (0028,0004) REVERSE = pixels shall be printed with the opposite polarity as specified by the Photometric Interpretation (0028,0004)
Magnification Type	(2010,0060)	Printer dependent, configurable
Smoothing Type	(2010,0080)	Printer dependent, configurable
Requested Image Size	(2020,0030)	Printer/image dependent.
Preformatted Grayscale Image Sequence	(2020,0110)	
>Samples Per Pixel	(0028,0002)	1
>Photometric Interpretation	(0028,0004)	MONOCHROME1 MONOCHROME2 See Note 2
>Rows	(0028,0010)	Printer/Image dependent
>Columns	(0028,0011)	Printer/Image dependent
>Pixel Aspect Ratio	(0028,0034)	1/1
>Bits Allocated	(0028,0100)	8-16, See Note 2
>Bits Stored	(0028,0101)	8-16, See Note 2
>High Bit	(0028,0102)	7-15, See Note 2
>Pixel Representation	(0028,0103)	0 (unsigned)
>Pixel Data	(7FE0,0010)	

Note 1: This value depends on the format chosen for printing. For auto printing this is always set to 1. During Non1 printing this takes different values.

Note 2: Depending on these values ACRQA 2.0 will modify the image before it is set in to the image box. For example if bits allocated=bits stored=8 and image to be printed is a Fuji CR image which has bits allocated=16 and bits stored =12 then the image is first scaled to fit into 8 bits and then sent out. Similarly if the photometric interpretation on the image is MONOCHROME1 and the printer supports only MONOCHOROME2 then the image is first inverted before sending to the printer.

Note 3: All attributes described for the Image Box Pixel Presentation Module are configurable per AE Title via the Printer Configuration service tool.

7.2.3.1.2 DIMSE Service Group

DIMSE Service Element	Usage SCU
N-SET	M

7.2.3.1.2.1 N-SET

7.2.3.1.2.1.1 Attributes

Attribute Name	Tag	Usage SCU
Image Position	(2020,0010)	M
Preformatted Grayscale Image Sequence	(2020,0110) (2020,0111)	M
>Samples Per Pixel	(0028,0002)	M
>Photometric Interpretation	(0028,0004)	M
>Rows	(0028,0010)	M
>Columns	(0028,0011)	M
>Pixel Aspect Ratio	(0028,0034)	1/1
>Bits Allocated	(0028,0100)	M
>Bits Stored	(0028,0101)	M
>High Bit	(0028,0102)	M
>Pixel Representation	(0028,0103)	M
>Pixel Data	(7FE0,0010)	M
Polarity	(2020,0020)	Used
Referenced Overlay Sequence	(0008,1130)	Not used
>SOP Class UID	(0008,1150)	Not used
>SOP Instance UID	(0008,1155)	Not Used
Magnification Type	(2010,0060)	Used
Smoothing Type	(2010,0080)	Used
Requested Image Size	(2020,0030)	Printer dependent. If the printer supports this attribute, it is used else not

7.2.3.1.2.1.2 Status

Service Status	Status Codes	Further Meaning	Application Behavior When receiving Status Codes
Failue	C605	Insufficient memory in printer to store the image	ACRQA 2.0 fails to print and retires. If after retries fails a warning message is displayed.

7.2.4 Printer SOP Class

7.2.4.1 IOD Description

7.2.4.1.1 IOD modules

Module	Reference	Module Description
SOP Common		Contains SOP Common information
Printer Module	7.2.4.1.2	Contains status information to monitor the printer

7.2.4.1.2 Printer Module

Attribute Name	Tag	Attribute Description
Printer Status	(2110,0010)	NORMAL WARNING FAILURE
Printer Status Info	(2110,0020)	For which Defined Terms is behaviour defined: WARNING SUPPLY EMPTY SUPPLY LOW RECEIVER FULL FILM JAM
Printer Name	(2110,0030)	
Manufacturer	(0008,0070)	
Manufacturer Model Name	(0008,1090)	
Device Serial Number	(0018,1000)	
Software Versions	(0018,1020)	
Date Of Last Calibration	(0018,1200)	
Time Of Last Calibration	(0018,1201)	

7.2.4.2 DIMSE Service Group

DIMSE Service Element	Usage SCU
N-GET	U

7.2.4.2.1 N-GET

7.2.4.2.1.1 Attributes

Attribute name	Tag	Usage SCU
Printer Status	(2110,0010)	Used
Printer Status Info	(2110,0020)	Used
Printer Name	(2110,0030)	Used
Manufacturer	(0008,0070)	Used
Manufacturer Model Name	(0008,1090)	Used
Device Serial Number	(0018,1000)	Used
Software Versions	(0018,1020)	Used
Date Last Calibration	(0018,1200)	Used
Last Calibration	(0018,1201)	Used

7.2.4.2.1.2 Behavior

ACRQA 2.0 uses the N-GET to request the SCP to get a Printer SOP Instance. The printer status and printer status info is then displayed on the GUI for the operator.

If the printer status is FAILURE the print is terminated with a warning.

7.3 SEQUENCING OF REAL-WORLD ACTIVITIES

When a print operation is initiated, the AE:

1. Initiates a DICOM association and selects a Presentation Context
2. N-GETs printer status from the well known Printer SOP Instance
3. N-CREATEs a Basic Film Session SOP Instance
4. N-CREATEs a Basic Film Box SOP Instance
5. N-SETs the Basic Film Box SOP Instance with the Image Box SOP Instance for each image on the film
6. Prints by an N-ACTION on the Basic Film Session SOP Instance.
7. Releases the DICOM association after printing is successful or failure has been signalled to the user

7.4 ADDITIONAL CONFIGURATION INFORMATION

ACRQA 2.0 DICOM print SCU needs additional printer specific information in order for correct operation. These additional fields are printer dependent and are configured via a printer specific default configuration file for each printer. The parameters are:

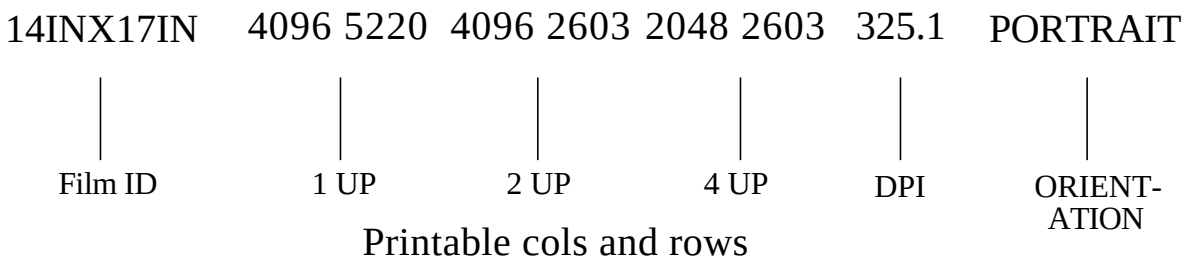
· Different film types the printer supports, i.e., 14X17, 8X10 etc.

· Printable columns and rows for each film type.

- Printable columns and rows for 2up and 4up
- Pixels per inch for each type of film.

The above parameters are used for auto fitting and true size and reduced size printing. See ACRQA 2.0 operation manual and service manual for details.

An example of the parameters required is:



For 2up and 4up printing if the individual image size exceeds the printable rows and columns as shown above the image is shrunk to the maximum printable rows and columns before setting it into the image box.

Printing true size or reduced size on printers that have a variable DPI is achieved by sending a constant image matrix to the printer. This is achieved by two parameters in the default config file for that printer. The parameter EQUALIZE_IMAGE_MATRIX controls the equalization and the normalized image matrix and the dpi are controlled by a line of the form:

NOR14INX17IN 3200 4078 .1

which states that the normalized constant matrix for a 14INX17IN film is 3200X4078 with a dpi of 0.1.

7.5 ADDITIONAL FEATURES

7.5.1 Printer Dependent LUTS

ACRQA 2.0 has the ability to apply a correction LUT to the pixel data before setting the Basic Image Grayscale Image Box. ACRQA 2.0 provides an utility for generating user specific LUTs using the printer calibration tool. Please refer to ACRQA 2.0 service/operator manual for details. **Note for 8 bit printers correction LUTs are not applied.**

ACRQA 2.0 has the ability to generate LUT according to the DICOM display standard. Please refer to the ACRQA 2.0 service/operator manual for details.

7.5.2 Image Size

ACRQA 2.0 has the ability to print the image data in three sizes:

7.5.2.1 Fit to Film

The pixel data is sent to the printer without any modification. The laser printers stretches the image to fill the entire printable area and prints the image on the selected film. The effect of this is as follows:

If the selected film type is 14INx17IN then a 8X10 image will be zoomed to fill the entire printable area on the film. On a 8INx10IN film a 14x17 image will be printed after reducing.

7.5.2.2 True Size

The image is printed the same size as projected on the CR plate, i.e., a 10 cm object measured on the printed film will measure 10cm in the plane of the sensor of the CR plate. This is achieved in two ways depending on the printers capabilities:

1. If the printer supports the "Requested Image Size" attribute, then this attribute is set to true size of the image (eg. 300 mm).

2. If the printer does not support "Requested Image Size" attribute then the image is first padded or trimmed before sending it to the printer. The required padding or trimming is calculated at the ACRQA 2.0 based on the printable rows and columns and the dpi of the printer.

The padding and trimming of the images has two effects the operator should be aware of:

1. If the image is padded then the image size is increased based on the film type and the image size. For example an 8x10 image when printed on to a 14x17 film will be padded enough so that the image is printed true size. The increase in the image size means increased image transmission time and increased processing time and memory requirements on the SCP side. The size of the image can grow very large (up to 30MB).

2. If an image of size 14inx17in is printed on a film type of 14x17 then the image will get cropped. This is because the exact printable area on a 14X17 film is less than 14inX17in, and varies between printers, eg. 13.5inX16.5in. Therefore in order to print a 14x17 image true size a 0.5 inch border is cropped to make the image 13.5inX16.5in and then printed. Printing a 8X10 image on a 8x10 film also results in cropping of the image. However printing a 8x10 image on a 14x17 film will not result in cropping.

There is no annotation added to the printed image to indicate that cropping (and discarding of acquired data) has occurred.

7.5.2.3 Reduced Size

The image is printed at a percentage of life size (default is 67%) with the following exceptions:

If the image can be printed on the selected film in true size without cropping it will be printer true size else it will be printed reduced.

Ex. Printing a 14inX17in image onto a 14X17 film in reduced mode will print the image reduced since the 14inX17in image cannot be printed in true size on a 14X17 film as explained in section 7.4.2.2. However 8inX10in and 10inX12in images come out true size on a 14X17 film since both 8inX10in and 10inX12in images can be printed on a 14X17 film in true size without any cropping.

If the printer supports "Requested Image Size" attribute then the attribute is used. If the printer does not support this attribute then the image is padded accordingly and sent to the printer**.**

Depending on the reduction factor set, the image size and the film size the image may be cropped during reduced printing.

For either True Size or Reduced Size printing, if the print SCP does not support Requested Image Size attribute, the image size that is transmitted might be very large (up to 30MB). If the print SCP is not configured with enough memory then printing may fail.

7.5.3 Image Annotation

All annotations are burnt into the image before it is sent to the printer. Individual fields can be controlled as well as the font type and size. Refer to ACRQA 2.0 operator/service manual.