Technical Publications

Direction 2143048

Revision 2.0

MR VECTRA CONFORMANCE STATEMENT FOR DICOM v3.0 (ID/NET v3.0)

-MRVectra Series, Vectra Series, Sierra (4.10)

REVISION HISTORY

REV	DATE	REASON FOR CHANGE
1.0	Oct. 28,1994	Initial release.
2.0	June 19,1995	Add Query/Retrieve Service Class.

LIST OF EFFECTIVE PAGES

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SECTION 1 − INTRODUCTION

1.0   **OVERVIEW**

Section 1, *Introduction*, provides general information about the content and scope of this document.

Section A (2), *Conformance Statement*, is the DICOM v3.0 Conformance Statement related to this product. Conformance Statements define the subset of options selected from those offered by the DICOM v3.0 standard.

Section 3, *MR Vectra Information Object Definition*, and **Section 4**, *Secondary Capture Image Information Object Definition*, define the technical specifications required to interoperate with a GE Medical Systems (GEMS) ID/Net v3.0 network interface. They define the technical details of the Information Object Definitions (IOD's) listed in the Conformance Statement.

Section 5, *MR Vectra Query/Retrieve Information Model Definition*, defines the information required to interoperate using the DICOM v3.0 Query/Retrieve models.

1.1 **OVERALL CONFORMANCE STATEMENT DOCUMENTATION STRUCTURE**

The Documentation Structure of the ID/Net v3.0 Conformance Statements and their relationship with the DICOM v3.0 Conformance Statements is shown in Illustration 1−2.

ILLUSTRATION 1−2
DOCUMENTATION STRUCTURE

ID/NET V3.0

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

APPLICATION ENTITY SPECIFICATION

(services classes, Information objects, message
exchange, etc.)

CT9800
DICOM v3.0
(...0)
...:
...5G5

CT Advantage
Conformance
...for

**PRODUCT
IMPLEMENTATION:**

MR Vectra
Conformance
Statement for
DICOM v3.0
(ID/Net v3.0)
Direction:
2143048

....

DICOM STANDARD

**STANDARD
SPECIFICATION:**

DICOM v3.0
Part 1

M v3.0
t 2

M v3.0
t 3

M v3.0
t 4

DICOM v3.0
Part 5

M v3.0
t 6

M v3.0
t 7

M v3.0
t 8

The Documentation Structure given in Illustration 1−2 shows the overall documentation structure for all of the GEMS ID/Net v3.0 Conformance Statements. ID/Net v2.0 documentation is also openly available, but the two documentation structures are independent of one another.

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

> *MR Vectra*
> *Conformance Statement for DICOM v3.0 (ID/Net v3.0)*
> *Direction 2143048.*

This Conformance Statement documents the DICOM v3.0 Conformance Statement and Technical Specification required to interoperate with the GEMS ID/Net v3.0 network interface. Introductory information, which is applicable to all GEMS ID/Net v3.0 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 v3.0 terminology and general concepts. It should be read prior to reading the individual products' ID/Net v3.0 Conformance Statements.

The ID/Net v3.0 Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP, OSI, etc.). 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 ID/Net v3.0 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:

> ACR−NEMA / DICOM Representative
> NEMA
> 2101 L Street, N.W., Suite 300
> Washington, DC 20037 USA
> Phone: (202) 457−1965

1.2   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 Conformance Statement document.

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

1.3   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 ID/Net v3.0 implementations. This specification, called a Conformance Statement (previously an Implementation Profile), includes a DICOM v3.0 Conformance Statement and is necessary to ensure proper processing and interpretation of GEMS medical image data exchanged using DICOM v3.0. The GEMS ID/Net v3.0 Conformance Statements are available to the public.

The reader of this 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 the Technical Specification of this Conformance Statement are the Module Definitions which define all data elements used by this GEMS ID/Net v3.0 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 retransmit all of the private data elements which are sent by GEMS devices.

1.4   **IMPORTANT REMARKS**

The use of these 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 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 are 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. ID/Net v3.0 is based on DICOM v3.0 as specified in each ID/Net 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 ID/Net 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.

- **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.

1.5   **REFERENCES**

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

1.6   **DEFINITIONS**

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

1.7   **SYMBOLS AND ABBREVIATIONS**

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

1.8   **CONVENTIONS**

Please refer to DICOM Standard Part 3 (Information Object Definitions) for the Attribute Type Definitions which are used in the Module Descriptions found in sections 3 and 4 of this conformance statement.

SECTION A − CONFORMANCE STATEMENT

A.0   **INTRODUCTION**

This Conformance Statement (CS) specifies the GE MR Vectra scanner compliance to DICOM v3.0. It details the DICOM Service Classes and roles which are supported by this product. Other sections of this document describe the Information Object data elements which are used by this implementation.

Note that the format of this section strictly follows the format of DICOM Standard Part2(Conformance) Appendix A. Please refer to that part of the standard while reading this section.

A.1   **IMPLEMENTATION MODEL**

A.1.1   **Application Data Flow Diagram**

The Basic and Specific Application models for this device are shown in Ill. 2−1 .

ILLUSTRATION 2−1
SPECIFIC AE APPLICATION MODEL
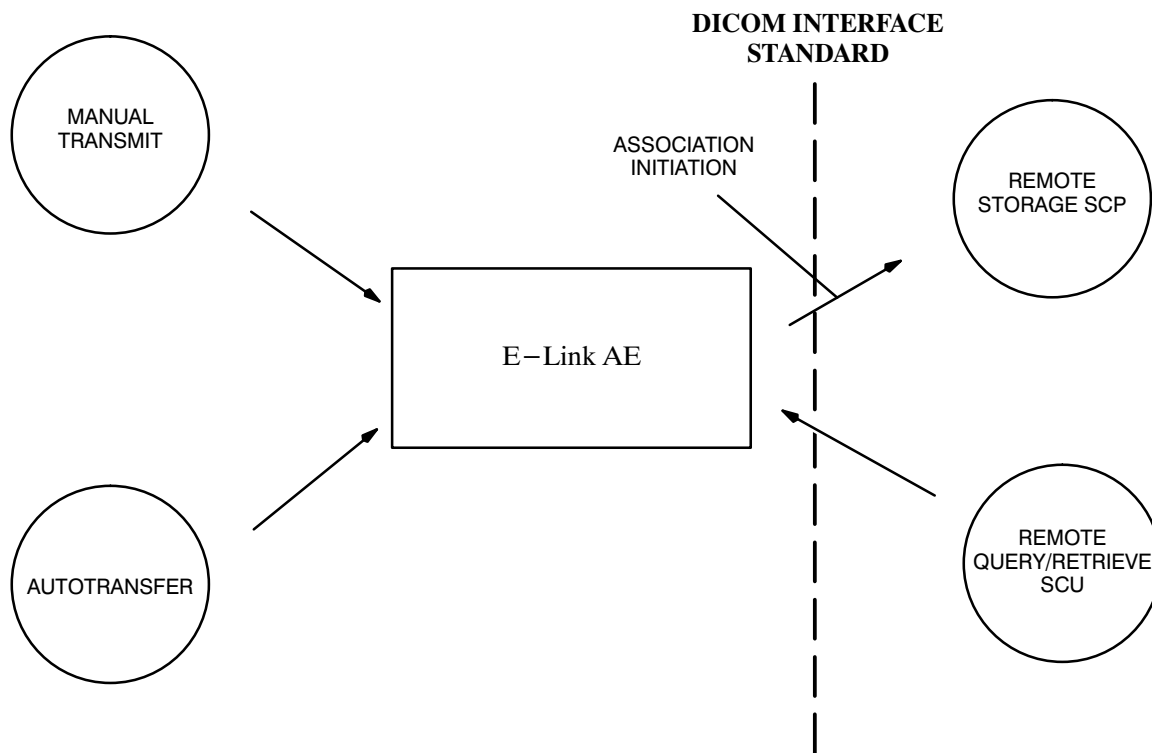
The E−Link Application Entity (AE) is an application which handles all DICOM protocol communications. E−Link AE is automatically brought up when an Operator's Console (OC) or Diagnostic Console (DC3) is powered on.

All remote DICOM AE's must be manually configured on the OC/DC3, usually at software installation time, by a GEMS Field Engineer.

There are two local real world activities, Manual Transmit (MT), and AutoTransfer (AUT), which can cause the E−Link AE to initiate a DICOM association to store an image.

MT consists of an operator selecting a Study, Series, or an Image from the <u>Network</u> screen of the console User Interface and choosing to send that image(s) to a selected destination.

If AUT is enabled, after the technologist prescribes a scan and begins acquiring the images, the OC will automatically (without operator intervention) initiate a DICOM association after every image is completed, and send the <u>image</u> to a preset destination.

There is no local real world event required for the E−Link AE to respond to a DICOM Query. The E−Link AE is always prepared to respond to a DICOM query by any remote DICOM AE which has been configured on the GEMS system. E−Link can then send (STORE) image(s) to the remote entity if requested by a retrieve (MOVE) request.

A.1.2   Functional Definition of AE's

Application Entity 1, E−Link

Supports the following functions:

- Has access to patient demographics and pixel data in the local database

- Manually (MT) or automatically (AUT) initiates a DICOM association to send images

- Responds to DICOM associations containing a query request using the information in the console's local database

- Moves images to any configured remote DICOM AE when requested to do so by the remote querying device

A.1.3   **Sequencing of Real−World Activities**

Image Send:

- The E−Link AE will initiate a DICOM association

- The AE will select the appropriate Abstract and Transfer Syntaxes from those accepted by the remote AE.

- The AE will use the C−STORE command to send the image.

Query/Retrieve:

- The E−Link AE will respond to a DICOM association initiation and accept only the Abstract and Transfer syntaxes specified in this document.

- At some later point, the E−Link AE will respond to a C−MOVE request and send the image(s) to a specified remote AE when (if) requested to do so.

A.2   **AE SPECIFICATIONS**

A.2.1   **AE1 Specification**

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

SOP Class Name	SOP Class UID
CT Image Information Object Storage SC	1.2.840.10008.5.1.4.1.1.2
MR Image Information Object Storage SC	1.2.840.10008.5.1.4.1.1.4
SC Image Information Object Storage SC	1.2.840.10008.5.1.4.1.1.7

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

SOP Class Name	SOP Class UID
Verification (Echo) SC	1.2.840.10008.1.1
Study Root Query/Retrieve Info. model − FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Info. model − MOVE	1.2.840.10008.5.1.4.1.2.2.2

A.2.1.1   Association Establishment Policies

A.2.1.1.1   General

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

DICOM 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 initiated by the E−Link AE is:

Maximum Length PDU	4 Kbytes

The SOP class Extended Negotiation is not supported.

The maximum number of Presentation Contexts Items that will be proposed is 3.

The user info items sent by this product are:

- Maximum PDU Length and,
- Implementation UID

A.2.1.1.2   Number of Associations

The E−Link AE will initiate only one DICOM association to perform an image store at a time.

A.2.1.1.3   Asynchronous Nature

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

A.2.1.1.4   Implementation Identifying Information

The Implementation UID allows unique identification of a set of products that share the same implementation.

The Implementation UID for this ID/Net v3.0 Implementation is:

Storage & Q/R Implementation UID	1.2.840.113619.6.3

This Implementation UID applies only to those ID/Net v3.0 Implementations that are available on GE Vectra Consoles.

The Implementation UID is sent in the Implementation Class UID Sub-Item. The Implementation Class UID Sub-Item is defined in Annex D of DICOM v3.0 Part 7: Message Exchange.

A.2.1.2   **Association Initiation by Real−World Activity**

This AE attempts to initiate a new association due to two Real−World Activities:

A. "Manual Transmit" initiated by the operator, and

B. "AutoTransfer" where the image is sent to a single preset destination after image reconstruction with no operator intervention (this includes localizer, prospective, and retrospective image types).

A.2.1.2.1   **Real−World Activity A, and B**

Although there are two different real world activities which can begin an image storage process, the DICOM association initiation and transfer process is identical.

A.2.1.2.1.1   **Associated Real−World Activity**

Upon request, either manual or automatic, an image and/or overlay plane will be sent to a DICOM Storage SCP.

A.2.1.2.1.2   **Proposed Presentation Contexts**

Presentation Context Table − Proposed					
Abstract Syntax		Transfer Syntax		Role	Expanded
Name	UID	Name List	UID List		Negotiation
CT Image Info Obj.	1.2.840.10008.5.1.4.1.1.2	Little Endian Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None
MR Image Info Obj.	1.2.840.10008.5.1.4.1.1.4	Little Endian Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None
Secondary Capture Info Obj.	1.2.840.10008.5.1.4.1.1.7	Little Endian Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2	SCU	None

A software implementer should be aware that E−Link may package multiple Presentation Data Values (PDV's) into a single Protocol Data Unit (PDU) as stated in the DICOM Standard Part 8, Appendix E.

A.2.1.2.1.2.1   **SOP Specific Conformance Statement for Image Storage SOP Classes**

This implementation can perform one C-STORE operation over a single association.

Each C-STORE operation supports a "Per Image" Store Timeout. This timeout starts once a C-STORE request has been issued and stops once a C-STORE confirmation has been received. This timeout is 90 seconds.

A.2.1.2.2   **Association Acceptance Policy**

A.2.1.2.2.1   **Real−World Activity**

> This AE accepts associations for the Query/Retrieve (Q/R) SC using the Study Root Query Model.

A.2.1.2.2.1.1   **Associated Real−World Activity**

> This AE is indefinitely listening for Q/R associations.

A.2.1.2.2.1.2   **Accepted Presentation Context Table**

Presentation Context Table − Accepted					
Abstract Syntax		**Transfer Syntax**		**Role**	**Expanded**
Name	**UID**	**Name List**	**UID List**		**Negotiation**
Study Root Query/Retrieve Info. model − FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Study Root Query/Retrieve Info. model − MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Verification SCP	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

A.2.1.2.2.1.2.1 SOP Specific Conformance for Query/Retrieve FIND SOP Class SCP

> The C−FIND response status values are supported as defined in DICOM v3.0 Part 4.

> All Required (R) and Unique (U) Study, Series, and Image Level Keys for the Study Root Query/Retrieve Information Model are supported. Some Optional (O) Keys are also supported, as described later in this document (see section 5).

A.2.1.2.2.1.2.2 SOP Specific Conformance for Query/Retrieve MOVE SOP Class SCP

> Prioritization of C−FIND & C−MOVE requests are all set to normal.

> All images requested in the C−MOVE will be sent over a single association (the association will not be established and torn down for each image).

A.2.1.2.2.1.3   **Presentation Context Acceptance Criterion**

> No criterion.

A.2.1.2.2.1.4   **Transfer Syntax Selection Policies**

> Storage SCU supports Explicit VR Big Endian and Implicit VR Little Endian, and priority for Explicit VR Big Endian is higher. Verification SCP and Query/Retrieve SCP supports only Implicit VR Little Endian.

A.3   **COMMUNICATION PROFILES**

A.3.1   **Supported Communication Stacks (parts 8,9)**

DICOM Upper Layer (Part 8) is supported using TCP/IP over Ethernet v2.0.

A.3.2   **OSI Stack**

OSI stack not supported.

A.3.2.1   **International Standardized Profile (ISP)**

ISP not supported.

A.3.2.2   **API (Application Programming Interface)**

Not applicable to this product.

A.3.2.3   **Physical Media Support**

There are no physical media dependencies beyond ethernet v2.0 requirements.

A.3.3   **TCP/IP Stack**

The TCP/IP stack is inherited from a UNIX Operating System.

A.3.3.1   **API**

Not applicable to this product.

A.3.3.2   **Physical Media Support**

Ethernet v2.0, IEEE 802.3.

A.3.4   **Point−to−Point Stack**

A 50−pin ACR−NEMA (DICOM v3.0 Part8) connection is not applicable to this product.

A.4   EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

A.4.1   **Standard Extended/Specialized/Private SOP's**

A Standard Extended SOP is used when MR Vectra IOD is sent. Its UID is the same as Standard SOP's.

A.5   **CONFIGURATION**

A.5.1   **AE Title/Presentation Address Mapping**

- The Local AE Title is configurable. This must be configured by a GEMS Field Service Engineer during an installation.

A.5.2   **Configurable Parameters**

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

- Local AE Title
- Local IP Address
- Local IP Netmask

The following fields are configurable for every remote DICOM node:

- Remote AE Title
- Responding TCP/IP Port
- Remote IP Address
- IP Address of a Gateway for Remote Device

Note: All configuration must be performed by a GE Field Engineer.

Note: Max PDU length is not configurable at run time.

A.6   **SUPPORT OF EXTENDED CHARACTER SETS**

No extended character sets are supported.

SECTION 3 − MR VECTRA INFORMATION OBJECT DEFINITION

This section contain the actual detailed specification of the DICOM v3.0 MR Image Information Object Definition. It is specified in the following sections:

3.0 − Interoperability Schema

3.1 − Entity Descriptions

3.2 − Entity Module Table

3.3 − Entity Module Library

3.0   MR IMAGE INTEROPERABILITY SCHEMA

ILLUSTRATION 3−1
MR IMAGE ENTITY RELATIONSHIP DIAGRAM
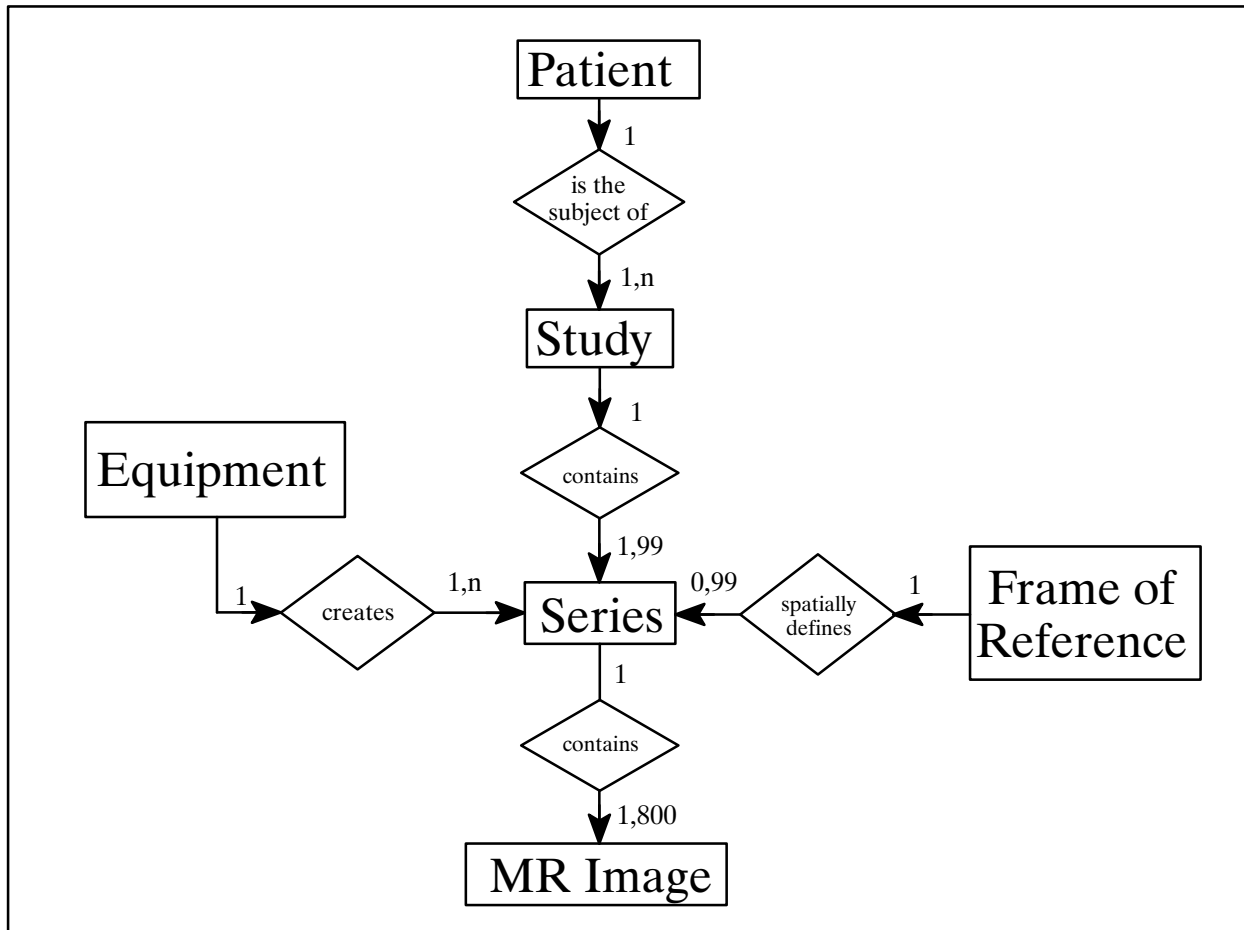
The Entity−Relationship diagram for the MR Image interoperability schema is shown in Illustration 3−1. In this figure, the following diagrammatic convention is established to represent the information organization:

- 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 800 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).

NOTE:
The relationship between Study and Image can have up to 800 Images per Study, too. For example, if each Series has 100 Images, the Study will be muximum 8 Series.

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 MR Information Object.

3.1.1   Series Entity

A *Series Entity* defines the attributes which identify distinct logical sets of images. One key criteria is used to group images into a Series. All Series within a Study are of the same modality type.

1. MR Image SOP Instances are sent with a Frame of Reference Identifier, all images within a particular Series are spatially related to each other. Each Series can have one, and only one, related Frame of Reference Entity. However, within a Study, each Series can be related to a different Frame of Reference. (Refer to 3.1.5.)

3.1.2   Frame Of Reference Entity

The *Frame of Reference Entity* uniquely identifies the spatial coordinate system which has been used to produce a Series of Images. A Series is related to one, and only one, Frame of Reference Entity. However, it is possible to have multiple Series within a Study which are spatially and temporally related under the same frame of reference.

CAUTION

For MRVectra/Vectra/Sierra System, each image in a series may have a different Frame of Reference. In case of changing LANDMARK(Positioning Light Point) in a series, all images within the series are not spatially related. So, you must check the Frame of Reference UID(0020, 0052) in order to determine that two images in the series are actually related.

3.2   **ENTITY MODULE TABLE**

Within an entity of the DICOM v3.0 MR Image Information Object Definition, 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 3−1 identifies the defined modules within the entities which comprise the DICOM v3.0 MR Image Information Object Definition. Modules are identified by Module Name.

A Reference pointer is provided which identifies the section which provides a complete definition of the module and the attributes which comprise the module.

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

TABLE 3−1
MR IMAGE INFORMATION OBJECT DEFINITION (IOD) MODULE TABLE

Entity Name	Module Name	Module Library Section
Patient	**Patient**	**3.3.1.1**
Study	**General Study**	**3.3.2.1**
	Patient Study	**3.3.2.2**
Series	**General Series**	**3.3.3.1**
Frame of Reference	**Frame of Reference**	**3.3.4.1**
Equipment	**General Equipment**	**3.3.5.1**
Image	**General Image**	**3.3.6.1**
	Image Plane	**3.3.6.2**
	Image Pixel	**3.3.6.3**
	Contrast/Bolus	**3.3.6.4**
	MR Image	**3.3.6.5**
	VOI LUT	**3.3.6.6**
	SOP Common	**3.3.6.7**

Note: 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 but it should be noted that they are the same ones as defined in DICOM Part 3.

3.3 **ENTITY MODULE LIBRARY**

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 MR Information Object.

3.3.1 **Patient Entity Module**

3.3.1.1 **Patient Module**

TABLE 3–2
PATIENT MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Patient Name	(0010,0010)	2	
Patient ID	(0010,0020)	2	
Patient Birthday	(0010,0030)	2	
Patient Sex	(0010,0040)	2	

3.3.2   Study Entity Modules

3.3.2.1   General Study Module

TABLE 3−3
GENERAL STUDY ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Study Instance UID	(0020,000D)	1	
Study Date	(0008,0020)	2	
Study Time	(0008,0030)	2	
Referring Physician's Name	(0008,0090)	2	Sent zero length
Study ID	(0020,0010)	2	
Accession Number	(0008,0050)	2	Sent zero length
Study Description	(0008,1030)	3	

3.3.2.2   Patient Study Module

TABLE 3−4
PATIENT STUDY ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Admitting Diagnoses Description	**(0008,1080)**	**3**	
Patient's Age	**(0010,1010)**	**3**	
Patient Weight	**(0010,1030)**	**3**	

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3.3.3 **Series Entity Module**

3.3.3.1 **General Series Module**

TABLE 3−5
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Modality	**(0008,0060)**	**1**	**Enumerated Value** "MR" − Magnetic Resonance
Series Instance UID	**(0020,000E)**	**1**	
Series Number	**(0020,0011)**	**2**	
Laterality	**(0020,0060)**	**2C**	**Send zero length**
Series Description	**(0008,103E)**	**3**	
Body Part Examined	**(0018,0015)**	**3**	**NOTE:** Sent a string of characters which Operater freely described as 'Anatomic Location'
Patient Position	**(0018,5100)**	**2C**	**(Condition is met for MR, therefore required to be sent)**

3.3.4   **Frame Of Reference Entity Module**

3.3.4.1   **Frame Of Reference Module**

This module contains attributes used to identify the Frame of Reference of a Series within a Study.

TABLE 3−6
FRAME OF REFERENCE IDENTIFICATION ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Frame of Reference UID	(0020,0052)	1	
Position Reference Indicator	(0020,1040)	2	**NOTE:** Sent a string of characters which Operater freely described as 'Anatomic Reference'

3.3.5   **Equipment Entity Module**

3.3.5.1   **General Equipment Module**

TABLE 3−7
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Manufacturer	**(0008,0070)**	**2**	
Institution Name	**(0008,0080)**	**3**	
Station Name	**(0008,1010)**	**3**	
Manufacturer Model	**(0008,1090)**	**3**	
Device Serial Number	**(0018,1000)**	**3**	
Software Versions	**(0018,1020)**	**3**	
Pixel Padding Value	**(0028,0120)**	**3**	**Defined Terms:** −8192

3.3.6   **Image Entity Modules**

3.3.6.1   **General Image Module**

TABLE 3−8
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Image Number	**(0020,0013)**	**2**	
Image Date	**(0008,0023)**	**2C**	
Image Time	**(0008,0033)**	**2C**	
Image Type	**(0008,0008)**	**3**	
Reference Image Sequence	**(0008,1140)**	**3**	
Referenced SOP Class UID	**(0008,1150)**	**1C**	
Reference SOP Instance UID	**(0008,1155)**	**1C**	
Image Comment	**(0020,4000)**	**3**	

3.3.6.1.1   **Attribute Image Type (0008, 0008)**

ILLUSTRATION 3−2
IMAGE TYPE DECISION TREE
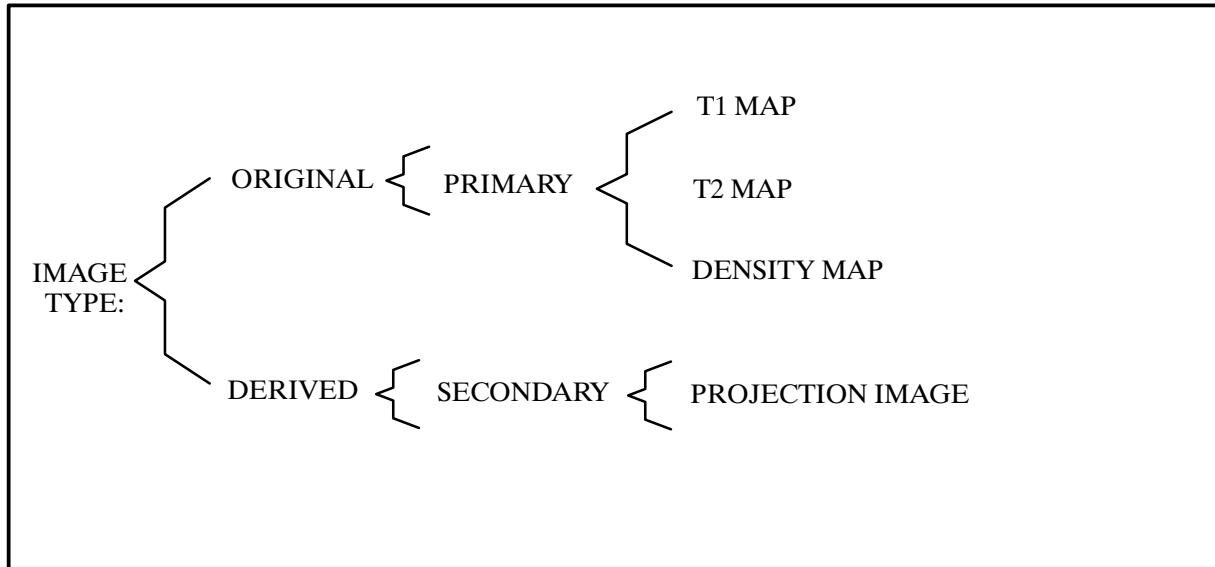
This information is used by applications to provide important identification charac-teristics. This attribute is a three valued element. Illustration 3−2 is a decision tree which provides the valid combinations of the three values which may be sent.

This attribute is multi−valued and is provided in the following manner:

Value 1: Identifies an image to be either an **ORIGINAL** image or a **DERIVED** image. An **ORIGINAL** image is an image whose pixel values represent original, non−trans-formed data. A **DERIVED** image is an image which has been created by combining two or more images together.

The string of either "ORIGINAL" or "DERIVED" is sent.

Value 2: Identifies the image to be created as either a **PRIMARY** or a **SECONDARY** image. A **PRIMARY** image is an image which has been created as part of the initial patient examination process. A **SECONDARY** image is an image which has been created as the result of some post processing activity.

The string of either "PRIMARY" or "SECONDARY" is sent.

Value 3: Identifies the type of processing which created the image.

One of the following strings may be sent: "T1 MAP", "T2 MAP", "DENSITY MAP", or "PROJECTION IMAGE".

3.3.6.2   **Image Plane Module**

TABLE 3−9
IMAGE PLANE MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Pixel Spacing	**(0028,0030)**	**1**	
Image Orientation (patient)	**(0020,0037)**	**1**	**NOTE:** Be sure to read the DICOM v3.0 "Image Orientation/Position with respect to the patient" definitions.
Image Position (patient)	**(0020,0032)**	**1**	**NOTE:** Be sure to read the DICOM v3.0 "Image Orientation/Position with respect to the patient" definitions.
Slice Thickness	**(0018,0050)**	**2**	
Slice Location	**(0020,1041)**	**3**	

3.3.6.3 **Image Pixel Module**

TABLE 3−10
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Samples per Pixel	**(0028,0002)**	**1**	**Defined Value:** 1
Photometric Interpretation	**(0028,0004)**	**1**	**Defined Value:** "MONOCHROME2"
Rows	**(0028,0010)**	**1**	
Columns	**(0028,0011)**	**1**	
Bits Allocated	**(0028,0100)**	**1**	**Enumerated Values:** 16
Bits Stored	**(0028,0101)**	**1**	**Enumerated Value:** 16
High Bit	**(0028,0102)**	**1**	**Enumerated Value:** 15
Pixel Representation	**(0028,0103)**	**1**	**Enumerated Value:** 1
Smallest Pixel Value	**(0028,0106)**	**3**	**Defined Value:** −8192
Largest Pixel Value	**(0028,0107)**	**3**	**Defined Value:** 8191
Pixel Data	**(7FE0,0010)**	**1**	

3.3.6.4   Contrast/Bolus Module

TABLE 3−11
CONTRAST/BOLUS MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	
Revision 1:			
Contrast/Bolus Agent	(0018,0010)	2	**Defined Terms:** "Contrast" "NONE"
Contrast/Bolus Start Time	(0018,1042)	3	

3.3.6.5   **MR Image Module**

TABLE 3−12
MR IMAGE MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Image Type	(0008,0008)	1	
Samples per Pixel	(0028,0002)	1	
Photometric Interpretation	(0028,0004)	1	
Bits Allocated	(0028,0100)	1	
Scanning Sequence	(0018,0020)	1	**Defined Terms:** "SE" "IR" "GR"
Sequence Variant	(0018,0021)	1	**Defined Terms: (see Standard Part 3)**
Scan Options	(0018,0022)	2	**Defined Terms (See Standard Part 3, plus the following listed values are used by GEMS):** "CE" (ECG Cine) "CP" (Peripheral Cine) "NP" (No Phase Wrap) "VB" (Variable Bandwidth) "PM" (Pomp Scan) "BW" (Cut Off Frequency) "3D" (3D Scan) "MF" (Morpho Filter) "MT" (MTC) "RF" (Ramped RF)
MR Acquisition Type	(0018,0023)	2	**Defined Terms:** "2D" "3D"
Repetition Time	(0018,0080)	2C	
Echo Time	(0018,0081)	2	
Echo Train Length	(0018,0091)	2	
Inversion Time	(0018,0082)	2C	
Trigger Time	(0018,1060)	2C	

Attribute Name	Element Tag	Type	Notes (continued from previous page)
Sequence Name	(0018,0024)	3	
Angio Flag	(0018,0025)	3	
Number of Averages	(0018,0083)	3	Fractional values indicate Fractional Fourier acquisition
Imaged Nucleus	(0018,0085)	3	**Defined Terms:** "1H"
Echo Number	(0018,0086)	3	
Magnetic Field Strength	(0018,0087)	3	
Percent Sampling	(0018,0093)	3	
Pixel Bandwidth	(0018,0095)	3	
Nominal Interval	(0018,1062)	3	
Heart Rate	(0018,1088)	3	
Cardiac Number of Images	(0018,1090)	3	
Reconstruction Diameter	(0018,1100)	3	
Receiving Coil	(0018,1250)	3	
Transmitting Coil	(0018,1251)	3	
Phase Encoding Direction	(0018,1312)	3	**Defined Terms:** "ROW"
Flip Angle	(0018,1314)	3	
Variable Flip Angle	(0018,1315)	3	**Defined Terms:** "N"
SAR	(0018,1316)	3	

3.3.6.6   **VOI LUT Module**

TABLE 3−13
VOI LUT MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Window Center	(0028,1050)	3	
Window Width	(0028,1051)	1C	

3.3.6.7   **SOP Common Module**

TABLE 3−14
SOP COMMON MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
SOP Class UID	**(0008,0016)**	**1**	
SOP Instance UID	**(0008,0018)**	**1**	

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SECTION 4 − MR VECTRA SECONDARY CAPTURE IMAGE INFORMATION OBJECT DEFINITION

This section specifies the subset of the DICOM v3.0 Secondary Capture Image Information Object Definition used to represent the information included in Secondary Captures produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

4.0 − Interoperability Schema

4.1 − Entity Descriptions

4.2 − Entity Module Table

4.3 − Entity Module Library

4.0   **SC IMAGE INTEROPERABILITY SCHEMA**

ILLUSTRATION 4−1
SC IMAGE ENTITY RELATIONSHIP DIAGRAM
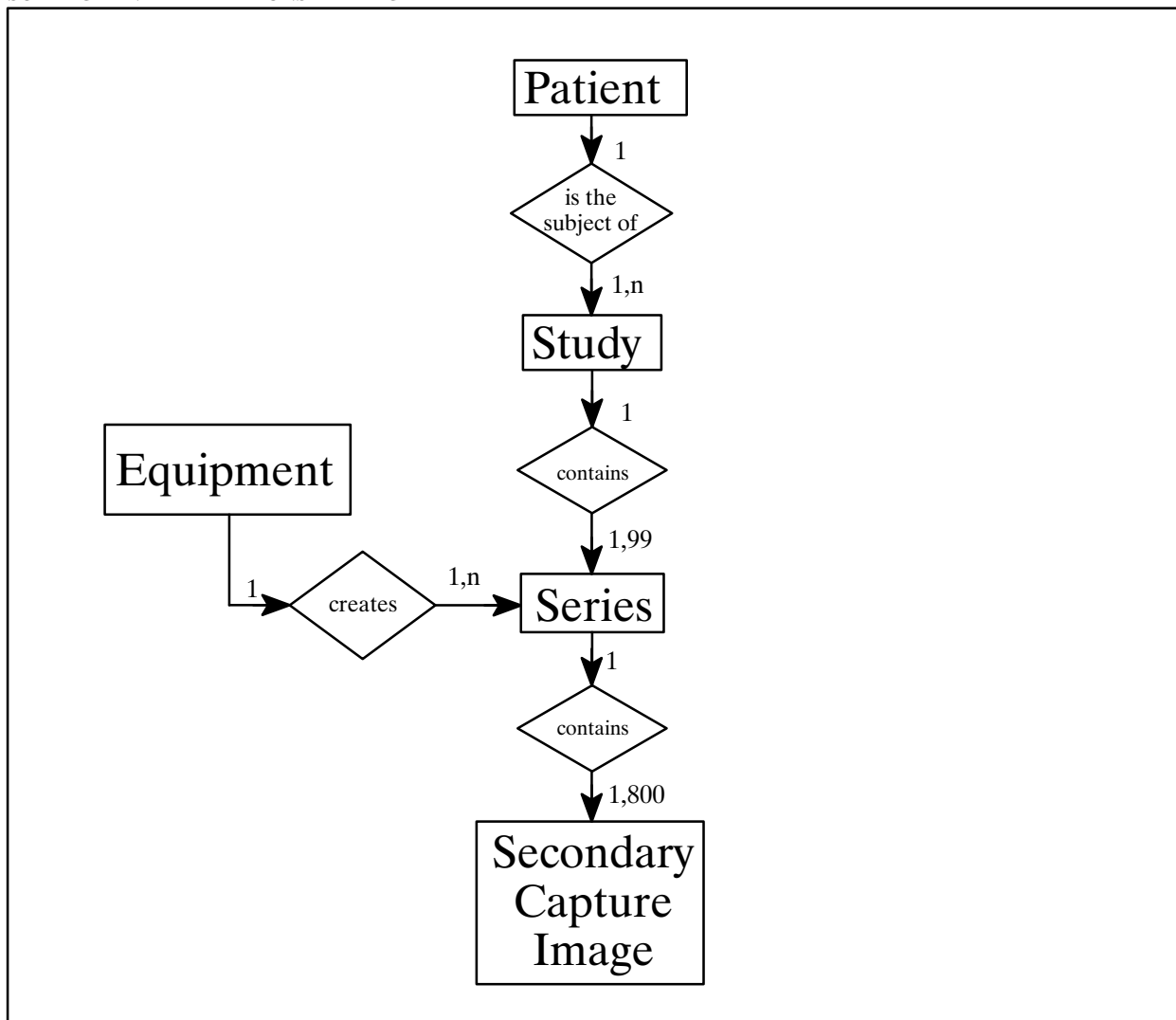
The Entity−Relationship diagram for the SC Image interoperability schema is shown in Illustration 4−1. In this illustration, the following diagrammatic convention is established to represent the information organization:

- 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.

4.1   ENTITY DESCRIPTIONS

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

4.2   **ENTITY MODULE TABLE**

Within an entity, 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 does not infer any encoding of information into datasets.

Table 4−1 identifies the defined modules within the entities which comprise the DICOM v3.0 Secondary Capture Information Object Definition. Modules are identified by Module Name.

A Reference pointer is provided which identifies the sections which provides a complete definition of the module and the attributes which comprise the module.

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

TABLE 4−1
 SC IMAGE MODULE DEFINITION TABLE

Entity Name	Module Name	Module Library Section
Patient	**Patient**	**(see Section 3)**
Study	**General Study**	**(see Section 3)**
	Patient Study	**(see Section 3)**
Series	**General Series**	**(see Section 3)**
Equipment	**General Equipment**	**(see Section 3)**
	SC Equipment	**4.3.1.1**
Image	**General Image**	**4.3.2.1**
	Image Pixel	**4.3.2.2**
	SC Image	**4.3.2.3**
	Overlay Plane	**4.3.2.4**
	Modality LUT	**4.3.2.5**
	VOI LUT	**(see Section 3)**
	SOP Common	**(see Section 3)**

(* Section 3, "MR Vectra Information Object Definition", uses the same modules as Secondary Capture where the note "see Section 3" appears.)

Note: 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 but it should be noted that they are the same ones as defined in DICOM Part 3.

4.3   **ENTITY MODULE LIBRARY**

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 MR Information Object.

4.3.1   **Equipment Entity Module**

4.3.1.1   **SC Equipment Module**

TABLE 4−2
SC EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Conversion Type	(0008,0064)	1	Defined Value: "WSD"
Modality	(0008,0060)	3	Defined Value: "MR"
Secondary Capture Device ID	(0018,1010)	3	
Secondary Capture Device Manufacturer	(0018,1016)	3	
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	3	
Secondary Capture Device Software Version	(0018,1019)	3	

4.3.2   Image Entity Modules

4.3.2.1   General Image Module

TABLE 4−3
 GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Image Number	**(0020,0013)**	**2**	
Patient Orientation	**(0020,0020)**	**2C**	
Image Date	**(0008,0023)**	**2C**	
Image Time	**(0008,0033)**	**2C**	
Image Type	**(0008,0008)**	**3**	
Image Comments	**(0020,4000)**	**3**	

4.3.2.1.1 **Attribute Image Type (0008, 0008)**

ILLUSTRATION 4−2
SC GENERAL IMAGE DECISION TREE
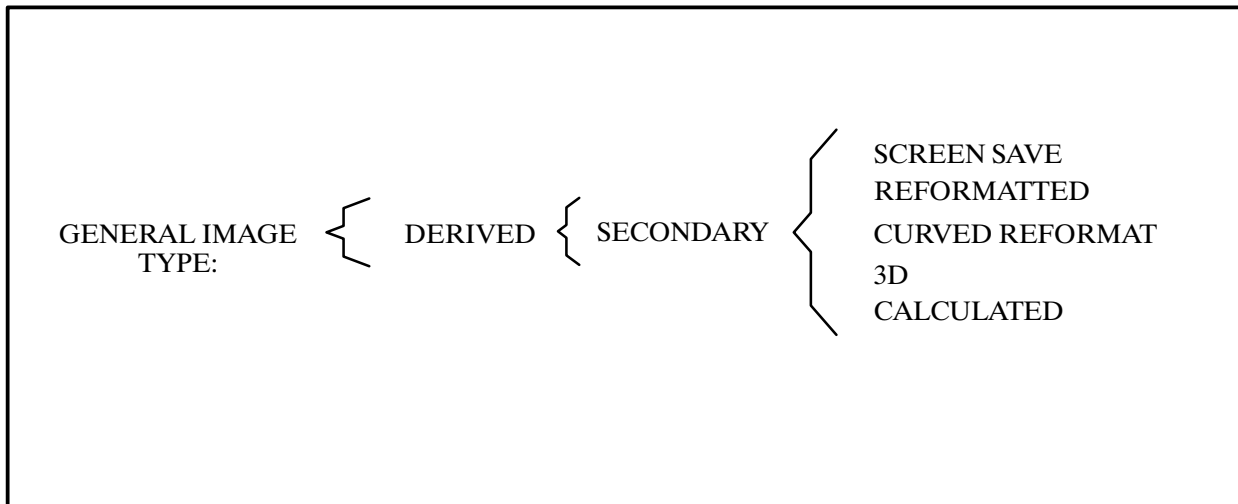
GENERAL IMAGE TYPE: { DERIVED { SECONDARY { SCREEN SAVE / REFORMATTED / CURVED REFORMAT / 3D / CALCULATED

This information is used by applications to provide important identification characteristics. This attribute is a three valued element. Illustration 4−2 is a decision tree which provides the valid combinations of the three values which may be sent.

This attribute is multi−valued and should be provided in the following manner:

Value 1: Basically, it identifies an image to be either an **ORIGINAL** image or a **DERIVED** image. An **ORIGINAL** image is an image whose pixel values represent original, non−transformed data. A **DERIVED** image is an image which has been created by combining two or more images together. But, MR Vectra SC Device doesn't distinguish them, therefore, the string of "DERIVED" is always sent.

Value 2: Identifies the image to be created as a **SECONDARY** image. A **SECONDARY** image is an image which has been created as the result of some post processing activity.

The string of "SECONDARY" is sent.

Value 3: Identifies the type of processing which created the image. This description is implementation specific.

One of the following string is sent: "SCREEN SAVE","REFORMATTED","3D", "CURVED REFORMAT" or "CALCULATED".

4.3.2.2   **Image Pixel Module**

TABLE 4−4
IMAGE PIXEL MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Samples per Pixel	(0028,0002)	1	
Photometric Interpretation	(0028,0004)	1	Defined Value: "MONOCHROME2"
Rows	(0028,0010)	1	
Columns	(0028,0011)	1	
Bits Allocated	(0028,0100)	1	Enumerated Value: 16
Bits Stored	(0028,0101)	1	
High Bit	(0028,0102)	1	
Pixel Representation	(0028,0103)	1	
Pixel Data	(7FE0,0010)	1	

Smallest Image Pixel Value	(0028,0106)	3	Defined Value:
			  For Screen Save Image: 0
			  For Other Image: −8192

Largest Image Pixel Value	(0028,0107)	3	Defined Value:
			  For Screen Save Image: 255
			  For Other Image: 8191

4.3.2.3   **SC Image Module**

TABLE 4 – 5
SC IMAGE MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Date of Secondary Capture	(0018,1012)	3	
Time of Secondary Capture	(0018,1014)	3	

4.3.2.4   **Overlay Plane Module**

      Conditional Descriptions:

For a screen save image, group 6000 will be sent with Overlay Plane Data.

All overlay planes are one bit overlay planes.

TABLE 4−6
OVERLAY PLANE MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Rows	(60xx, 0010)	1	
Columns	(60xx, 0011)	1	
Overlay Type	(60xx, 0040)	1	**Enumerated Value:** "G"=Graphics
Origin	(60xx, 0050)	1	**Enumerated Multiple Value:** 0001 0001
Bits Allocated	(60xx, 0100)	1	**Enumerated Value:** 0001
Bit Position	(60xx, 0102)	1	**Enumerated Value:** 0000
Overlay Data	(60xx, 3000)	1C	

4.3.2.5   **Modality LUT Module**

TABLE 4–7
MODALITY LUT MODULE ATTRIBUTES

Attribute Name	Element Tag	Type	Notes
Revision 1:			
Rescale Intercept	(0028,1052)	1C	
Rescale Slope	(0028,1053)	1C	
Rescale Type	(0028,1054)	1C	

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SECTION 5 − MR VECTRA QUERY/RETRIEVE INFORMATION MODEL DEFINITION

This section specifies the subset of the DICOM v3.0 Query / Retrieve Information Model Definition used to represent the information included in a Query/Retrieve produced by this implementation. Corresponding attributes are conveyed using the module construct. The contents of this section are:

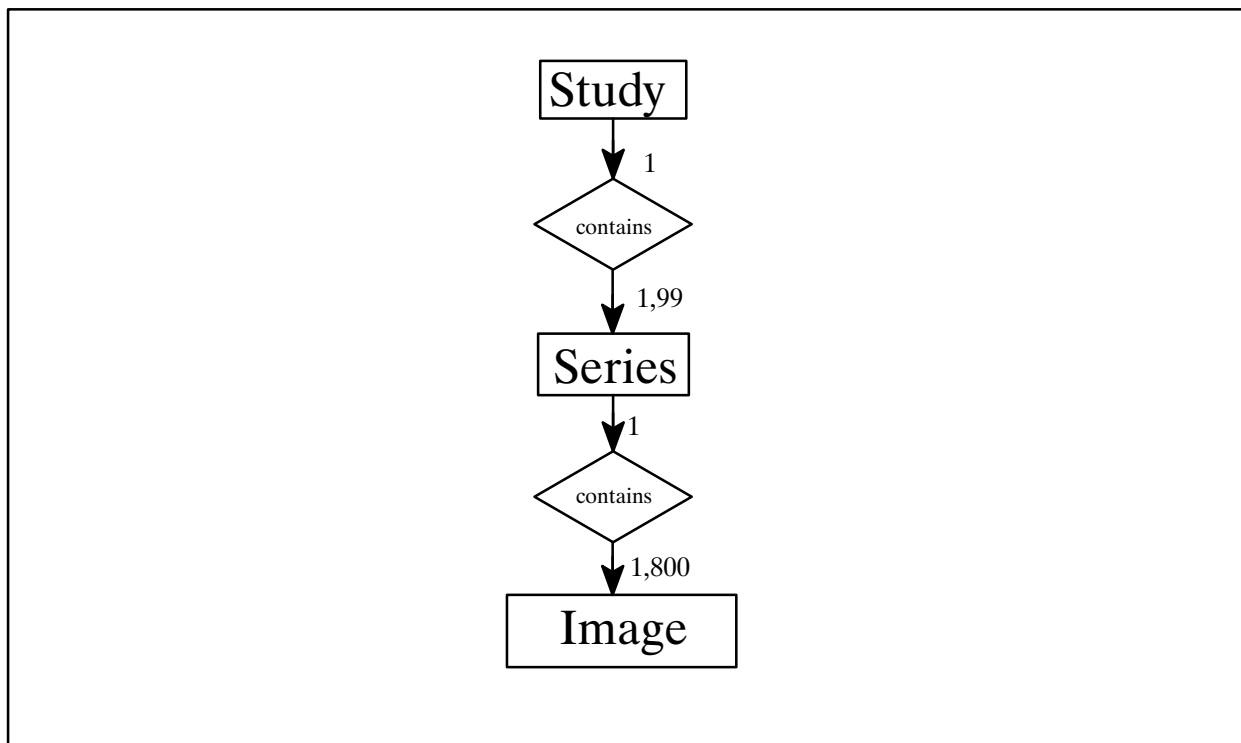5.0 − Interoperability Schema

5.1 − Entity Descriptions

5.2 − Study Level

5.3 − Series Level

5.4 − Image Level

5.0   INTEROPERABILITY SCHEMA

ILLUSTRATION 5−1
STUDY ROOT QUERY/RETRIEVE ENTITY RELATIONSHIP DIAGRAM

The Entity−Relationship diagram for the Study Root Query/Retrieve Information Model interoperability schema is shown in Illustration 5−1. In this illustration, the following diagrammatic convention is established to represent the following 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.

5.1   ENTITY DESCRIPTIONS

Please refer to DICOM Standard Part 4 for a description of each of the entities contained within the Study Root Query/Retrieve Information Model.

5.2   Study Level

5.2.1   Study Level Keys for the Study Root Query/Retrieve Information Model

Table 5−1 defines the keys supported at the Study level of the Study Root Query/Re-trieve Information Model. Table 5−2 specifies the Query/Retrieve Level and AE Title which are included in a C−FIND Response.

TABLE 5−1
STUDY LEVEL KEY ATTRIBUTES (NOTE: R=Required, O=Optional, U=Unique)

Attribute Name	Element Tag	Type	Notes: R=Required, O=Optional, U=Unique
Revision 2:			
Study Date	(0008,0020)	R	
Study Time	(0008,0030)	R	
Accession Number	(0008,0050)	R	
Patient Name	(0010,0010)	R	
Patient ID	(0010,0020)	R	
Study Instance UID	(0020,000D)	U	
Study ID	(0020,0010)	R	
Referring Physician	(0008,0090)	O	
Procedure Description	(0008,1030)	O	
Patient Sex	(0010,0040)	O	
Patient Age	(0010,1010)	O	
Patient Weight	(0010,1030)	O	

TABLE 5−2
Q/R LEVEL & AE TITLE SPECIFICATION − STUDY

Attribute Name	Element Tag	Type	Notes
Q/R Information Model Level	(0008,0052)	R	**Defined Value:** STUDY
Retrieve AE Title	(0008,0054)	R	**Defined Value:** Called AE Title

5.3   **Series Level**

5.3.1   **Series Level Keys for the Study Root Query/Retrieve Information Model**

Table 5−3 defines the keys supported at the Series level of the Study Root Query/Retrieve Information Model. Table 5−4 specifies the Query/Retrieve Level and AE Title which are included in a C−FIND Response.

TABLE 5−3
SERIES LEVEL KEY ATTRIBUTES (NOTE: R=Required, O=Optional, U=Unique)

Attribute Name	Element Tag	Type	Notes: R=Required, O=Optional, U=Unique
Revision 2:			
Modality	**(0008,0060)**	**R**	
Series Instance UID	**(0020,000E)**	**U**	
Series Number	**(0020,0011)**	**R**	
Study Description	**(0008,1030)**	**O**	
Series Description	**(0008,103E)**	**O**	
Patient Position	**(0018,5100)**	**O**	
Position Reference Indicator	**(0020,1040)**	**O**	

TABLE 5−4
Q/R LEVEL & AE TITLE SPECIFICATION − SERIES

Attribute Name	Element Tag	Type	Notes
Q/R Information Model Level	**(0008,0052)**	**R**	**Defined Value:** SERIES
Retrieve AE Title	**(0008,0054)**	**R**	**Defined Value:** Called AE Title

5.4 **Image Level**

5.4.1 **Image Level Keys for the Study Root Query/Retrieve Information Model**

Table 5−5 defines the keys supported at the Image level of the Study Root Query/Retrieve Information Model. Table 5−6 specifies the Query/Retrieve Level and AE Title which are included in a C−FIND Response.

TABLE 5−5
MR IMAGE LEVEL KEY ATTRIBUTES (NOTE: R=Required, O=Optional, U=Unique)

Attribute Name	Element Tag	Type	Notes
Revision 2:			
SOP Instance UID	**(0008,0018)**	**U**	
Image Number	**(0020,0013)**	**R**	
SOP Class UID	**(0008,0016)**	**O**	
Image Date	**(0008,0023)**	**O**	
Image Time	**(0008,0033)**	**O**	
Contrast/Bolus Agent	**(0018,0010)**	**O**	
Slice Thickness	**(0018,0050)**	**O**	
Repetition Time	**(0018,0080)**	**O**	
Echo Time	**(0018,0081)**	**O**	
Inversion Time	**(0018,0082)**	**O**	
Number of Averages	**(0018,0083)**	**O**	
Trigger Time	**(0018,1060)**	**O**	
Reconstruction Diameter	**(0018,1100)**	**O**	
Flip Angle	**(0018,1314)**	**O**	
Slice Location	**(0020,1041)**	**O**	

TABLE 5−6
Q/R LEVEL & AE TITLE SPECIFICATION − IMAGE

Attribute Name	Element Tag	Type	Notes
Q/R Information Model Level	(0008,0052)	R	**Defined Value:** IMAGE
Retrieve AE Title	(0008,0054)	R	**Defined Value:** Called AE Title

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