DICOM CONFORMANCE STATEMENT
MWM & MPPS SCU
FOR
TOSHIBA SUPERCONDUCTING MRI SYSTEMS

VISART-series/ EXCELART-series

(MIIMR0004EAA)

TOSHIBA CORPORATION

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1 Introduction

This document is a DICOM Conformance Statement for Toshiba's Superconducting MRI Systems(FLEXART-series/VISART-series/ EXCELART-series/SECOND CONSOLE). It is intended to provide the reader with the knowledge of how to integrate this product within a DICOM compliant hospital network. It details the DICOM Service Classes, Information Objects, and Communication Protocols which are supported by this product.

If the reader is unfamiliar with DICOM, it is recommended that they read the DICOM Specification(referenced below) prior to reading this conformance statement. Also note that this document is formatted according to the DICOM Specification, Part 2:Conformance.

1.1 References

- ACR-NEMA Digital Imaging and Communications in Medicine, DICOM V3.0.

1.2 Definitions

- **Association Establishment** - An Association Establishment is the first phase of communication between two DICOM Application Entities. The AEs use the Association Establishment to negotiate how data will be encoded and the type of data to be exchanged.
- **Called Application Entity Title** - The Called AE Title defines the intended receiver of an Association.
- **Calling Application Entity Title** - The Calling AE Title defines the requestor of an Association.
- **DICOM Message Service Element (DIMSE)** - A DIMSE defines the services and protocols utilized by an Application Entity to exchange messages.
- **Information Object Definition (IOD)** - An IOD is a data model which is an abstraction of real-world information. This data model defines the nature and attributes relevant to the class of real-world objects represented.
- **Service Class Provider (SCP)** - A Service Class Provider plays the "server" role to perform operations and invoke notifications during an Association. An example of a Storage Service Class Provider would be an image storage device. In this case, the image storage device is storing the image that was sent by a Service Class User.
- **Service Class User (SCU)** - A Service Class User plays the "client" role to invoke operations and perform notifications during an Association. An example of a Storage Service Class User would be an image acquisition device. In this case, the image acquisition device will create and send a DICOM image by requesting that a Service Class Provider store that image.
- **Service/Object Pair (SOP) Class** - A SOP Class is defined by the union of an Information Object Definition and a set of DIMSE Services. A DICOM Application Entity may support one or more SOP Classes. Each SOP Class is uniquely identified by a SOP Class UID.
- **SOP Instance** - A specific occurrence of a Information Object.
- **Transfer Syntax** - The Transfer Syntax is a set of encoding rules that allow DICOM Application Entities to negotiate the encoding techniques (e.g. data element structure, byte ordering, compression) they are able to support. The Transfer Syntax is negotiated during Association Negotiation.
- **Unique Identifier (UID)** - A Unique Identifier is a globally unique, ISO compliant, ASCII-numeric string. It guarantees uniqueness across multiple countries, sites, vendors and equipment.

1.3 Acronyms, Abbreviations and Symbols

- ACC American College of Cardiology
- ACR American College of Radiology
- ASCII American Standard Code for Information Interchange
- AE Application Entity
- ANSI American National Standards Institute
- CEN TC251 Comite Europeen de Normalisation - Technical Committee 251 - Medical Informatics
- DICOM Digital Imaging and Communications in Medicine
- DIMSE DICOM Message Service Element
- DIMSE-C DICOM Message Service Element - Composite
- DIMSE-N DICOM Message Service Element - Normalized
- HIS Hospital Information System
- HL7 Health Level 7
- IE Information Entity
- IOD Information Object Definition
- ISO International Standards Organization
- JIRA Japan Industries Association of Radiological Systems
- NEMA National Electrical Manufacturers Association
- OSI Open Systems Interconnection
- PDU Protocol Data Unit
- RIS Radiology Information System
- SCP Service Class Provider
- SCU Service Class User
- SOP Service-Object Pair
- TCP/IP Transmission Control Protocol/Internet Protocol
- UID Unique Identifier

2 Implementation Model

2.1 Application Data Flow Diagram

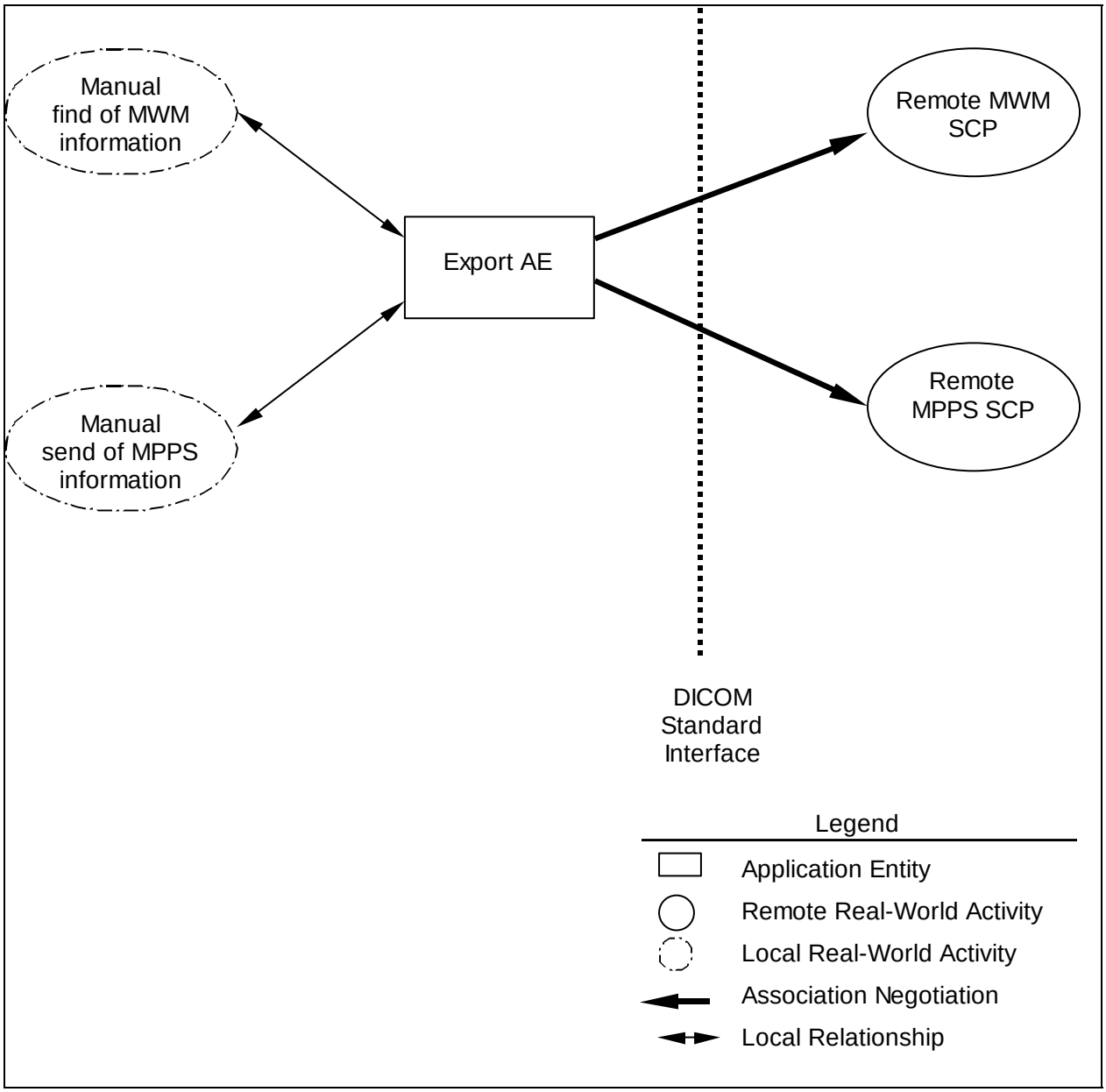

Figure 1

2.2 Functional Definitions of AE's

2.2.1 Export AE

Export AE is used to transmit request for Study List to a remote DICOM device and to retrieve Study List with Procedure Step. It therefore performs the following tasks:

- Establishes DICOM Association with remote DICOM device
- Performs request of DICOM Modality Worklist Object to remote DICOM device
- Retrieves Study List with Procedure Step Information from remote DICOM device

Export AE is used to transmit the information of performed procedure step to a remote DICOM device. It therefore performs the following tasks:

- Builds DICOM MPPS Information Objects
- Establishes DICOM Association with remote DICOM device
- Performs transmit of DICOM MPPS Information Objects to remote DICOM device

2.3 Sequencing of Real World Activities

2.3.1 Features

2.3.1.1 Manual find of MWM information

- Operator requests to retrieve Study List before that day's exam.
- When the find fails, Operator can manually attempt to find Study List again at a later time.

2.3.1.2 Manual send of MPPS information

- The start time of the study is sent automatically.
- The end time of the study is sent when the operator manually selects the termination status of the study.
- When the transfer fails, Operator can manually attempt to resend MPPS information at a later time.

2.3.2 Operation

2.3.2.1 Manual find of MWM information

The operation for manual Worklist retrieving is described below:
Step-1: Input the search condition.
Step-2: Request find.

2.3.2.2 Manual send of MPPS information

The operation for manual MPPS information sending is described below:
Step-1: Starting the study will automatically or manually trigger sending of the study start time.
Step-2: When the study is terminated a pop-up menu is displayed for the operator to select a termination status(completed or discontinued).

3 AE Specifications

3.1 Export Specification

Export AE provides Standard Conformance to the following DICOM SOP Classes as an SCU:

Table 1

SOP Class Name	SOP Class UID
Modality Worklist Information Model - Find	1.2.840.10008.5.1.4.31
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3

3.1.1 Export Association Establishment Policies

3.1.1.1 Export General

Export AE will utilize and understand the following Application Context Name:

Table 2

DICOM V3.0 Application Context	1.2.840.10008.3.1.1.1

Export AE supports a minimum PDU size of 16Kbytes and a maximum PDU size of 16Kbytes. The default value is set to 16Kbytes.

3.1.1.2 Export Number of Associations

Export AE can only establish one association at a time, independent of the number of destinations chosen.

3.1.1.3 Export Asynchronous Nature

Export AE allows a single outstanding operation on any association. Therefore, Export AE does not support asynchronous operations window negotiation, other than the default as specified by the DICOM specification.

3.1.1.4 Export Implementation Identifying Information

Export AE will specify the following Implementation Identifying Information:

- Implementation Class UID 1.2.392.200036.9116.4.1.12
- Implementation Version Name TM_MR_DCM_V1.2

3.1.2 Export Association Initiation by Real-World Activity

Export AE initiates an association when the following activity is chosen by the operator.

- "Manual find of study information"
  - ♦ Modality Worklist Management(MWM) - Retrieve Worklist from a remote DICOM device
- "Manual send of study information"
  - ♦ Modality Performed Procedure Step (MPPS): - Send MPPS information to a remote DICOM device

3.1.2.1 Export Real-World Activity - MWM

3.1.2.1.1 Export Associated Real-World Activity - MWM

MWM is executed by the MRI System after the operator's Worklist search requests are queued.

3.1.2.1.2 Export Proposed Presentation Contexts - MWM

Export AE proposes the following Presentation Contexts shown below:

Table 3

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended**
Name	**UID**	**Name List**	**UID List**		**Negotiation**
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

3.1.2.1.2.1 Export SOP Specific Conformance - MWM

- Export AE operation involves the following sequence of steps for one search request.
  (1) Association establishment(requestor only)
  (2) Worklist retrieve(SCU only)
  (3) Association release(requestor only)

  Export AE judges that the search request succeeded when the result of (2) "Worklist retrieve" is "Success" even if the result of (3) "Association release" is "Failure".
- MWM Information Object Definition is described in chapter 8.

3.1.2.2 Export Real-World Activity - MPPS

3.1.2.2.1 Export Associated Real-World Activity - MPPS

Export AE performs DICOM MPPS to a destination device. If a communication error occurs, the MPPS operation is automatically retried several times.

3.1.2.2.2 Export Proposed Presentation Contexts - MPPS

Export AE proposes the following Presentation Contexts shown below:

Table 4

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Extended**
Name	**UID**	**Name List**	**UID List**		**Negotiation**
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.2.2.1 Export SOP Specific Conformance - MPPS

- Export AE operation involves the following sequence of steps for each request MPPS.
  - (1) Association establishment (requestor only)
  - (2) MPPS information transfer (SCU only)
  - (3) Association release (requestor only)

  Export AE judges that the transfer of MPPS information succeeded when the result of (2) "MPPS information transfer" is "Success" even if the result of (3) "Association release" is "Failure".
- MPPS Information Object Definition is described in chapter 9.

3.1.3 Export Association Acceptance Policy

Export AE does not accept any associations generated by remote applications.

4 Communication Profiles

4.1 Supported Communication Stacks

This product provides DICOM TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.2 OSI Stack

Not applicable to this product.

4.3 TCP/IP Stack

This product inherits its TCP/IP stack from the computer system upon which it executes.

4.3.1 API

Not applicable to this product.

4.3.2 Physical Media Support

This product is indifferent to the physical medium over which TCP/IP executes; it inherits the medium from the computer system upon which it executes.

4.4 Point-to-Point Stack

Not applicable to this product.

5 Extensions/Specializations/Privatizations

Not applicable to this product.

6 Configuration

For the MR Systems, the configuration can be set using the Online Setup interface.
Note: Settings and changes are performed by Toshiba Service Personnel at the time of installation of the system.

6.1 AE Title/Presentation Address Mapping

Mapping from the AE titles to the presentation address are as follows:

- One port number and one AE title can be described for one host name.
  - Each AE title is mapped to one port number.
  - The MR Systems has following default values:

  Local AE Title TM_MR_DCM_V1.0

6.2 Configurable Parameters

6.2.1 Time-out Value, Retry Count, Retry Interval

The time-out value, retry count , and retry interval in each status are shown below.

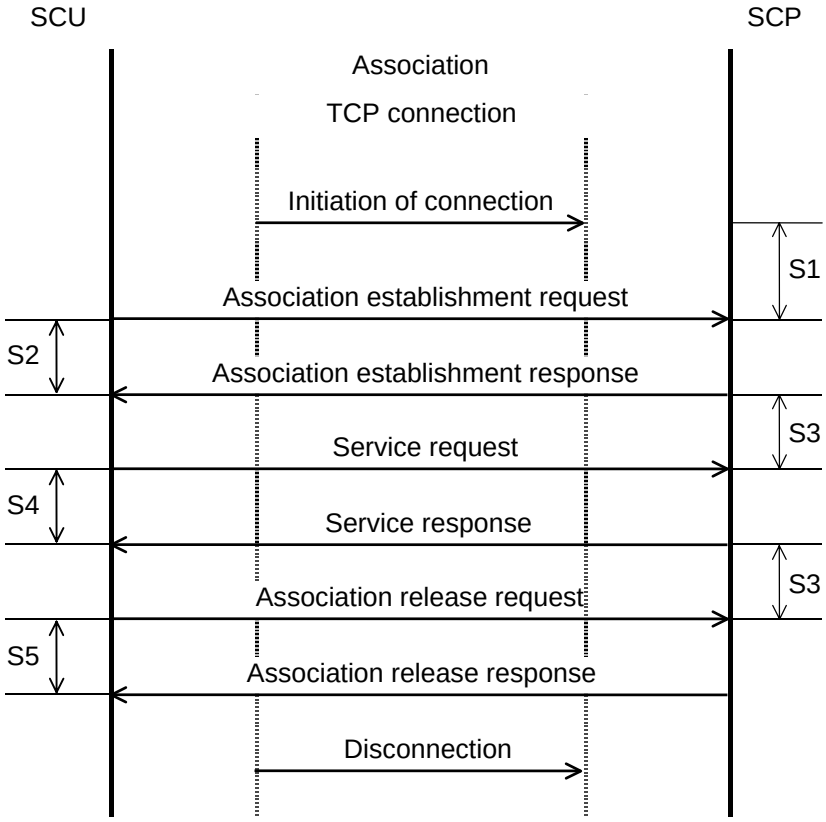

Figure 2

Table 5

Status	Item	Time-out value	Retry count	Retry interval	Remarks
S1	Association establishment request waiting time	Not set	Not set	Not set	Not applicable to this product.
S2	Association establishment response waiting time	default:30 seconds range:1 to 10000	Not set	Not set	Only one parameter can be set in Toshiba MRI Systems.
S3	Service request waiting time	Not set	Not set	Not set	Not applicable to this product.
S4	Service response waiting time	default:300 seconds range:1 to 10000	Not set	Not set	Only one parameter can be set in Toshiba MRI Systems.
S5	Association release waiting time	default:30 seconds range:1 to 10000	Not set	Not set	Only one parameter can be set in Toshiba MRI Systems.

6.3 Implementation Information and Maximum Reception PDU Size

The default values for the MRI System are used for the Implementation Class UID, the Implementation Version Name, and the Maximum length received. They cannot be changed.

Table 6

Parameter	Default
Implementation Class UID	1.2.392.200036.9116.4.1.12
Implementation Version Name	TM_MR_DCM_V1.2
Maximum length received (unit: byte)	0x4000

7 Support of Extended Character Sets

This product supports the following character sets:

- ISO-IR 6 (default) ISO 646
- ISO-IR 87(Japanese) JIS X 0208(Kanji)

8 MWM Information Object Definition

The attribute listed in the following tables represent a small set of the possible attributes which could be supported by a Modality Worklist SCU.

8.1 MWM IOD Modules

Table 7

Information Entity	Module	Reference
General Modules	SOP Common Module	8.3.1
Patient Modules	Patient Relationship Module	Not Used
	Patient Identification Module	8.2.1, 8.3.2
	Patient Demographic Module	8.3.3
	Patient Medical Module	8.3.4
Visit Modules	Visit Relationship Module	Not Used
	Visit Identification Module	Not Used
	Visit Status Module	Not Used
	Visit Admission Module	Not Used
Study Modules	Scheduled Procedure Step Module	8.2.2, 8.3.5
	Requested Procedure Module	8.3.6
	Imaging Service Request Module	8.3.7

8.2 Matching Key Attributes

8.2.1 Patient Identification Module

Table 8

Description/Module	Tag	Matching Key Type	Matching Type
Patient's Name	(0010,0010)	Required	Wild Card Matching.
Patient ID	(0010,0020)	Required	Single Value Matching only.

8.2.2 Scheduled Procedure Step Module

Table 9

Description/Module	Tag	Matching Key Type	Matching Type
Scheduled Procedure Step Sequence	(0040,0100)	Required	
>Modality	(0008,0060)	Required	Single Value Matching only.
>Scheduled Station AE Title	(0040,0001)	Required	Single Value Matching only.
>Scheduled Procedure Step Start Date	(0040,0002)	Required	Single Value Matching or Range Matching.
>Scheduled Procedure Step Start Time	(0040,0003)	Required	Single Value Matching or Range Matching.
>Scheduled Performing Physician's Name	(0040,0006)	Required	Wild Card Matching.

8.3 Return Key Attributes

8.3.1 SOP Common Module

Table 10

Description/Module	Tag	Return Key Type	Note
Specific Character Set	(0008,0005)	1C	

8.3.2 Patient Identification Module

Table 11

Description/Module	Tag	Return Key Type	Note
Patient's Name	(0010,0010)	1	
Patient ID	(0010,0020)	1	

8.3.3 Patient Demographic Module

Table 12

Description/Module	Tag	Return Key Type	Note
Patient's Birth Date	(0010,0030)	2	
Patient's Sex	(0010,0040)	2	
Patient's Weight	(0010,1030)	2	
Patient Comments	(0010,4000)	3	

8.3.4 Patient Medical Module

Table 13

Description/Module	Tag	Return Key Type	Note
Pregnancy Status	(0010,21C0)	2	

8.3.5 Scheduled Procedure Step Module

Table 14

Description/Module	Tag	Return Key Type	Note
Scheduled Procedure Step Sequence	(0040,0100)	1	
>Scheduled Station AE Title	(0040,0001)	1	
>Scheduled Procedure Step Start Date	(0040,0002)	1	
>Scheduled Procedure Step Start Time	(0040,0003)	1	
>Scheduled Performing Physician's Name	(0040,0006)	2	
>Modality	(0008,0060)	1	
>Scheduled Procedure Step Description	(0040,0007)	1C	
>Scheduled Protocol Code Sequence	(0040,0008)	1C	
>>Code Value	(0008,0100)	1C	
>>Coding Scheme Designator	(0008,0102)	1C	
>>Coding Scheme Version	(0008,0103)	3	
>>Code Meaning	(0008,0104)	3	
>Scheduled Procedure Step ID	(0040,0009)	1	

8.3.6 Requested Procedure Module

Table 15

Description/Module	Tag	Return Key Type	Note
Requested Procedure ID	(0040,1001)	1	
Requested Procedure Description	(0032,1060)	1C	
Requested Procedure Code Sequence	(0032,1064)	1C	
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Coding Scheme Version	(0008,0103)	3	
>Code Meaning	(0008,0104)	3	
Study Instance UID	(0020,000D)	1	
Referenced Study Sequence	(0008,1110)	2	
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	

8.3.7 Image Service Request Module

Table 16

Description/Module	Tag	Return Key Type	Note
Referring Physician's Name	(0008,0090)	2	
Accession Number	(0008,0050)	2	

9 MPPS Information Object Definition

The attribute listed in the following tables represent a small set of the possible attributes which could be supported by a Modality Performed Procedure Step SCU.

9.1 MPPS IOD Modules

9.1.1 C-CREATE

Table 17

Module	Reference
SOP Common Module	9.2.1
Performed Procedure Step Relationship Module	9.2.2
Performed Procedure Step Information Module	9.2.3
Image Acquisition Result Module	9.2.4
Radiation Dose Module	Not used
Billing and Material Management Codes Module	Not used

9.1.2 N-SET

Table 18

Module	Reference
SOP Common Module	9.3.1
Performed Procedure Step Relationship Module	Not used
Performed Procedure Step Information Module	9.3.2
Image Acquisition Result Module	9.3.3
Radiation Dose Module	Not used
Billing and Material Management Codes Module	9.3.4

9.2 N-CREATE Attributes

9.2.1 SOP Common Module

Table 19

Attribute Name	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Not set when the system is English mode Set "\ISO 2022 IR 87" when the system is Japanese mode

9.2.2 Performed Procedure Step Relationship Module

Table 20

Attribute Name	Tag	Type	Attribute Description
Scheduled Step Attribute Sequence	(0040,0270)	1	Always set
>Study Instance UID	(0020,000D)	1	Always set
>Referenced Study Sequence	(0008,1110)	2	Length=0 when no entry is made
>> Referenced SOP Class UID	(0008,1150)	1C	Not set when no data is available
>> Referenced SOP Instance UID	(0008,1155)	1C	Not set when no data is available
>Accession Number	(0008,0050)	2	Length=0 when no entry is made
>Placer Order Number/Imaging Service Request	(0040,2016)	3	Not set when no data is available
>Filler Order Number/Imaging Service Request	(0040,2017)	3	Not set when no data is available
>Requested Procedure ID	(0040,1001)	2	Length=0 when no entry is made
>Requested Procedure Description	(0032,1060)	2	Length=0 when no entry is made
>Scheduled Procedure Step Description	(0040,0007)	2	Length=0 when no entry is made
>Scheduled Protocol Code Sequence	(0040,0008)	2	Length=0 when no entry is made
>>Code Value	(0008,0100)	1C	Not set when no data is available
>>Coding Scheme Designator	(0008,0102)	1C	Not set when no data is available
>>Coding Scheme Version	(0008,0103)	3	Not set when no data is available
>>Code Meaning	(0008,0104)	3	Not set when no data is available
>Scheduled Procedure Step ID	(0040,0009)	2	Length=0 when no entry is made
Patient’s Name	(0010,0010)	2	Length=0 when no entry is made
Patient ID	(0010,0020)	2	Length=0 when no entry is made
Patient’s Birth Date	(0010,0030)	2	Length=0 when no entry is made
Patient’s Sex	(0010,0040)	2	Length=0 when no entry is made
Referenced Patient Sequence	(0008,1120)	2	Length=0 when no entry is made
>Referenced SOP Class UID	(0008,1150)	1C	Not set when no entry is made
>Referenced SOP Instance UID	(0008,1155)	1C	Not set when no entry is made

9.2.3 Performed Procedure Step Information Module

Table 21

Attribute Name	Tag	Type	Attribute Description
Performed Procedure Step ID	(0040,0253)	1	Always set
Performed Station AE Title	(0040,0241)	1	Always set
Performed Station Name	(0040,0242)	2	Length=0 when no entry is made
Performed Location	(0040,0243)	2	Length=0 when no entry is made
Performed Procedure Step Start Date	(0040,0244)	1	Always set
Performed Procedure Step Start Time	(0040,0245)	1	Always set
Performed Procedure Step Status	(0040,0252)	1	Always set(“IN PROGRESS”)
Performed Procedure Step Description	(0040,0254)	2	Length=0 when no entry is made
Performed Procedure Type Description	(0040,0255)	2	Length=0 when no entry is made
Performed Procedure Step End Date	(0040,0250)	2	Always set, Length=0
Performed Procedure Step End Time	(0040,0251)	2	Always set, Length=0
Comments on the Performed Procedure Step	(0040,0280)	3	Not set when no data is available
Procedure Code Sequence	(0008,1032)	2	Length=0 when no entry is made
>Code Value	(0008,0100)	1C	Not set when no data is available
>Coding Scheme Designator	(0008,0102)	1C	Not set when no data is available
>Coding Scheme Version	(0008,0103)	3	Not set when no data is available
>Code Meaning	(0008,0104)	3	Not set when no data is available

9.2.4 Image Acquisition Result Module

Table 22

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Always set(“MR”)
Study ID	(0020,0010)	2	Always set
Performed Protocol Code Sequence	(0040,0260)	2	Always set, Length=0
Performed Series Sequence	(0040,0340)	2	Always set, Length=0

9.3 N-SET Attributes

9.3.1 SOP Common Module

Table 23

Attribute Name	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Not set when the system is English mode Set "\ISO 2022 IR 87" when the system is Japanese mode

9.3.2 Performed Procedure Step Information Module

Table 24

Attribute Name	Tag	Type (*1)	Attribute Description
Performed Procedure Step Status	(0040,0252)	3	Always set (“COMPLETED" / "DISCONTINUED”)
Performed Procedure Step Description	(0040,0254)	3	Not set when no entry is made
Performed Procedure Type Description	(0040,0255)	3	Not set when no entry is made
Performed Procedure Step End Date	(0040,0250)	3 (1)	Always set
Performed Procedure Step End Time	(0040,0251)	3 (1)	Always set

*1) Requirement Type Final State

9.3.3 Image Acquisition Result Module

Table 25

Attribute Name	Tag	Type (*1)	Attribute Description
Performed Series Sequence	(0040,0340)	3(1)	Always set
>Retrieve AE Title	(0008,0054)	2(2)	Length=0 when no entry is made
> Series Description	(0008,103E)	2C(2)	Length=0 when no entry is made
>Performing Physician’s Name	(0008,1050)	2C(2)	Length=0 when no entry is made
>Operator’s Name	(0008,1070)	2C(2)	Length=0 when no entry is made
> Protocol Name	(0018,1030)	1C(1)	Always set
> Series Instance UID	(0020,000E)	1C(1)	Always set

*1) Requirement Type Final State

9.3.4 Billing and Material Management Codes Module

Table 26

Attribute Name	Tag	Type	Attribute Description
Film Consumption Sequence	(0040,0321)	3	Not set when no data is available
>Number of Films	(2100,0170)	3	Not set when no data is available
>Medium Type	(2000,0030)	3	Not set when no data is available
>Film Size ID	(2010,0050)	3	Not set when no data is available

E