No. MIIMS0009EA

DICOM
CONFORMANCE STATEMENT
FOR
MODEL TFS-3000
(MIIMS0009EA)

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Table of Contents

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1 INTRODUCTION

This document is a DICOM Conformance Statement for Toshiba's TFS-3000. 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 readers are 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 (AEs). 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 requester 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 that 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 stores 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 creates and sends a DICOM image by requesting that a Service Class Provider store that image.
- **Service/Object Pair (SOP) Class** - An 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 an SOP Class UID.

- **SOP Instance** - A specific occurrence of an 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) that 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
- JIS Japanese Industrial Standards
- 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

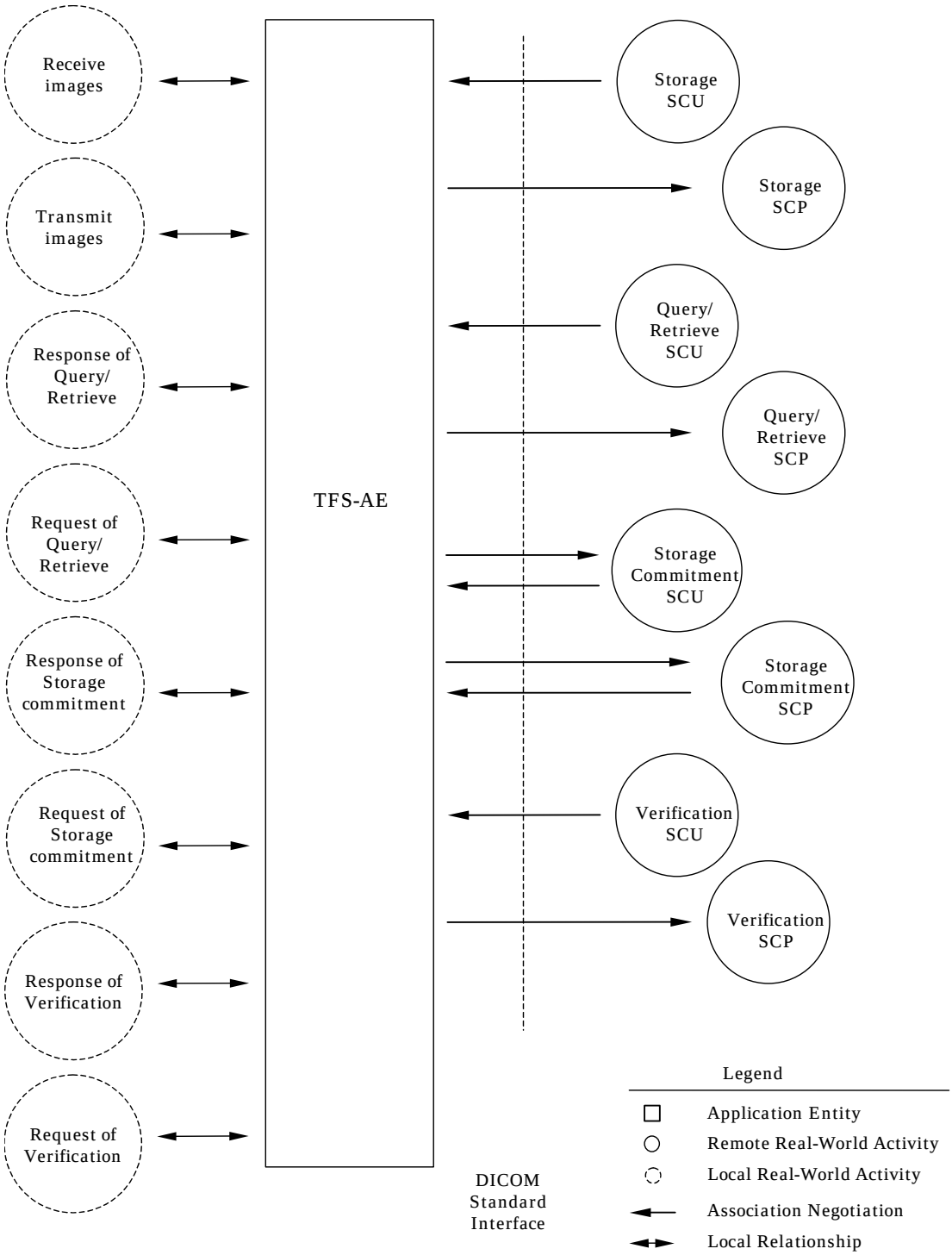

Figure 1

2.2 Functional Definitions of AE's

2.2.1 TFS-AE

TFS-AE is used to transmit verification requests, Query and Retrieve requests and images to a remote DICOM device and to request storage commitment to other devices.
TFS-AE is also used to respond to requests to verify that the TFS-3000 is present and active on the network, to receive images from remote DICOM devices, to respond to queries from other devices and to respond to storage commitment requests to explicitly take responsibility for storing images received.
If configured with off-line storage, TFS-AE commits to permanently storing an SOP Instance, unless it is manually deleted from TFS-3000. Off-line storage capacity varies based on an individual TFS-3000's configuration.
In a cache-only configuration, TFS-3000 commits to storing a SOP Instance as long as there is available disk space. In this configuration, TFS-3000 may delete SOP Instances based on a user request or based on auto-pilot cache management rules.
SOP instances can be retrieved from TFS-3000 via C-FIND and C-MOVE.

2.3 Sequencing of Real World Activities

2.3.1 Features

2.3.1.1 Receive Images

- TFS-AE stores a received image, without change, in its internal data store and stores each image with the File Meta Information attached to it.
- TFS-AE extracts the query information with respect to the patient, study, series and image, and stores this information within its internal database.

2.3.1.2 Transmit Images

- TFS-AE acts as a Service Class User of C-STORE to transmit images to other compatible devices.

2.3.1.3 Response of Query/Retrieve

- TFS-AE responds to queries based on the records stored in its database.
- TFS-AE acts as a Service Class Provider of C-MOVE to retrieve images. It does so by obtaining a reference from the database then obtaining the image object itself from the data store.

2.3.1.4 Request of Query/Retrieve

- TFS-AE acts as a Service Class User of C-FIND to queries to other compatible devices.
- TFS-AE acts as a Service Class User of C-MOVE to retrieve images from other compatible devices.

2.3.1.5 Response of Storage Commitment

- TFS-AE acts as a Service Class Provider of Storage Commitment to explicitly take responsibility for storing images received.

2.3.1.6 Request of Storage Commitment

- TFS-AE may send images to another SCP for permanent storage. The request for storage commitment may then be transmitted from TFS-AE.

2.3.1.7 Response of Verification

- TFS-AE acts a Service Class Provider of C-ECHO to validate DICOM connection.

2.3.1.8 Request of Verification

- TFS-AE will issue Verification requests in response to requests from the user to test validity of DICOM connection.

2.3.2 Operation

2.3.2.1 Receive Images

There is no specific operation for receiving images.

2.3.2.2 Transmit Images

The user can transmit images of studies that he or she selects on the list of the Study Manager, which is a tool for the user to handle studies stored in the TFS-3000.

2.3.2.3 Response of Query/Retrieve

There is no specific operation to respond to Query/Retrieve requests.

2.3.2.4 Request of Query/Retrieve

The user can query to other devices and retrieve images from those devices using

Study Manager.

2.3.2.5 Response of Storage Commitment

There is no specific operation to respond to Storage Commitment requests.

2.3.2.6 Request of Storage Commitment

There is no specific operation to request Storage Commitment to other devices if the commitment parameter for those devices is set.

2.3.2.7 Response of Verification

There is no specific operation to respond to Verification requests.

2.3.2.8 Request of Verification

The user can transmit C-ECHO request from the Network Manager, which is a tool to set communication parameters of stations that are connected to the TFS-3000.

3 AE SPECIFICATIONS

3.1 Specification

TFS-AE provides Standard Conformance to the following DICOM SOP Classes as SCU and SCP:

Table 1

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
CR Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
US Multi-frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3
US Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
NM Image Storage (retired)	1.2.840.10008.5.1.4.1.1.5
US Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9
Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10
Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1
XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2
XA Bi-plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
Visible Light Storage	1.2.840.10008.5.1.4.1.1.77.1
Visible Light Multi-frame Storage	1.2.840.10008.5.1.4.1.1.77.2
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128

Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
Storage Commitment Push Model	1.2.840.10008.1.20.1
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
Patient/Study Only Query/Retrieve Information Model-Find	1.2.840.10008.5.1.4.1.2.3.1
Patient/Study Only Query/Retrieve Information Model-Move	1.2.840.10008.5.1.4.1.2.3.2

3.1.1 Association Establishment Policies

3.1.1.1 General

The following Application Context Name will be proposed and recognized by TFS-AE:

Table 2

DICOM V3.0 Application Context	1.2.840.10008.3.1.1.1

Maximum PDU size is configurable. The default value for this is 100,000 bytes.

3.1.1.2 Number of Associations

- Export Number of Associations

TFS-AE can establish 10 associations for Query/Retrieve, Storage, and Storage Commitment at a time. But each destination is permitted to establish only one association.

- Import Number of Associations

TFS-AE can establish 10 associations at a time.

3.1.1.3 Asynchronous Nature

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

3.1.1.4 Implementation Identifying Information

TFS-AE will respond with the following implementation identifying parameters:

Table 3

Implementation Class UID	Implementation Version Name
1.2.124.113532.3510	MITRAJUNE1997

3.1.2 Association Initiation by Real-World Activity

TFS-AE initiates an association for the following activities:

- "Request of Verification"
  - Verification - Send Verification requests to test validity of DICOM connection.
- "Transmit Images"
  - Storage - Transmit images to a remote DICOM device.
- "Request of Storage Commitment"
  - N-ACTION - Request for Storage Commitment to SOP instances.
- "Response of Storage Commitment"
  - N-EVENT-REPORT
    - Send the successfully stored SOP instances list to reply to the Storage Commitment request.
- "Request of Query/Retrieve"
  - C-FIND - Get a study list from a remote DICOM device.

- C-MOVE - Send a request to transfer images from a remote device to the local device.

3.1.2.1 Real-World Activity – Verification

3.1.2.1.1 Associated Real-World Activity - Verification

TFS-AE will test validity of DICOM connection when user requires Verification.

3.1.2.1.2 Proposed Presentation Contexts - Verification

TFS-AE requests the Presentation Contexts listed in Table 4:

Table 4

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.1.2.1 SOP Specific Conformance - Verification

TFS-AE provides standard conformance to the DICOM Verification Service Class.

3.1.2.2 Real-World Activity – Storage

3.1.2.2.1 Associated Real-World Activity - Storage

TFS-AE will transmit images that have been sent to it previously, driven by user request.

3.1.2.2.2 Proposed Presentation Contexts - Storage

TFS-AE may request any of the Presentation Contexts listed in Table 5 for Storage:

Table 5

Presentation Context Table

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**	**(Refer to the following table.**		
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	Table A	SCU	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Table A		
US Multi-frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3	Table B		
US Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Table B		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Table A		
NM Image Storage (retired)	1.2.840.10008.5.1.4.1.1.5	Table A		
US Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Table B		
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Table B		
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	Table B		
Stand-alone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	Table A		
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9	Table A		
Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10	Table A		
Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11	Table A		
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Table A		
XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Table A		
XA Bi-plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	Table A		
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	Table A		

Presentation Context Table

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**	**(Refer to the following table.**		
Visible Light Storage	1.2.840.10008.5.1.4.1.1.77.1	Table B		
Visible Light Multi-frame Storage	1.2.840.10008.5.1.4.1.1.77.2	Table B		
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Table A		
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Table A		
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Table A		
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Table A		
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Table A		
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Table A		
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Table A		

Transfer Syntax table A

Transfer Syntax	
Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Big Endian	1.2.840.10008.1.2.2
RLE Lossless, PackBits	1.2.840.10008.1.2.5
JPEG Process 1, baseline, lossy (8bit)	1.2.840.10008.1.2.4.50
JPEG Process 2,4, extended lossy (12bit)	1.2.840.10008.1.2.4.51
JPEG Process 14, lossless	1.2.840.10008.1.2.4.57
JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70

Transfer Syntax table B

Transfer Syntax	
Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Big Endian	1.2.840.10008.1.2.2

3.1.2.2.2.1 SOP Specific Conformance – Storage

TFS-AE conforms to the DICOM Storage Service Class as an SCU.

3.1.2.3 Real-World Activity – Storage Commitment (N-ACTION)

3.1.2.3.1 Associated Real-World Activity – Storage Commitment (N-ACTION)

In some configurations (e.g. cache-only), TFS-AE may send images to another SCP (e.g. a PACS) for permanent storage. The request for storage commitment may then be transmitted from TFS-AE together with a list of references to one or more SOP instances. This action is invoked through the DIMSE N-ACTION primitive. The following message is supported:

- Request Storage Commitment – to request the safekeeping of a set of SOP instances

3.1.2.3.2 Proposed Presentation Contexts – Storage Commitment (N-ACTION)

TFS-AE requests the Presentation Contexts listed in Table 6:

Table 6

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.3.2.1 SOP Specific Conformance – Storage Commitment (N-ACTION)

TFS-AE provides standard conformance to the DICOM Storage Commitment Service Class. TFS-AE supports the following elements for this SOP class as an SCU. The Transaction UID Attribute (0008,1195) value generated by TFS-AE uniquely identifies each Storage Commitment Request.

The SCP must open a new association to TFS-AE in order to transmit the result of the commitment request since TFS-AE closes the association after receiving the N-ACTION response from the SCP.

Table 7

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

3.1.2.4 Real-World Activity – Storage Commitment (N-EVENT-REPORT)

3.1.2.4.1 Associated Real-World Activity – Storage Commitment (N-EVENT-REPORT)

If TFS-AE determines that it has successfully completed storage commitment, TFS-AE issues an N-EVENT-REPORT to the SCU including references to the successfully stored SOP Instances contained in the N-ACTION.

The N-EVENT-REPORT contains the Transaction UID value contained in the initiating N-ACTION. The N-EVENT-REPORT is sent on a separate association from the N-ACTION operation.

3.1.2.4.2 Proposed Presentation Contexts – Storage Commitment (N-EVENT-REPORT)

TFS-AE requests the Presentation Contexts listed in Table 8:

Table 8

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.1.2.4.2.1 SOP Specific Conformance – Storage Commitment (N-EVENT-REPORT)

TFS-AE provides standard conformance to the DICOM Storage Commitment Service Class. TFS-AE supports the following elements for this SOP class as an SCP. The N-EVENT-REPORT contains the Transaction UID value contained in the initiating N-ACTION.

Table 9

Event Type Name	Event Type ID	Attribute Name	Tag
Storage Commitment Request Successful	1	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)
Storage Commitment Request Complete – Failures exist	2	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)

3.1.2.5 Real-World Activity – Query/Retrieve (C-FIND)

3.1.2.5.1 Associated Real-World Activity – Query/Retrieve (C-FIND)

TFS-AE will initiate query requests to an SCP.

3.1.2.5.2 Proposed Presentation Contexts – Query/Retrieve (C-FIND)

TFS-AE will initiate any of the Presentation Contexts listed in Table 10 for Query.

Table 10

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Info. Model-Find	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Study Root Info. Model-Find	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Patient/Study Only Info. Model-Find	1.2.840.10008.5.1.4.1.2.3.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.5.2.1 SOP Specific Conformance – Query/Retrieve (C-FIND)

SOP classes of the Query/Retrieve Service Class are implemented via the DIMSE C-FIND service as defined in Part 7 of the DICOM standard.
TFS-AE will initiate one C-FIND Presentation Context per association request. Search keys for the Query/Retrieve SCU are described in chapter 9.

3.1.2.6 Real-World Activity – Query/Retrieve (C-MOVE)

3.1.2.6.1 Associated Real-World Activity – Query/Retrieve (C-MOVE)

TFS-AE will initiate retrieve requests to an SCP.

3.1.2.6.2 Proposed Presentation Contexts – Query/Retrieve (C-MOVE)

TFS-AE will initiate any of the Presentation Contexts listed in Table 11 for C-MOVE.

Table 11

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Patient Root Info. Model-Move	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Study Root Info. Model-Move	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Patient/Study Only Info. Model-Move	1.2.840.10008.5.1.4.1.2.3.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.6.2.1 SOP Specific Conformance – Query/Retrieve (C-MOVE)

SOP classes of the Query/Retrieve Service Class are implemented via the DIMSE C-MOVE service as defined in Part 7 of the DICOM standard.

3.1.3 Association Acceptance Policy

When TFS-AE receives an association request, it will allow the following activities to be performed during that association:

- "Response of Verification"
  – Verification - Allow a remote DICOM device to verify that the local device is active on the DICOM network.
- "Receive Images"
  – Storage - Allow a remote DICOM device to send images to the local device.
- "Response of Storage Commitment"
  – N-ACTION - Allow a remote DICOM device to request the safekeeping of a set of SOP instances.
- "Request of Storage Commitment"
  – N-EVENT-REPORT
  - Allow a remote DICOM device to notify the result of a Storage Commitment.
- "Response of Query/Retrieve"
  – C-FIND - Allow a remote DICOM device to get a list of studies stored in the local device.
  – C-MOVE - Allow a remote DICOM device to transfer images stored in the local device to the remote device.

3.1.3.1 Real-World Activity – Verification

3.1.3.1.1 Associated Real-World Activity – Verification

TFS-AE will respond to the Verification requests to provide an SCU with the ability to determine if TFS-AE is receiving DICOM requests.

3.1.3.1.2 Presentation Context Table – Verification

TFS-AE will accept any of the Presentation Contexts listed in Table 12 for Verification.

Table 12

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.1.3.1.2.1 SOP Specific Conformance – Verification

TFS-AE provides standard conformance to the DICOM Verification Service Class. TFS-AE returns the following status code.

Table 13

Service Status	Further Meaning	Protocol Codes	Related Fields	Description
Success	Success	0000		Operation performed properly

3.1.3.1.3 Presentation Context Acceptance Criterion – Verification

TFS-AE will always accept a Presentation Context for the Verification SOP Class with the default DICOM transfer syntax listed in Table 12.

3.1.3.1.4 Transfer Syntax Selection Policies – Verification

Since no DICOM data object is associated with a Verification command, only the default DICOM transfer syntax is required/supported.

3.1.3.2 Real-World Activity – Storage

3.1.3.2.1 Associated Real-World Activity – Storage

TFS-3000 will store images that are sent to it from an SCU. All images received by TFS-AE can be retrieved at a later time; however, the rate of return of the images will vary depending the state of the images. The images can be in one of three states:

- Online The image is immediately available.
- Nearline The image is automatically available, however, there may be a

small delay in the retrieval time

- Offline The image requires manual assistance to become online. The retrieval request will return a failure code.

3.1.3.2.2 Presentation Context Table – Storage

TFS-AE will accept any of the Presentation Contexts listed in Table 14 for Storage:

Table 14

Presentation Context Table

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**	**(Refer to the following table.**		
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	Table A	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Table A		
US Multi-frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3	Table B		
US Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Table B		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Table A		
NM Image Storage(retired)	1.2.840.10008.5.1.4.1.1.5	Table A		
US Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Table B		
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Table B		
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	Table B		
Stand-alone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	Table A		
Stand-alone Curve Storage	1.2.840.10008.5.1.4.1.1.9	Table A		
Stand-alone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10	Table A		
Stand-alone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11	Table A		
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Table A		
XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Table A		

Presentation Context Table

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	**UID**	**(Refer to the following table.**		
XA Bi-plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	Table A		
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	Table A		
Visible Light Storage	1.2.840.10008.5.1.4.1.1.77.1	Table B		
Visible Light Multi-frame Storage	1.2.840.10008.5.1.4.1.1.77.2	Table B		
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Table A		
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Table A		
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Table A		
Digital X-Ray Mammography – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Table A		
Digital X-Ray Mammography – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Table A		
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Table A		
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Table A		

Transfer Syntax table A

Transfer Syntax	
Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Big Endian	1.2.840.10008.1.2.2
RLE Lossless, PackBits	1.2.840.10008.1.2.5
JPEG Process 1, baseline, lossy (8bit)	1.2.840.10008.1.2.4.50
JPEG Process 2,4, extended lossy (12bit)	1.2.840.10008.1.2.4.51
JPEG Process 14, lossless	1.2.840.10008.1.2.4.57
JPEG Process 14, selection value 1, lossless	1.2.840.10008.1.2.4.70

Transfer Syntax table B

Transfer Syntax	
Name	UID
Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Big Endian	1.2.840.10008.1.2.2

3.1.3.2.2.1 SOP Specific Conformance - Storage

TFS-AE conforms to the DICOM Storage Service Class at Level 2 (FULL). No elements are discarded or coerced by TFS-AE. In the event of a successful C-STORE operation, the image has been written to internal storage, and can be retrieved at any later time. TFS-AE returns one of the following status codes.

Table 15

Service Status	Further Meaning	Protocol Codes	Description
Refused	Out of Resources	0xA700	Indicates that there was not enough storage space to store the image. Recovery from this condition is left to the administrative functions.
	SOP Class not supported	0x0122	Indicates that the SOP Class of the image in the C-STORE operation did not match the Abstract Syntax negotiated for the Presentation Context.
Error	Data Set does not match SOP Class	0xA900	Indicates that the Data Set does not encode an instance of the SOP Class specified.
	Failed	0xC000	The operation was not successful.
	Unable to register object, study locked; no new objects allowed	0xC005	Indicates that no new objects can be added to this study because it has been locked.
	Cannot understand	0xC005	Indicates that the Data Set cannot be parsed into elements.
Warning	Data set does not match SOP Class	0xB007	Indicates that the Data Set does not match the SOP Class, but that the image was stored anyway.
Success	Success	0x0000	Operation performed properly.

3.1.3.3 Presentation Context Acceptance Criterion - Storage

TFS-AE will accept any number of Storage Presentation Contexts per association request. Any one Abstract Syntax may be specified more than once in an association request, if the Transfer Syntaxes differ between the Presentation Contexts.

3.1.3.4 Transfer Syntax Selection Policies - Storage

TFS-AE will accept a transfer syntax other than Implicit VR Little Endian if it is negotiated.

3.1.3.5 Real-World Activity – Storage Commitment (N-ACTION)

3.1.3.5.1 Associated Real-World Activity - Storage Commitment (N-ACTION)

TFS-3000 stores images that are sent to it from an SCU. The request for Storage Commitment may then be transmitted to TFS-AE together with a list of references to one or more SOP instances. TFS-AE will receive and respond to DIMSE N-ACTION.

3.1.3.5.2 Presentation Context Table - Storage Commitment (N-ACTION)

Table 16

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.1.3.5.2.1 SOP Specific Conformance - Storage Commitment (N-ACTION)

TFS-AE supports the following elements for this SOP class as an SCP:

Table 17

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

TFS-AE returns the following status code in an N-ACTION Response.

Table 18

Service Status	Further Meaning	Protocol Codes	Description
Success	Success	0x0000	Successful notification

3.1.3.5.3 Transfer Syntax Selection Policies - Storage Commitment (N-ACTION)

TFS-AE supports only the Little Endian Implicit Transfer Syntax.

3.1.3.6 Real-World Activity – Storage Commitment (N-EVENT-REPORT)

3.1.3.6.1 Associated Real-World Activity - Storage Commitment (N-EVENT-REPORT)

TFS-AE expects N-EVENT-REPORT from the SCP after the association for the commitment request is closed.

3.1.3.6.2 Presentation Context Table - Storage Commitment (N-EVENT-REPORT)

Table 19

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.3.6.2.1 SOP Specific Conformance - Storage Commitment (N-EVENT-REPORT)

TFS-AE supports the Event Information as specified in Table 20.

Table 20

Event Type Name	Event Type ID	Attribute Name	Tag
Storage Commitment Request Successful	1	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)
Storage Commitment Request Complete – Failures exist	2	Transaction UID	(0008,1195)
		Referenced SOP Sequence	(0008,1199)
		> Referenced SOP Class UID	(0008,1150)
		> Referenced SOP Instance UID	(0008,1155)

TFS-AE returns an N-EVEVT-REPORT response primitive with the following status code.

Table 21

Service Status	Further Meaning	Protocol Codes	Description
Success	Success	0x0000	Successful notification

3.1.3.6.3 Transfer Syntax Selection Policies - Storage Commitment (N-EVENT-REPORT)

TFS-AE supports only the Little Endian Implicit Transfer Syntax.

3.1.3.7 Real-World Activity – Query/Retrieve (C-FIND)

3.1.3.7.1 Associated Real-World Activity - Query/Retrieve (C-FIND)

TFS-AE will respond to query requests that are sent to it from an SCU.

3.1.3.7.2 Presentation Context Table - Query/Retrieve (C-FIND)

TFS-AE will accept any of the Presentation Contexts listed in Table 22 for Query.

Table 22

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Info. 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
Study Root 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	See Note 1
Patient/Study Only Info. Model-Find	1.2.840.10008.5.1.4.1.2.3.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	See Note 1

Note 1: TFS-AE will respond with the following information:

Table 23

Field Name	Value	Description of Field
Relational-queries	1	relational queries supported

3.1.3.7.2.1 SOP Specific Conformance - Query/Retrieve (C-FIND)

SOP classes of the Query/Retrieve Service Class are implemented via the DIMSE C-FIND and C-MOVE services as defined in Part 7 of the DICOM standard.

TFS-AE supports hierarchical queries. TFS-AE supports relational queries. TFS-AE, by default, supports all mandatory search keys. Search keys for the Query/Retrieve SCP are described in chapter 9.

TFS-AE returns one of the following status codes to a C-FIND request.

Table 24

Service Status	Further Meaning	Protocol Codes	Description
Refused	Out of Resources	0xA700	Local resources is insufficient.
Failed	Identifier does not match SOP Class	0xA900	The specified identifier contains a request that does not match the specified SOP Class.
	Unable to process	0xC001	For some reason (database off-line?) we cannot process this request at this time.
Cancel	Matching terminated due to Cancel Request	0xFE00	The original requester canceled this operation.
Pending	Pending	0xFF00	All optional keys are supported in the same manner as required keys.
	Pending	0xFF01	The matching operation is continuing. Warning that one or more optional keys were not supported in the same manner as required keys.
Success	Success	0x0000	Operation performed properly.

3.1.3.7.2.2 Presentation Context Acceptance Criterion - Query/Retrieve (C-FIND)

TFS-AE will accept any number of C-FIND Presentation Context per association request. Any one Abstract Syntax may be specified more than once in an association request, if the Transfer Syntaxes differ between the Presentation Contexts.

3.1.3.7.2.3 Transfer Syntax Selection Policies - Query/Retrieve (C-FIND)

TFS-AE currently only supports the default transfer syntax of Implicit Little Endian.

3.1.3.8 Real-World Activity – Query/Retrieve (C-MOVE)

3.1.3.8.1 Associated Real-World Activity - Query/Retrieve (C-MOVE)

TFS-AE will respond to retrieve requests that are sent to it from an SCU.

3.1.3.8.2 Presentation Context Table - Query/Retrieve (C-MOVE)

TFS-AE will accept any of the Presentation Contexts listed in Table 25 for C-MOVE.

Table 25

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Patient Root Info. Model-Move	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
Study Root 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
Patient/Study Only Info. Model-Move	1.2.840.10008.5.1.4.1.2.3.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.1.3.8.2.1 SOP Specific Conformance - Query/Retrieve (C-MOVE)

TFS-AE will try to establish an association with C-MOVE destination specified in C-MOVE request. One or more of the Presentation Contexts listed in the Store section of this document may be negotiated in this association.

TFS-AE returns one of the following status codes to a C-MOVE request.

Table 26

Service Status	Further Meaning	Protocol Codes	Description
Refused	Out of Resources	0xA701	Unable to calculate number of matches.
	Out of Resources	0xA702	Unable to perform storage of images to move destination.
Failed	Move destination unknown	0xA801	The destination of this move request is unknown.
	Identifier does not match SOP Class	0xA900	The specified identifier contains a request that does not match the specified SOP Class.
	Unable to process	0xC002	Indicates that TFS-AE cannot process this request at this time.
Cancel	Storage terminated due to Cancel Request	0xFE00	The original requester canceled this operation.
Warning	Warning	0xB000	Storage complete with one or more failures.
Pending	Pending	0xFF00	The storage operation is continuing.
	Pending for a long time	0xFF01	This operation is expected to require a long period of time to complete. The SCU may break the association at any time, but the operation will continue to completion.
Success	Success	0x0000	Operation performed properly.

3.1.3.8.2.2 Presentation Context Acceptance Criterion - Query/Retrieve (C-MOVE)

TFS-AE will accept any number of C-MOVE Presentation Contexts per association request. Any one Abstract Syntax may be specified more than once in an association request, if the Transfer Syntaxes differ between the Presentation Contexts.

3.1.3.8.2.3 Transfer Syntax Selection Policies - Query/Retrieve (C-MOVE)

If the C-MOVE destination supports a limited number of Transfer Syntaxes, TFS-AE can be configured on a per-destination basis to convert the IOD from the original transfer syntax to Implicit Little Endian.

4 COMMUNICATION PROFILES

4.1 Supported Communication Stacks

This product provides DICOM V3.0 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 TFS-3000, the configuration can be set using the Service Tool.

6.1 AE Title/Presentation Address Mapping

The mapping from the AE titles to the presentation addresses is provided by the database. Along with this mapping, the database stores those AE titles that are allowed to communicate with TFS-3000. The AE title of TFS-3000 is the same as the computer name of the machine that TFS-AE is installed on. TFS-3000 has following default values:

Local Port Number 104

6.2 Time-out Value, Retry Count, Retry Interval

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

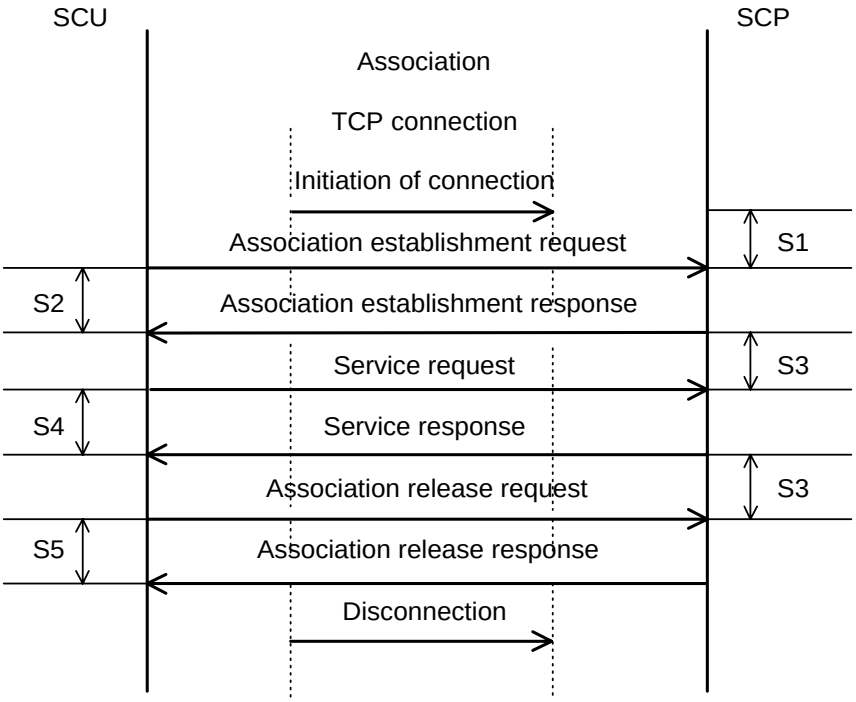

Figure 2

Table 27

Status	Item	Time-out value	Retry count	Retry interval	Remarks
S1	Association establishment request waiting time	Default: 300 seconds	Not set	Not set	Can be set for each AE.
S2	Association establishment response waiting time	Default: 300 seconds	Not set	Not set	Can be set for each AE.
S3	Service request waiting time	Default: 300 seconds	Not set	Not set	Can be set for each AE.
S4	Service response waiting time	Default: 300 seconds	Not set	Not set	Can be set for each AE.
S5	Association release waiting time	Default: 300 seconds	Not set	Not set	Can be set for each AE.

6.3 Maximum PDU size

The maximum PDU size can be set for each station. The default value for this is 100,000 bytes.

7 SUPPORT OF EXTENDED CHARACTER SETS

This product supports the following character sets:

- ISO-IR 6 (default) Basic G0 Set
- ISO-IR 100 Latin Alphabet No.1

TFS-AE receives and transmits images containing characters shown above. TFS-AE sends result of a search including above characters. If TFS-AE receives result of a search that contains characters from an unsupported character set, a character may not be correctly displayed on a list.

8 INFORMATION OBJECT DEFINITION - Storage SCU/SCP

8.1 Entity Module Definitions

The information modules of each object depend on the source of the data because TFS-AE stores a received image, without change, in its internal data store and send it to a destination.

9 SEARCH KEYS

9.1 Query/Retrieve (C-FIND)

The search keys used for the Query/Retrieve SCU/SCP (C-FIND) are shown.

9.1.1 Patient Root Q/R Information Model - Find

9.1.1.1 Patient Level

Table 28

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	R	Specified search condition
Patient ID	(0010,0020)	U	Specified search condition

Type: U=Unique Key, R=Required Key

9.1.1.2 Study Level

Table 29

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008,0020)	R	Specified search condition
Study Time	(0008,0030)	R	Specified search condition
Accession Number	(0008,0050)	R	Specified search condition
Study Description	(0008,1030)	O	Specified search condition
Study ID	(0020,0010)	R	Specified search condition
Study Instance UID	(0020,000d)	U	Specified search condition

Type: U=Unique Key, R=Required Key, O=Optional Key

9.1.1.3 Series Level

Table 30

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	R	Specified search condition
Series Description	(0008,103e)	O	Specified search condition
Series Number	(0020,0011)	R	Specified search condition
Series Instance UID	(0020,000e)	U	Specified search condition

Type: U=Unique Key, R=Required Key, O=Optional Key

9.1.1.4 Image Level

Table 31

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	R	Specified search condition
SOP Instance UID	(0008,0018)	U	Specified search condition

Type: U=Unique Key, R=Required Key

9.1.2 Study Root Q/R Information Model - Find

9.1.2.1 Study Level

Table 32

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008,0020)	R	Specified search condition
Study Time	(0008,0030)	R	Specified search condition
Accession Number	(0008,0050)	R	Specified search condition
Patient's Name	(0010,0010)	R	Specified search condition
Patient ID	(0010,0020)	R	Specified search condition
Study Description	(0008,1030)	O	Specified search condition
Study ID	(0020,0010)	R	Specified search condition
Study Instance UID	(0020,000d)	U	Specified search condition

Type: U=Unique Key, R=Required Key, O=Optional Key

9.1.2.2 Series Level

Attributes for the Series Level of the Study Root Query/Retrieve Information Model are the same as the attributes for the Series Level of the Patient Root Query/Retrieve Information Model described in 9.1.1.3

9.1.2.3 Image Level

Attributes for the Image Level of the Study Root Query/Retrieve Information Model are the same as the attributes for the Image Level of the Patient Root Query/Retrieve Information Model described in 9.1.1.4

9.1.3 Patient/Study Only Q/R Information Model - Find

9.1.3.1 Patient Level

Attributes for the Patient Level of the Patient/Study Only Query/Retrieve Information Model are the same as the attributes for the Patient Level of the Patient Root Query/Retrieve Information Model described in 9.1.1.1

9.1.3.2 Study Level

Attributes for the Study Level of the Patient/Study Only Query/Retrieve Information Model are the same as the attributes for the Study Level of the Patient Root Query/Retrieve Information Model described in 9.1.1.2