DICOM Conformance Statement

Version: 1.3

krucom

Overview

X-Tray is middleware that mediates DICOM Services between Healthcare Infomration Systems (RIS/HIS), Modalities and PACS. A DICOM Modality Worklist is provided to remote applications by X-Tray. The worklist is composed of study information retrieved from the Information System. This document is intended to describe X-Tray's conformance to DICOM.

SOP Classes	**User of Service (SCU)**	**Provider of Service (SCP)**
Verification	Yes	Yes
Modality Worklist Information Model – FIND	Yes	Yes

Table 0-1 *Network Services*

Connectivity to Information Systems is achieved through the following interfaces:

- Text File (ASCII and extended character sets)
- Structured Query Language (ODBC)
- HL-7
- DICOM

More information about the non-DICOM connections can be found in the separate documentation for each connection method.

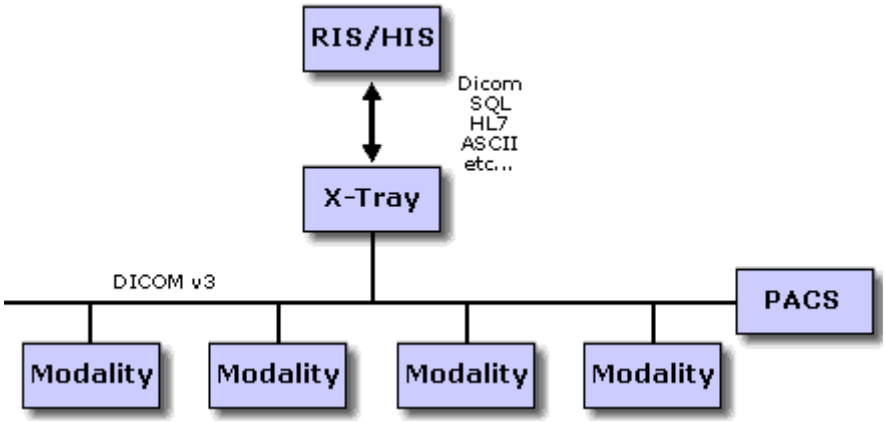

Figure 0-1 *X-Tray is a worklist server.*

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1 Introduction

1.1 Revision History

Version	Date	Comments	Author
1.0	2001-01-16	Initial release	JK
1.1	2003-09-02	Layout Rearrangements	LK
1.2	2005-10-12	Change of document base	FL
1.3	2006-02-06	Worklist SCU capabilities included in DCS	FL

Table 1.1-1 *Revision history*

1.2 Audience

This document is intended for health system integrators.

1.3 Definitions, Terms and Abbreviations

[AE]
Application Entity

[DICOM]
Digital Imaging and Communications in Medicine

[DIMSE]
DICOM Message Service Element

[PDU]
Protocol Data Unit

[SCP]
Service Class Provider

[SCU]
Service Class User

[SOP]
DICOM Service-Object Pair

[TCP/IP]
Transmission Control Protocol/Internet Protocol

[UID]
Unique Identifier

[UML]
Unified Modelling Language

1.4 References

[DICOM]

Digital Imaging and Communications in Medicine (DICOM), NEMA PS 3.1-3.16, 2004

1.5 X-Tray Editions

There are three different editions of X-Tray:

- X-Tray Enterprise
- X-Tray Dedicated
- X-Tray OEM

1.5.1 X-Tray Enterprise

X-Tray Enterprise is middleware that provides DICOM Modality Worklist to remote applications. The worklist is composed of study information retrieved from the Information System. The X-Tray Enterprise edition license does not limit the number of clients.

1.5.2 X-Tray Dedicated

X-Tray Dedicated edition is similar to the Enterprise edition except that its license limits the number of clients.

1.5.3 X-Tray OEM

X-Tray OEM edition is a product supplied to Information System vendors who wish to seamlessly supply their Information System with DICOM Services. The specifications for X-Tray OEM edition are not covered in this DICOM Conformance Statement.

1.6 Trademarks

DICOM is a trademark of the National Electrical Manufacturers Association (NEMA). X-Tray is a Trademark of Krucom AB. Windows is a trademark of Microsoft Corporation.

2 Networking

2.1 Implementation Model

2.1.1 Application Data Flow

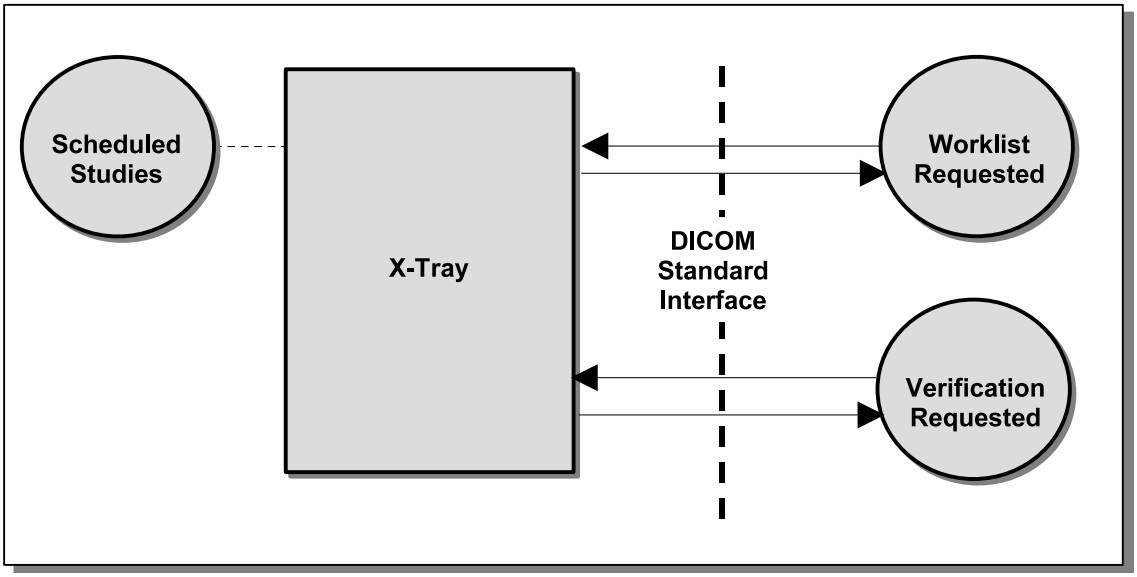

Figure 2.1.1-1 *Implementation Model*

2.1.2 Functional Definition of AE's

2.1.2.1 Functional Definition

X-Tray waits for DICOM clients to initiate an association. When an association is established the client may request a worklist or verification. X-Tray queries the connected Information System(s) periodically through one or several of the available interfaces. Figure 2.1.1-1 shows the DICOM Implementation Model for X-Tray.

2.1.3 Sequencing of Real World Activities

An Association encompasses a DICOM session. The Association is initiated by the SCU who sends an A-Associate Request supplying which DICOM services are supported. The SCP responds with an A-Associate Response notifying which services were accepted. This procedure is knows as an Association Negotiation. A DICOM session is normally closed by the SCU sending an A-Release command. A session can also be aborted by either the SCP or SCU with the A-Abort command.

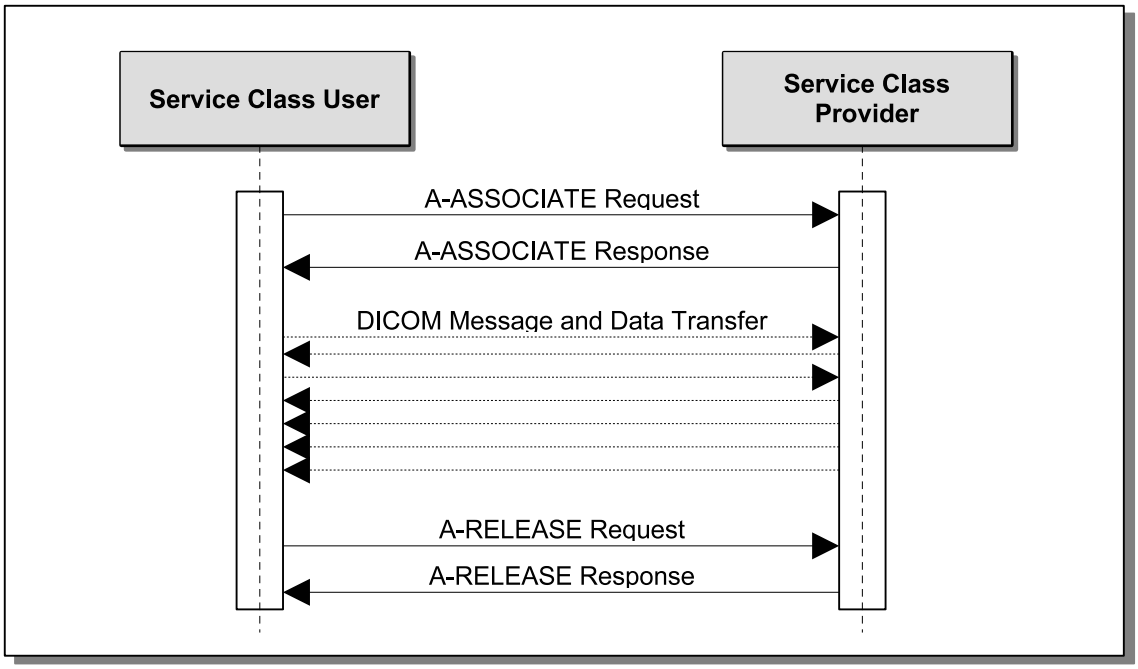

Figure 2.1.3-1 *UML sequence representation of a DICOM session*

2.2 AE Specifications

This section describes the X-Tray Application Entity.

2.2.1 X-Tray Application Entity

2.2.1.1 SOP Classes

X-Tray provides Standard Conformance to the following SOP classes:

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	Yes
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes

Table 2.2.1.1-1 *SOP Classes supported by X-Tray*

2.2.1.2 Association Policies

2.2.1.2.1 General

X-Tray accepts and initiates associations.

Maximum PDU size received	16 kB

Table 2.2.1.2.1-1 *Maximum received PDU size*

2.2.1.2.2 Number of Associations

There is no limit for the maximum number of simultaneous associations. X-Tray will handle simultaneous requests. However the hardware upon which X-Tray executes upon should be dimensioned to handle the expected workload.

Maximum number of simultaneous associations	Unlimited

Table 2.2.1.2.2-1 *Number of associations as a SCP for X-Tray*

2.2.1.2.3 Asynchronous Nature

X-Tray does not support negotiation of multiple outstanding transactions. I.e. the maximum number of outstanding transactions is one.

2.2.1.2.4 Implementation Identifying Information

Implementation Class UID	1.2.752.48.1.1.1.20000228
Implementation Version Name	KRUCOM20000228

Table 2.2.1.2.4-1 *DICOM implementation class and version for X-Tray*

2.2.1.3 Association Acceptance Policy

There are three Association acceptance policies that can be set for X-Tray. In Table the policies are ordered from the least strict to the strictest policy. SCUs failing to fulfil the criteria in the used policy will be rejected.

Level of Strictness	**Name**	**Description**
0	ALL	Accepts all SCUs
1	CALLED AE	Accepts all SCUs who use the correct called AE Title
2	CALLING AE	Accepts all SCUs who have a known calling AE Tile and that use the correct called AE Title

Table 2.2.1.3-1 *X-Tray DICOM Workflow Policies*

2.2.1.3.1 Activity - Receive Worklist Request

2.2.1.3.1.1 Description and sequencing of Activities

In order for a client to request a worklist an association first needs to be established with X-Tray. To request the worklist the client sends a C-Find Request with the query criteria. X-Tray responds with the resulting worklist using C-Find Response. There will be one C-Find Response for each entry matching the query criteria. If there are no matches to a query a C-Find Response with the status of success and an empty data set will be returned.

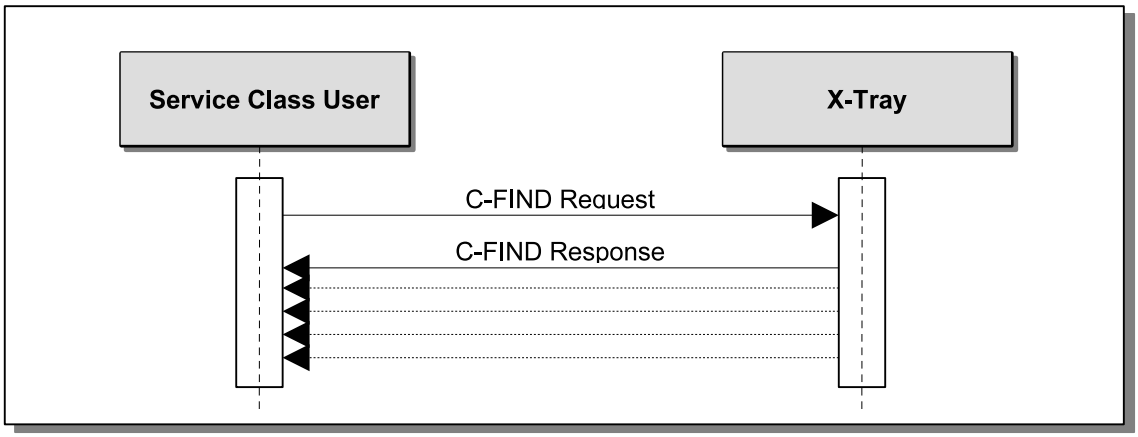

Figure 2.2.1.3.1.1-1 *UML sequence representation of a Worklist Request*

2.2.1.3.1.2 Accepted Presentation Contexts

Abstract Syntax		**Transfer Syntax**		**Role**	**Extended Negotiation**
Name	**UID**	**Name**	**UID**		
Modality Worklist Information Model– FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Table 2.2.1.3.1.2-1 *Accepted presentation contexts for Worklist reqeusts*

2.2.1.3.1.3 Extended Negotiation

No extended negotiation is performed.

2.2.1.3.1.4 SOP Specific Conformance for Modality Worklist SOP Class

X-Tray uses filters to enable precise steering of which data is returned after a query. The client's Calling AE Title is used to link a query to a filter. Clients must be registered in X-Tray in order to retrieve worklist data. After the appropriate filter has been applied, X-Tray handles the query according to the matching criteria as specified. Table 2.2.1.3.1.4-1 shows which Return and Matching Key Attributes X-Tray supports.

Description/Module	**Tag**	**VR**	**Matching**
SOP Common Module			
Specific Character Set	(0008,0005)	CS	
Scheduled Procedure Step Module			

Description/Module	Tag	VR	Matching
Scheduled Procedure Step Sequence	(0040,0100)	SQ	Sequence Matching
>Modality	(0008,0060)	CS	Single Value Matching
>Scheduled Station AE Title	(0040,0001)	AE	Single Value Matching
>Scheduled Procedure Step Start Date	(0040,0002)	DA	Single Value Matching or Range Matching
>Scheduled Procedure Step Start Time	(0040,0003)	TM	Single Value Matching or Range Matching
>Scheduled Performing Physician's Name	(0040,0006)	PN	Single Value Matching or Range Matching
>Scheduled Procedure Step Description	(0040,0007)	LO	
>Scheduled Procedure Step ID	(0040,0009)	SH	
>Scheduled Station Name	(0040,0010)	SH	
>Pre-Medication	(0040,0012)	LO	
>Comments on the Scheduled Procedure Step	(0040,0400)	LT	
Requested Procedure Module			
Study Instance UID	(0020,000D)	UI	
Requested Procedure Description	(0032,1060)	LO	
Requested Procedure ID	(0040,1001)	SH	Single Value Matching
Names of Intended Recipients of results	(0040,1010)	PN	
Requested Procedure Comments	(0040,1400)	LT	
Imaging Service Request Module			
Accession Number	(0008,0050)	SH	Single Value Matching
Referring Physician's Name	(0008,0090)	PN	
Requesting Physician	(0032,1032)	PN	
Requesting Service	(0032,1033)	LO	
Visit Admission Module			
Admitting Diagnosis Description	(0008,1080)	LO	
Admitting Date	(0038,0020)	DA	
Patient Identification Module			

Description/Module	Tag	VR	Matching
Patient's Name	(0010,0010)	PN	Single Value Matching or Wild Card Matching
Patient ID	(0010,0020)	LO	
Other Paitent IDs	(0010,1000)	LO	
Patient Demographic Module			
Patient's Birth Date	(0010,0030)	DA	
Patient's Sex	(0010,0040)	CS	
Patient's Age	(0010,1010)	AS	
Patient's Size	(0010,1020)	DS	
Patient's Weight	(0010,1030)	DS	
Patient's Address	(0010,1040)	LO	
Patient's Telephone Numbers	(0010,2154)	SH	
Patient Comments	(0010,4000)	LO	

Table 2.2.1.3.1.4-1 *Attributes for the Modality Worklist Information Model*

2.2.1.3.2 Activity - Verification

2.2.1.3.2.1 Description and sequencing of Activities

The Verification service uses the DICOM C-Echo command. This function is provided as a utility and can be seen as the DICOM version of the TCP/IP command ‘ping’. The Verification is initiated by the client sending a C-Echo Request after an association has been established. X-Tray responds with a C-Echo Response.

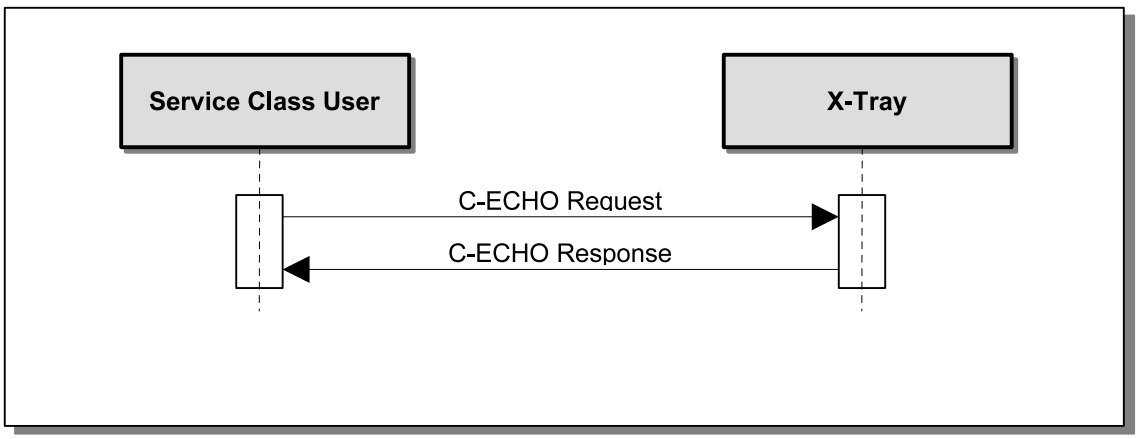

Figure 2.2.1.3.2.1-1 *UML sequence representation of a Verification Request*

2.2.1.3.2.2 Accepted Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Verification SOP Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Table 2.2.1.3.2.2-1 *Accepted presentation contexts for Verification*

2.2.1.3.2.3 Extended Negotiation

No extended negotiation is performed.

2.2.1.3.2.4 SOP Specific Conformance for Verification SOP Class

X-Tray provides standard conformance to the DICOM Verification Service Class.

2.2.1.4 Association Initiation Policy

X-Tray initiates Associations, one per active Worklist SCU, at configurable intervals. If no instance of the DICOM Worklist SCU Information System interface is used no association will be initiated.

2.2.1.4.1 Activity - Worklist Request

2.2.1.4.1.1 Description and sequencing of Activities

Several different Information System interfaces are available to X-Tray. One of theese being the DICOM Modality Worklist SCU interface. X-Tray may have none, one or multiple Worklist SCU instances active. The Modality Worklist SCU periodically queries a Worklist SCP to maintain a Worklist database. X-Tray can be configured to send a C-ECHO Request, primarily in aid of fault finding, before each C-FIND Request.

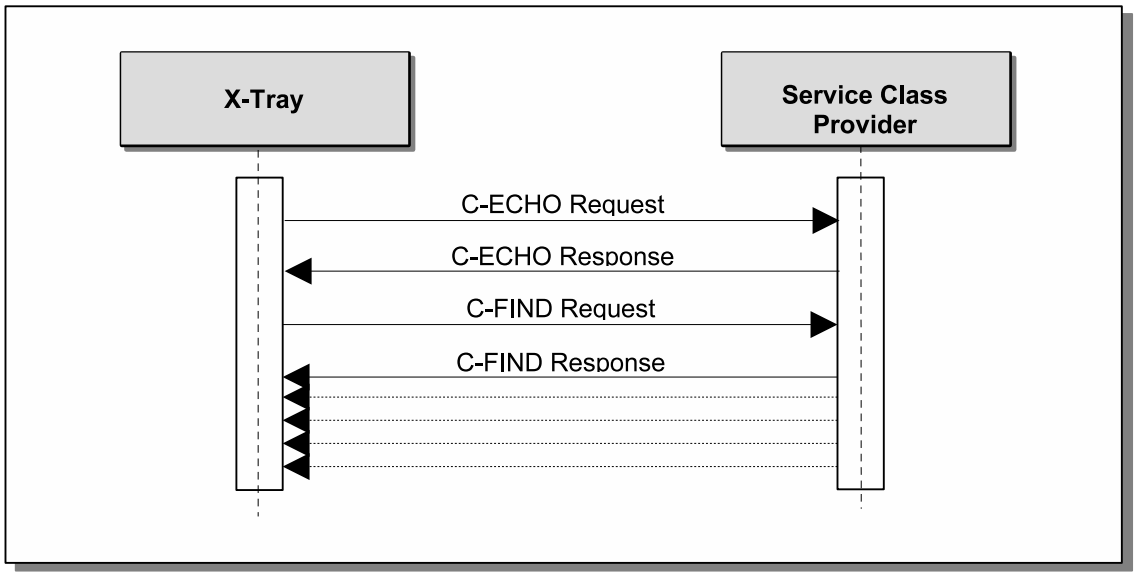

Figure 2.2.1.4.1.1-1 *UML sequence representation of a Worklist Request*

2.2.1.4.1.2 Proposed Presentation Contexts

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

Table 2.2.1.4.1.2-1 *Proposed presentation contexts for Worklist Request*

2.2.1.4.1.3 Extended Negotiation

No extended negotiation is performed.

2.2.1.4.1.4 SOP Specific Conformance for Worklist SOP Class

The Worklist SCU queries for the same attributes that the Modality Worklist SCP is configured to provide. Table 2.2.1.4.1.4-1 below shows which attributes that may be present in the Worklist Request Identifier. Each attribute may be populated with a constant value.

Description/Module	Tag	VR	Comments
SOP Common Module			
Specific Character Set	(0008,0005)	CS	
Scheduled Procedure Step Module			
Scheduled Procedure Step Sequence	(0040,0100)	SQ	
>Modality	(0008,0060)	CS	
>Scheduled Station AE Title	(0040,0001)	AE	
>Scheduled Procedure Step Start Date	(0040,0002)	DA	Configurable Date Horizon
>Scheduled Procedure Step Start Time	(0040,0003)	TM	Configurable Time Horizon
>Scheduled Performing Physician's Name	(0040,0006)	PN	
>Scheduled Procedure Step Description	(0040,0007)	LO	
>Scheduled Procedure Step ID	(0040,0009)	SH	
>Scheduled Station Name	(0040,0010)	SH	
>Pre-Medication	(0040,0012)	LO	
>Comments on the Scheduled Procedure Step	(0040,0400)	LT	
Requested Procedure Module			
Study Instance UID	(0020,000D)	UI	

Description/Module	Tag	VR	Comments
Requested Procedure Description	(0032,1060)	LO	
Requested Procedure ID	(0040,1001)	SH	
Names of Intended Recipients of results	(0040,1010)	PN	
Requested Procedure Comments	(0040,1400)	LT	
Imaging Service Request Module			
Accession Number	(0008,0050)	SH	
Referring Physician's Name	(0008,0090)	PN	
Requesting Physician	(0032,1032)	PN	
Requesting Service	(0032,1033)	LO	
Visit Admission Module			
Admitting Diagnosis Description	(0008,1080)	LO	
Admitting Date	(0038,0020)	DA	
Patient Identification Module			
Patient's Name	(0010,0010)	PN	
Patient ID	(0010,0020)	LO	
Other Paitent IDs	(0010,1000)	LO	
Patient Demographic Module			
Patient's Birth Date	(0010,0030)	DA	
Patient's Sex	(0010,0040)	CS	
Patient's Age	(0010,1010)	AS	
Patient's Size	(0010,1020)	DS	
Patient's Weight	(0010,1030)	DS	
Patient's Address	(0010,1040)	LO	
Patient's Telephone Numbers	(0010,2154)	SH	
Patient Comments	(0010,4000)	LO	

Table 2.2.1.4.1.4-1 *Attributes for the Modality Worklist Information Model*

2.2.1.4.1.5 SOP Specific Conformance for Verification SOP Class

X-Tray provides standard conformance to the DICOM Verification Service Class.

2.3 Network Interfaces

2.3.1 Physical Network Interface

X-Tray uses the TCP/IP networking capabilities provided by the system upon which it is installed.

2.3.2 Additional Protocols

X-Tray Web Server uses operating system services for name resolution.

2.4 Configuration

X-Tray Web Server parameters are set in a configuration utility.

2.4.1 AE Title/Presentation Address Mapping

2.4.1.1 Local AE Titles

Application Entity	Default AE Title	Default TCP/IP Port
X-Tray	X-TRAY_WL_SCP	104

Table 2.4.1.1-1 *AE Title configuration*

2.4.1.2 Remote AE Title/Presentation Address Mapping

X-Tray has a one to one relationship between AE titles and Application Entities. This means that one AE title corresponds to one presentation address.

2.4.2 Parameters

Parameter	Configurable (Yes/No)	Default Value
General Parameters		
Maximum PDU size	No	16 kB
General DIMSE level time-out values	Yes	60 s
Time-out waiting for response to TCP/IP connect request. (Low-level timeout)	Yes	60 s
Time-out waiting for acceptance of a TCP/IP message over the network. (Low-level timeout)	No	System Dependent
Time-out waiting for data between TCP/IP packets. (Low-level timeout)	No	60 s
Any changes to default TCP/IP settings, such as configurable stack parameters	N/A	X-Tray runs under a standard Windows configuration.
X-Tray specific parameters		
AE specific DIMSE level time-out values	Yes	60 s
Number of simultaneous Associations by Service and/or SOP Class	No	Unlimited
Number of clients supported by X-Tray Enterprise Edition	No	Unlimited
Number of clients supported by X-Tray Dedicated Edition	Yes	1
Association acceptance policy	Yes	ALL - Accepts all SCUs

Table 2.4.2-1 *Configuration Parameters*

3 Support of Character Sets

Defined Term	Description
ISO_IR 6	Default Repertoire
ISO_IR 100	Latin alphabet No. 1

Table 3-1 *Character sets supported by X-Tray*