

Krucom Converter

DICOM Conformance Statement

Overview

Krucom Converter is middleware for automatic and transparent conversion of diagnostic images. Data related to the image can be added, removed or modified to achieve the desired format and functionality at the receiving end.

Solve image interoperability issues

Typically Krucom Converter solves image interoperability issues between acquisition equipment and PACS. When images are transferred to Krucom Converter, pre-defined criteria determines if processing is required or not. Afterwards the images are forwarded to their designated destination



Features

- no user input is required, conversions are performed automatically in the background.
- efficient performance suitable for high-volume image workflows.
- rule based triggers allow conditional actions to be performed.
- standard functions available to map, append, trim or replace DICOM attribute values.
- algorithms.
- DICOM communication with modalities and PACS.
- Original values are stored in DICOM private attributes.

DICOM

Krucom Converter can receive DICOM objects from any number of sending applications, and can relay objects to any number of Destination Archives, where each destination has its own conversion filter sequence configuration.



The available filters and the number of supported sending and receiving applications are regulated by license terms.

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Krucom Converter supports all current storage SOP classes in DICOM. See Appendix A for a complete list.	Yes	Yes

Table 0-1 Network Services

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1 Introduction

1.1 Revision History

Version	Date	Description
V 1.0	2006-11-15	Initial release.
	2008-10-24	Updated the Overview chapter.

Table 1.1-1 Revision history

1.2 Audience

This document is intended for health system integrators. The reader is assumed to have a working knowledge of DICOM and TCP/IP networking.

1.3 Remarks

This version of the document conforms to version 1.1 of the Krucom Converter application.

The DICOM standard does not guarantee system interoperability. Comparing Conformance Statements is one step to verify system compatibility. Further steps to check compatibility includes testing and verification.

The DICOM standard is a work in progress. It is continually developing and evolving to meet future requirements. Krucom AB reserves the rights to make changes to its products to reflect this.

1.4 Definitions, Terms and Abbreviations

Definitions, terms and abbreviations used in this document are defined within the different parts of the DICOM standard. Abbreviations and terms are as follows:

[AE]

DICOM Application Entity

[Destination Archive]

Any device that supports Storage as an SCP, e.g an archive or a workstation

[DICOM]

Digital Imaging and Communications in Medicine

[PDU]

Protocol Data Unit

[SCP]

Service Class Provider

[Sending Application]

Any device that supports Storage as an SCU

[SCU]

Service Class User

[SOP]

DICOM Service-Object Pair

[TCP/IP]

Transmission Control Protocol/Internet Protocol

[UID]

Unique Identifier

1.5 References

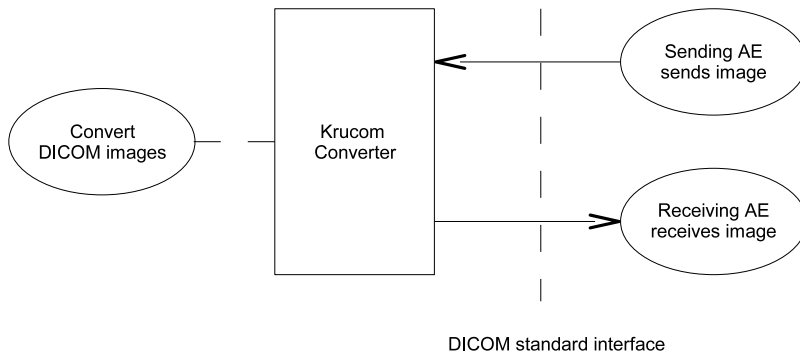
[DICOM]

Digital Imaging and Communications in Medicine (DICOM), NEMA PS 3.1-3.18, 2006

2 NETWORKING

2.1 Implementation Model

2.1.1 Application Data Flow



Krucom Converter receives a DICOM object from a sending AE. The Called AE Title used in the association specifies which Destination Archive to send to after conversion.

Krucom Converter executes a sequence of conversion filters on the object. The filter sequence is destination specific.

Krucom Converter attempts to send the converted object to the Destination Archive.

2.1.2 Functional Definition of Krucom Converter Application Entity

Krucom Converter acts as a Storage SCP and receives DICOM objects from sending applications. The Called AE Title defines the final destination of the object. If it not is recognized, the association is rejected.

If the Called AE Title is recognized, one or more pre-configured filters are applied to the object. A filter can typically move, copy or modify DICOM attribute values. Each Destination Archive can have its own filter configuration.

Proprietary filters exist for specific sites, customers or equipment and may be subject to additional licensing terms. See filter specific documentation for functionality and configuration.

If filtering was successful, Krucom Converter initiates an association and attempts to send the converted object to the final destination as a Storage SCU. Unsuccessful filtering will interrupt the object processing, and an error response will be sent back to the sending application. Upon an unsuccessful storage attempt, the Sending Application will receive an response with status code and message sent from the Destination Archive.

2.1.3 Sequencing of Real World Activities

Not applicable to the real world activity.

2.2 AE Specifications

2.2.1 Krucom Converter Application Entity

2.2.1.1 SOP Classes

Krucom Converter provides standard conformance to the following SOP classes:

SOP Class Name	SOP Class UID	SCU	SCP
Krucom Converter AE supports all storage SOP classes in DICOM. See Appendix A for the current list.		Yes	Yes
Verification SOP Class	1.2.840.10008.1.1	No	Yes

Table 2.2.1.1-1 SOP Classes for Krucom Converter Application Entity

2.2.1.2 Association Policies

2.2.1.2.1 General

Krucom Converter AE both accepts and initiates associations.

2.2.1.2.2 Number of Associations

Maximum number of simultaneous associations as an association initiator	Unlimited
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Table 2.2.1.2.2-1 Maximum number of associations as an association initiator for Krucom Converter

Maximum number of simultaneous associations as an association acceptor	Unlimited
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Table 2.2.1.2.2-2 Maximum number of associations as an association acceptor for Krucom Converter

2.2.1.2.3 Asynchronous Nature

Asynchronous communication (multiple outstanding transactions over a single association) is not supported by Krucom Converter.

2.2.1.2.4 Implementation Identifying Information

Implementation Class UID	1.2.752.48.3.1.1.6.1
Implementation Version Name	KRUCOM_J1.6.1

Table 2.2.1.2.4-1 DICOM implementation class and version of Krucom Converter

2.2.1.3 Association Acceptance Policy

Krucom Converter accepts Associations with a Called AE Title matching one of the preconfigured data routes. If the Called AE Title does not match any configured route the association will be rejected.

Krucom Converter can be configured to only accept Associations with certain Calling AE Titles. The default setting is to accept Associations from any Calling AE Title.

2.2.1.3.1 Activity - Receive Echo Request

2.2.1.3.1.1 Description and sequencing of Activities

Krucom Converter will respond successfully to any Echo request made over an open association, if the Called AE Title and Calling AE Title are present in configuration.

2.2.1.3.1.2 Accepted Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

Table 2.2.1.3.1.2-1 Accepted presentation contexts for activity Verification

2.2.1.3.1.3 Extended Negotiation

No extended negotiation is performed.

2.2.1.3.1.4 SOP Specific Conformance for Verification SOP Class

Krucom Converter provides standard conformance to the Verification Service Class.

2.2.1.3.2 Activity - Receive Storage Request

2.2.1.3.2.1 Description and Sequencing of Activities

Krucom Converter acts as a Storage SCP. As SOP instances are received they are temporarily cached on disk. When a SOP instance has been cached, it is filtered according to the present configuration which is defined by the Association's Called AE Title.

2.2.1.3.2.2 Accepted Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
All storage SOP classes in DICOM are supported. See Appendix A for a current list.		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

Table 2.2.1.3.2.2-1 Accepted presentation contexts for activity Receive Storage Requests

2.2.1.3.2.3 Extended Negotiation

No extended negotiation is performed.

2.2.1.3.2.4 SOP Specific Conformance for Storage SOP Classes

Krucom Converter AE performs standard conformance to the Storage Service Class.

2.2.1.3.2.4.1 Response Status

Krucom Converter will behave as described in the table below when generating the C-STORE response command message. Reports can be stored in a log file.

Service Status	Further Meaning	Status Codes	Behaviour
Success	The object was successfully filtered and successfully sent to Destination Archive	0000	Report success
Refused	Out of Resources	A7xx	No resources available, or the object was refused by Destination Archive. In the latter case, response message and code are relayed from Destination Archive.
		A701	No valid licence for Krucom Converter
Warning	Coersion of data elements	B000	Destination Archive received an object with a warning. Response message and code are relayed from Destination Archive.
	Elements discarded	B006	
	Data Set does not match SOP Class	B007	

Service Status	Further Meaning	Status Codes	Behaviour
Error	Identifier does not match SOP Class	A9xx	Storage attempt to Destination Archive failed. Response message and code are relayed from Destination Archive.
	The Data Set contains errors, or storage attempt to Destination Archive failed	C000	Report error. If storage attempt failed, the response message and code are relayed from Destination Archive.
	An error was raised during filtering, or storage attempt to Destination Archive failed	C001	Report error. A filtering error interrupts processing of the object. If storage attempt failed, the response message and code are relayed from Destination Archive.
	Storage attempt to Destination Archive failed	C002-CFFF	Report Error. Storage attempt to Destination Archive failed. Response message and code are relayed from Destination Archive.
Unknown	Destination Archive returned non-standard code	xxxx	Report error. Response message and code are relayed from Destination Archive

Table 2.2.1.3.2.4.1-1 C-STORE response status handling behaviours

2.2.1.4 Association Initiation Policy

2.2.1.4.1 Activity - Send Storage Request

2.2.1.4.1.1 Description and Sequencing of Activities

Krucom Converter acts as a Storage SCU and attempts to send objects to Destination Archives as they have been processed.

2.2.1.4.1.2 Proposed Presentation Contexts

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
All storage SOP classes in DICOM are supported. See Appendix A for a current list.		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

Table 2.2.1.4.1.2-1 Accepted presentation contexts for activity Send Storage Requests

2.2.1.4.1.3 Extended Negotiation

No extended negotiation is performed.

2.2.1.4.1.4 OP Specific Conformance for Storage SOP Classes

Krucom Converter AE performs standard conformance to the Storage Service Class.

2.2.1.4.1.4.1 Response Status

Krucom Converter will behave as described in the table below in response to the status returned in the C-STORE response command message. Reports can be stored in a log file.

Service Status	Further Meaning	Status Codes	Behaviour
Refused	Out of Resources	A7xx	Report error and relay response status and message to Sending Application
Error	Data Set does not match SOPClass	A9xx	Report error and relay response status and message to Sending Application
	Cannot understand	Cxxx	Report error and relay response status and message to Sending Application
Warning	Coercion of Data Elements	B000	Report warning and relay response status and message to Sending Application
	Data Set does not match SOP Class	B007	Report warning and relay response status and message to Sending Application
	Elements Discarded	B006	Report warning and relay response status and message to Sending Application
Success	The object was successfully stored	0000	Report success and relay response status and message to Sending Application
Unknown	SCP returned non-standard code	xxxx	Report error and relay response status and message to Sending Application

Table 2.2.1.4.1.4.1-1 C-STORE response status handling behaviours

2.3 Network Interfaces

2.3.1 Physical Network Interface

Krucom Converter uses the TCP/IP networking capabilities provided by the system upon which it is installed.

2.3.2 Additional Protocols

Krucom Converter uses operating system services for name resolution services.

2.4 Configuration

Configuration of Krucom Converter is described in the Krucom Converter Administration Guide.

2.4.1 AE Title/Presentation Address Mapping

2.4.1.1 Local AE Titles

Krucom Converter uses the configured Calling AE Title, by default KrucomConverter.

2.4.1.2 Remote AE Title/Presentation Address Mapping

Krucom Converter uses AE Titles to identify remote AE's and uses a one to one relationship between AE Title and 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	No	None
Time-out waiting for response to TCP/IP connect request. (Low-level timeout)	Yes	10 s
Time-out waiting for data between TCP/IP packets. (Low-level timeout)	No	None
Any changes to default TCP/IP settings, such as configurable stack parameters	No	None
Port for storage receive requests	Yes	104
Maximum allowed concurrent incoming associations	Yes	Unlimited
Destination Archive Parameters		
Host or IP address	Yes	None
Port	Yes	104
Called AE Title	Yes	None
Time-out waiting for acceptance or rejection Response to an Association Open Request. (Application Level timeout)	Yes	10 s
Accepted Calling AE Titles	Yes	Accept all
Calling AE Title	Yes	KrucomConvert
Additional Storage SOP Classes	Yes	None
Applicable filters	Yes	None
Append Filter Parameters		
Attribute to filter	Yes	None
String to append	Yes	None
Character index to append at	Yes	None
Maximum allowed length of filtered attribute	Yes	None
Write copy of unmodified attribute value into private attribute	Yes	None

Parameter	Configurable (Yes/No)	Default Value
Attributes and corresponding regular expressions to match on	Yes	None
Attributes and corresponding conditions on their lengths to match on	Yes	None
Cut Filter Parameters		
Attribute to filter	Yes	None
Character indices to remove	Yes	None
Write copy of unmodified attribute value into private attribute	Yes	None
Attributes and corresponding regular expressions to match on	Yes	None
Attributes and corresponding conditions on their lengths to match on	Yes	None

Table 2.4.2-1 Configuration Parameters

3 SUPPORT OF CHARACTER SETS

Krucom Converter support the following character sets:

Defined Term	Description
ISO_IR 6	Default Repertoire

Table 3-1 Character sets supported by Krucom Converter

Appendix A Supported SOP Classes

Below is a list of all storage SOP classes supported by Krucom Convert. It should cover all storage SOP classes defined in DICOM. However, since DICOM is an evolving standard additional SOP classes may have been defined since the printing of this conformance statement. Contact Krucom AB if a required SOP class is not listed.

SOP Class Name	SOP Class UID
Computed Radiography 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
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1

SOP Class Name	SOP Class UID
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129
Stored Print Storage	1.2.840.10008.5.1.1.27
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
X-Ray Angiographic Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3
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 Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography 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
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2
VL Slide Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65
Key Object Selection	1.2.840.10008.5.1.4.1.1.88.59
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1
Spatial Fiducials Storage	1.2.840.10008.5.1.4.1.1.66.2
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1

SOP Class Name	SOP Class UID
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2
Stereometric Relationship Storage	1.2.840.10008.5.1.4.1.1.77.1.5.3
Procedure Log	1.2.840.10008.5.1.4.1.1.88.40

Table A-1 Supported storage SOP Classes