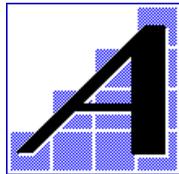

DICOM Conformance Statement RadWorks 5.0 Product Line

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Author	Position	Release Date	Signature
Frank Wessels	Senior Software Engineer / Program Manager	17-Sep-1999	

Reviewer	Position	Review Date	Signature
Stephan Heerkens	Senior Software Engineer / Program Manager		
Mark Sinke	Senior Software Engineer / Software Architect		
Harm-Jan Wessels	Director R&D		
Wijnand Stijn	Manager QA		

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1 INTRODUCTION

1.1 Scope and Field of Application

This document is the DICOM Conformance Statement for the RadWorks 5.0 product line of Applicare Medical Imaging B.V. The purpose of this document is to describe how the RadWorks application collaborates in a DICOM network with other Medical Imaging applications that conform to the DICOM 3.0 standard.

1.2 References

See Digital Imaging and Communications in Medicine (DICOM), parts 1 through 13 (NEMA PS 3.1-13).

1.3 Definitions

See Digital Imaging and Communications in Medicine (DICOM), parts 1 through 13 (NEMA PS 3.1-13).

1.4 Symbols and Abbreviations

See Digital Imaging and Communications in Medicine (DICOM), parts 1 through 13 (NEMA PS 3.1-13).

The name Applicare used in this document refers to Applicare Medical Imaging B.V.

The name RadWorks used in this document refers to version 5.0.

1.5 Revision History

Version	Date	Description
Preliminary	September 1995	Preliminary version
1.0	October 1995	First official version
1.1 (Draft)	July 1996	First revision (Draft)
2.0	November 1996	Second official version
2.1	June 1997	Updated for RadWorks 2.1 release
2.1a	August 1997	Final (minor) update for RadWorks 2.1 release
4.0	November 1998	Updated for RadWorks 4.0 release
5.0	5 August 1999	Updated for RadWorks 5.0 release
5.0.1	17 September	Updated for Media Storage

1.6 Important Considerations for the Reader

This DICOM Conformance Statement by itself is not sufficient to guarantee successful connectivity between RadWorks and equipment from other vendors. The following considerations should be made:

- The integration of equipment from different vendors (including Applicare) goes beyond the scope of the DICOM 3.0 standard and the DICOM Conformance Statements from Applicare and other vendors. It is the responsibility of the user (or user's agent) to assess the application requirements and to design a solution that integrates Applicare equipment with equipment from other vendors.
- When the comparison of this DICOM Conformance Statement with a DICOM Conformance Statement from another vendor indicates that connectivity should be possible it is the responsibility of the user (or user's agent) to verify this by carrying out validation tests and to check whether all required functionality (such as cutlines) is met.
- With regard to the future evolution of the DICOM 3.0 standard Applicare Medical Imaging B.V. reserves the right to make changes to the RadWorks architecture described in this document. The user (or user's agent) should ensure that any equipment connected via DICOM to Applicare equipment also follows the future evolution of the DICOM 3.0 standard. Failure to do so may result in (partial) loss of connectivity.

1.7 Acknowledgment of Tradenames

All tradenames mentioned in this document are recognized.

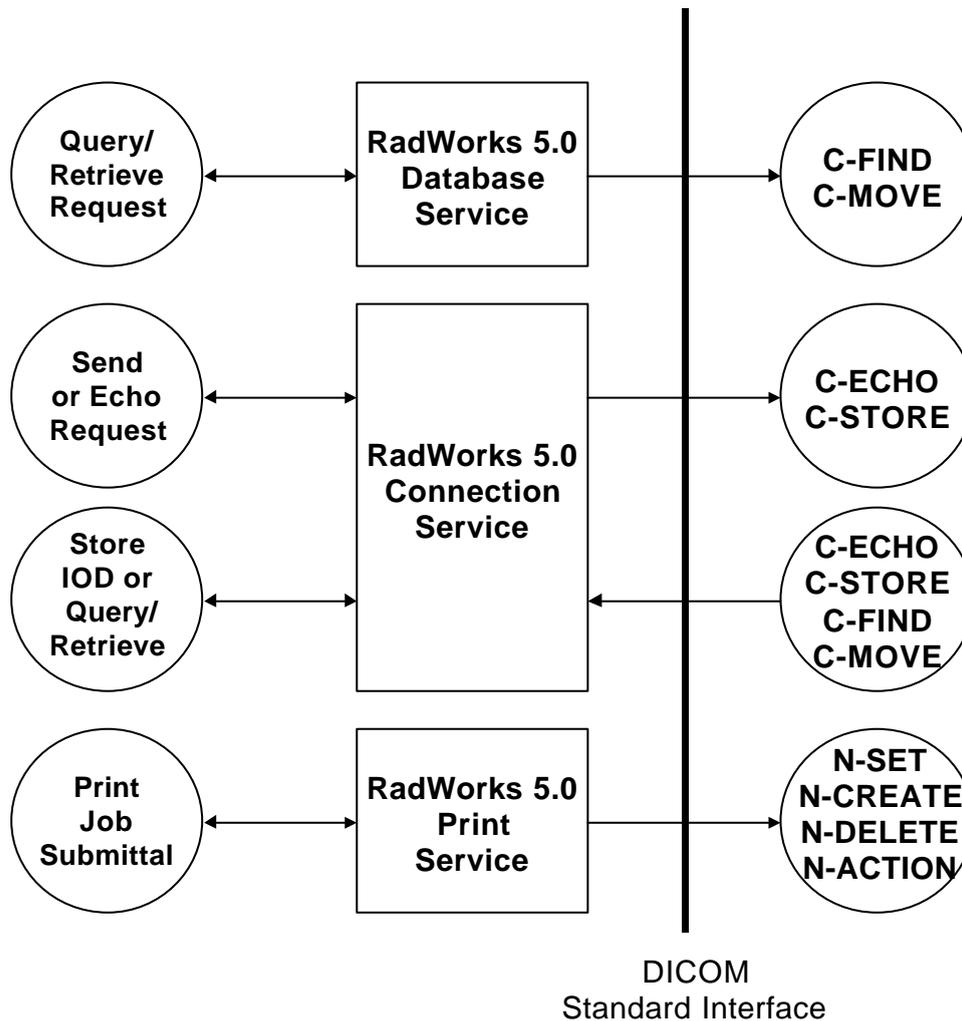
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2 IMPLEMENTATION MODEL

The RadWorks DICOM services are implemented as three separate processes that share a single Application Entity title. Currently all three processes can all initiate associations with remote Application Entities while one can accept associations from remote Application Entities as well.

2.1 Application Data Flow Diagram

The Implementation Model for the RadWorks DICOM services is depicted below:



The RadWorks 5.0 DICOM services are implemented as three separate Windows NT™ Services that run as background processes. They are started automatically during system start-up and will remain active until shutdown. This means that requests for, e.g., image storage can be accepted at all times when the system is up and running regardless of whether the RadWorks 5.0 application is active or not.

The RadWorks 5.0 Connection Service is responsible for image reception and transmission in addition to accepting requests for database queries and retrieves. It maintains logs of all studies that entered and left the system. It can perform scheduled image transfers to remote Application Entities at all times.

The RadWorks 5.0 Database Service handles queries to remote DICOM databases and initiates import requests. Please note that the destination of imports is the Connection Service.

The RadWorks 5.0 Print Service is responsible for managing print job queues for one or more printers or laser images. It supports several protocols of which the DICOM standard is one.

Please note that the RadWorks 5.0 Database and Connection Services are integral parts of a RadWorks system but that the client support in the Database Service for queries and retrieves is optional as well as the send support plus server support for queries and retrieves in the Connection Service. The Print Service is in itself an optional component of a RadWorks installation.

In addition to Storage SOP Class support for networking, RadWorks also supports the Media Storage Service Class for the Interchange of images as a File Set Reader (FSR) and File Set Creator (FSC). FSR is a standard feature and FSC is an optional feature. See section 3.2 for further details.

2.2 Functional Definitions of Application Entities

The Application Entity of the RadWorks 5.0 Connection Service acts as an SCU for the verification, storage, and storage commitment SOP classes and as an SCP for verification, storage, query, retrieve, and storage commitment SOP classes.

The Application Entity of the RadWorks 5.0 Database Service acts as an SCU for the query and retrieve SOP classes.

The Application Entity of the RadWorks 5.0 Print Service acts as an SCU for the basic grayscale and color print management meta SOP classes.

2.3 Sequencing of Real World Activities

Not applicable.

3 APPLICATION ENTITY SPECIFICATIONS

3.1 RadWorks 5.0 DICOM services AE Specifications

The RadWorks 5.0 DICOM services provide support for the following DICOM V3.0 SOP Classes as an SCU:

SOP Classes as SCU	
SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
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
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
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
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
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
Patient Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study Only Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient/Study Only Query/Retrieve Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18
Print Job SOP	1.2.840.10008.5.1.1.14
Modality Worklist Management	1.2.840.10008.5.1.4.31
Storage Commitment Push Model	1.2.840.10008.1.20.1

The RadWorks 5.0 DICOM services provide support for the following DICOM V3.0 SOP Classes as an SCP:

SOP Classes as SCP	
SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
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
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
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
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
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
Patient Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Storage Commitment Push Model	1.2.840.10008.1.20.1

3.1.1 Association Establishment Policies

3.1.1.1 General

The configuration of the RadWorks 5.0 DICOM services in the Windows NT™ Registry shall define such parameters as Application Entity title, host name, and port number that are shared by the Connection, Database and Print Services. They offer a maximum PDU size of 16 kB (16384 bytes) upon association initiation and accept maximum PDU sizes up to 16 kB (16384 bytes) on associations initiated by remote applications.

3.1.1.2 Number of Associations

The RadWorks 5.0 Connection Service supports multiple associations both as an SCU and SCP. By default the maximum number of simultaneous associations that the Connection Service will support as an SCP is 4.

When receiving images or processing query and retrieve requests as an SCP the Connection Service will start a new thread for each association which is being handled. As an SCU the Connection Service also supports multiple associations, for instance to verify a remote destination and simultaneously send images to a storage SCP.

The RadWorks 5.0 Database Service supports multiple associations as an SCU for queries and retrieves to different SCPs. Multiple queries and/or retrieves to the same SCP will be performed sequentially however.

The RadWorks 5.0 Print Service will queue multiple print jobs such that it only establishes one association as an SCU at a time when it manages multiple laser images via DICOM.

3.1.1.3 Asynchronous Nature

The RadWorks 5.0 DICOM services do not support asynchronous operations and will not perform asynchronous window negotiation.

3.1.1.4 Implementation Identifying Information

The Implementation Class UID is: 1.2.528.1.1001.2.19980612.1
The version name is: AMI_DICOM_40

3.1.2 Association Initiation Policy

The RadWorks 5.0 Connection Service initiates associations for the following activities:

- The RadWorks user wants to verify the DICOM communication with a remote system.
- The RadWorks user wants to send images from the local RadWorks database to a remote system.
- The RadWorks user wants to request storage commitment after images from the local RadWorks database have been transmitted to a remote system.

The RadWorks 5.0 Database Service initiates associations for the following activities:

- The RadWorks user wants to query the contents of a remote database.
- The RadWorks user wants to retrieve images from a remote database to the local RadWorks database.

The RadWorks 5.0 Print Service initiates associations for the following activities:

- The RadWorks user wants to print images to a laser imager.

3.1.2.1 Verify Communication with a Remote System

3.1.2.1.1 Associated Real World Activity

The RadWorks 5.0 Connection Service sends out a request to test DICOM communication with a remote DICOM system.

3.1.2.1.2 Accepted Presentation Contexts

Presentation Context Table					
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	SCU	None

3.1.2.1.3 SOP Specific Conformance Statement for SOP Class Verification

The RadWorks 5.0 Connection Service provides standard conformance.

3.1.2.2 Send Images to a Remote System

3.1.2.2.1 Associated Real World Activity

The user of the RadWorks system makes a selection of one or more studies and series in the local Database and subsequently presses the Send button which will initiate the transfer of images from the local database of RadWorks to the remote system.

3.1.2.2.2 Proposed Presentation Contexts

Presentation Context Table for Send To Remote System				
Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	UID			
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	See below	SCU	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	See below	SCU	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	See below	SCU	None
US Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	See below	SCU	None
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	See below	SCU	None
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	See below	SCU	None
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	See below	SCU	None
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	See below	SCU	None
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	See below	SCU	None
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	See below	SCU	None

Transfer Syntaxes for Send To Remote System	
Name	UID
Implicit VR, Little Endian	1.2.840.10008.1.2
Explicit VR, Little Endian	1.2.840.10008.1.2.1
Explicit VR, Lossy JPEG 8-Bit Image Compression	1.2.840.10008.1.2.4.50
Explicit VR, Lossy JPEG 12-Bit Image Compression	1.2.840.10008.1.2.4.51
Explicit VR, JPEG Lossless, Non-Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70

3.1.2.2.3 SOP Specific Conformance Statement for SOP Class Storage

The images stored in the local RadWorks database that are to be sent are converted from the local RadWorks DICOM V3.0 compliant format to instances of the corresponding SOP Storage class(es) and subsequently sent sequentially to the remote system.

RadWorks allows image transfers to be scheduled for specific times and has mechanisms for retrying a transfer in case that a transfer failed at an earlier time. After a configurable number of unsuccessful attempts RadWorks will mark the transfer as failed. The RadWorks system keeps a log of transfers that is viewable by the user. The log indicates the status of transfers.

RadWorks provides full (level 2) conformance as SCP of the Storage SOP class. This means that upon sending an image received via DICOM on to another DICOM compliant system it will send out all attributes that it received (this includes private attributes from other vendors). In addition it will include Applicare Medical Imaging B.V. private attributes for Annotations and Measurements that were added to the image as well as a Transformation Matrix for display. The structure of these private IOD modules is described in Appendix A.

By default RadWorks will ask for the “Explicit VR, Little Endian” transfer syntax in preference of the “Implicit VR, Little Endian” upon requesting the association. When “Explicit VR, Little Endian” is accepted RadWorks will behave conform supplement 14 “Unknown Value Representation” and consequently encode unknown attributes as “UN”. If this leads to problems RadWorks can be configured such that it will not request the “Explicit VR, Little Endian” but only the “Implicit VR, Little Endian”.

When the user selects a DICOM Lossy JPEG transfer syntax to be used for sending a certain study to another system the study will be compressed before transmission if it was not already compressed. The attribute “Derivative Description” (0008,2111) will be set to specify that lossy JPEG compression has been applied to the pixel data and this string has to be shown to the user when the images are subsequently viewed (as is done by RadWorks). In the case the receiving workstation is from a 3rd party vendor it is their responsibility to display this string correctly.

If a study was already compressed because it was received previously with compression it will be sent as is (i.e., the compressed pixel data stream will remain unaltered and hence no further loss of image quality will take place). If in the latter case the receiving Application Entity title does not support the requested DICOM Lossy JPEG transfer syntax the study will not be sent and its transfer will fail. Sending the study in decompressed form in this case could form a potential security hazard because the receiving system would not know that the study has been compressed.

There is a way to get around this by configuring RadWorks such that it automatically decompresses lossy JPEG compressed studies upon receiving. This then does allow the studies to be sent on as regular uncompressed DICOM studies although the attribute “Derivative Description” (0008,2111) will still specify that lossy JPEG compression has been applied to the pixel data and should still be shown to the user when the images are viewed. For more information see ‘3.1.3.2 Receive Images from a Remote System’.

RadWorks 5.0 offers support for marking Key Images. When an image is marked as a Key Image the attribute “Image Type” (0008,0008) is expanded to include “KEY_IMAGE”. Therefore this will also be contained in a Key Image when it is sent to another system or archive.

3.1.2.3 Query a Remote Database

3.1.2.3.1 Associated Real World Activity

The user of the RadWorks system wants to have a view on a remote DICOM database and either views the complete contents of the remote database or fills out a query dialogue box with fields for Patient Name, Patient ID, Study date, etc. Wildcards can be used instead of fully specified information to allow flexible queries.

3.1.2.3.2 Proposed Presentation Contexts

Presentation Context Table for Remote Database Query					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Patient Root Query/ Retrieve 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 Query/ Retrieve 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 Query/ Retrieve 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

3.1.2.3.3 SOP Specific Conformance Statement for SOP Class Query

The RadWorks 5.0 Database Service does not support Relational Queries. The following keys are supported for the Patient Root Query/Retrieve:

Supported keys for Patient Root Query/Retrieve			
Level	Description	Tag	Type
Patient	Patient's Name	(0010,0010)	R
Patient	Patient ID	(0010,0020)	U
Patient	Patient's Birth Date	(0010,0030)	O
Patient	Patient's Sex	(0010,0040)	O
Study	Study Date	(0008,0020)	R
Study	Study Time	(0008,0030)	R
Study	Accession Number	(0008,0050)	R
Study	Study ID	(0020,0010)	R
Study	Study Instance UID	(0020,000D)	U
Study	Referring Physician's Name	(0008,0090)	O
Study	Study Description	(0008,1030)	O
Study	Study Modality	(0008,0061)	O
Series	Modality	(0008,0060)	R
Series	Series Number	(0020,0011)	R
Series	Series Instance UID	(0020,000E)	U
Image	Image Number	(0020,0013)	R
Image	SOP Instance UID	(0008,0018)	U
Image	Rows	(0028,0010)	O
Image	Columns	(0028,0011)	O
Image	Bits Stored	(0028,0101)	O

In addition to the keys listed above the following keys are included:

Additional keys for Patient Root Query/Retrieve		
Level	Description	Tag
Study	Number of Study Related Series	(0020,1206)
Study	Number of Study Related Images	(0020,1208)
Series	Number of Series Related Images	(0020,1209)

The Patient/Study levels in the table above are also supported for the Patient/Study Only Query/Retrieve.

For a Study Root Query/Retrieve the following keys are supported:

Supported keys for Study Root Query/Retrieve			
Level	Description	Tag	Type
Study	Study Date	(0008,0020)	R
Study	Study Time	(0008,0030)	R
Study	Accession Number	(0008,0050)	R
Study	Patient's Name	(0010,0010)	R
Study	Patient ID	(0010,0020)	R
Study	Study ID	(0020,0010)	R
Study	Study Instance UID	(0020,000D)	U
Study	Referring Physician's Name	(0008,0090)	O
Study	Study Description	(0008,1030)	O
Study	Patient's Birth Date	(0010,0030)	O
Study	Patient's Sex	(0010,0040)	O
Study	Study Modality	(0008,0061)	O
Series	Modality	(0008,0060)	R
Series	Series Number	(0020,0011)	R
Series	Series Instance UID	(0020,000E)	U
Image	Image Number	(0020,0013)	R
Image	SOP Instance UID	(0008,0018)	U
Image	Rows	(0028,0010)	O
Image	Columns	(0028,0011)	O
Image	Bits Stored	(0028,0101)	O

In addition to the keys listed above the following keys are included:

Additional keys for Study Root Query/Retrieve		
Level	Description	Tag
Study	Number of Study Related Series	(0020,1206)
Study	Number of Study Related Images	(0020,1208)
Series	Number of Series Related Images	(0020,1209)

3.1.2.4 Retrieve from a Remote System

3.1.2.4.1 Associated Real World Activity

After a view on a remote DICOM database has been obtained the user makes a selection of one or more studies and series and subsequently presses the Import button which will initiate the transfer of images from the remote system to the local database of RadWorks.

Note that the RadWorks 5.0 Database Service performs the C-MOVE operation while the destination of the resulting C-STORE operation is the RadWorks 5.0 Connection Service.

3.1.2.4.2 Proposed Presentation Contexts

Presentation Context Table for Remote System Retrieve					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Patient Root Query/ Retrieve 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 Query/ Retrieve 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 Query/ Retrieve 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

3.1.2.4.3 SOP Specific Conformance Statement for SOP Class Retrieve

The RadWorks 5.0 Database Service provides standard conformance.

3.1.2.5 Print to a remote Laser Imager

3.1.2.5.1 Associated Real World Activity

The RadWorks user selects a study in the local database and submits it to the Print Service as a job for the desired laser imager. Several parameters such as the layout of the film and number of copies can be chosen by the user.

3.1.2.5.2 Proposed Presentation Contexts

Presentation Context Table for Remote System Retrieve					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
Basic Color Print Management Meta	1.2.840.10008.5.1.1.18	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None
Print Job SOP	1.2.840.10008.5.1.1.14	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.5.3 SOP Specific Conformance Statement for SOP Classes Basic Grayscale and Color Print Management Meta

The RadWorks 5.0 Print Service supports the following mandatory SOP classes as defined by the Basic Grayscale Print Management Meta class:

Supported SOP classes as Basic Grayscale Print Management Meta SOP class	
SOP Class Name	SOP Class UID
Basic Film Session	1.2.840.10008.5.1.1.1
Basic Film Box	1.2.840.10008.5.1.1.2
Basic Grayscale Image Box	1.2.840.10008.5.1.1.4
Printer	1.2.840.10008.5.1.1.16

For the Basic Color Print Management Meta class it supports:

Supported SOP classes as Basic Color Print Management Meta SOP class	
SOP Class Name	SOP Class UID
Basic Film Session	1.2.840.10008.5.1.1.1
Basic Film Box	1.2.840.10008.5.1.1.2
Basic Color Image Box	1.2.840.10008.5.1.1.4.1
Printer	1.2.840.10008.5.1.1.16

3.1.2.5.3.1 Conformance for SOP Class Basic Film Session

The RadWorks 5.0 Print Service includes the following attributes in the N-CREATE for the Basic Film Session SOP class:

Attributes for Basic Film Session SOP class N-CREATE	
Description	Tag
Number of Copies	(2000,0010)
Print Priority	(2000,0020)
Medium Type	(2000,0030)
Film Destination	(2000,0040)
Film Session Label	(2000,0050)
Memory Allocation	(2000,0060)

The N-SET and N-ACTION are currently unused. The N-DELETE is used to delete the complete Basic Film Session SOP instance hierarchy.

3.1.2.5.3.2 Conformance for SOP Class Basic Film Box

The RadWorks 5.0 Print Service includes the following attributes in the N-CREATE for the Basic Film Box SOP class:

Attributes for Basic Film Box SOP class N-CREATE		
Description	Tag	Usage
Image Display Format	(2010,0010)	A ¹
Referenced Film Session Sequence	(2010,0500)	A
> Referenced SOP Class UID	(0008,1150)	A
> Referenced SOP Instance UID	(0008,1155)	A
Film Orientation	(2010,0040)	A
Film Size ID	(2010,0050)	A
Magnification Type	(2010,0060)	C ²
Max Density	(2010,0130)	C
Configuration Information	(2010,0150)	C
Smoothing Type	(2010,0080)	C
Border Density	(2010,0100)	C
Empty Image Density	(2010,0110)	C
Min Density	(2010,0120)	C
Trim	(2010,0140)	C

The N-SET is currently unused. The N-ACTION is used to print a complete Basic Film Box SOP instance and N-DELETE is used to delete it after printing.

¹ A means the attribute is always sent

² C means the attribute is only sent when not empty

3.1.2.5.3.3 Conformance for SOP Class Basic Grayscale Image Box

The RadWorks 5.0 Print Service includes the following attributes in the N-SET for the Basic Grayscale Image SOP class:

Attributes for Basic Grayscale Image SOP Box class N-SET		
Description	Tag	Usage
Image Position	(2020,0010)	A
Preformatted Grayscale Image Sequence	(2020,0110)	A
> Samples Per Pixel	(0028,0002)	A
> Photometric Interpretation	(0028,0004)	A
> Rows	(0028,0010)	A
> Columns	(0028,0011)	A
> Pixel Aspect Ratio	(0028,0034)	A
> Bits Allocated ¹	(0028,0100)	A
> Bits Stored ¹	(0028,0101)	A
> High Bit ¹	(0028,0102)	A
> Pixel Representation	(0028,0103)	A
> Pixel Data	(7FE0,0010)	A
Magnification Type	(2010,0060)	C
Smoothing Type	(2010,0080)	C
Requested Image Size	(2020,0030)	C

3.1.2.5.3.4 Conformance for SOP Class Basic Color Image Box

The RadWorks 5.0 Print Service includes the following attributes in the N-SET for the Basic Color Image Box SOP class:

Attributes for Basic Color Image Box SOP class N-SET		
Description	Tag	Usage
Image Position	(2020,0010)	A
Preformatted Color Image Sequence	(2020,0111)	A
> Samples Per Pixel	(0028,0002)	A
> Photometric Interpretation	(0028,0004)	A
> Planar Configuration	(0028,0006)	A
> Rows	(0028,0010)	A
> Columns	(0028,0011)	A
> Pixel Aspect Ratio	(0028,0034)	A
> Bits Allocated	(0028,0100)	A
> Bits Stored	(0028,0101)	A
> High Bit	(0028,0102)	A
> Pixel Representation	(0028,0103)	A
> Pixel Data	(7FE0,0010)	A
Magnification Type	(2010,0060)	C
Smoothing Type	(2010,0080)	C
Requested Image Size	(2020,0030)	C

¹ The RadWorks 5.0 Print Service offers support for either 8 or 12-bit printing. For 12-bit printing Bits Allocated is set to 16, Bits Stored is set to 12, and High Bit is set to 11. For 8-bit printing the values are 8, 8, and 7 respectively.

3.1.2.5.3.5 Conformance for SOP Class Printer

The RadWorks 5.0 Print Service shall accept N-EVENT-REPORT and return confirmation accordingly.

The RadWorks 5.0 Print Service uses N-GET for the Printer SOP class to get information from the SCP.

3.1.2.5.4 SOP Specific Conformance Statement for SOP Class Print Job

RadWorks 5.0 can optionally request this SOP Class from the SCP. In case it is supported the RadWorks 5.0 Print Service will track the progress of the current job via N-EVENT-REPORTs and will not send the next job before completion of the current job.

3.1.2.5.5 Optional SOP Classes for Basic Grayscale Print Management Meta

Currently these are not supported by the RadWorks 5.0 Print Service.

3.1.2.5.6 Optional SOP Classes for Basic Color Print Management Meta

Currently these are not supported by the RadWorks 5.0 Print Service.

3.1.2.6 Retrieve a Modality Worklist from a Remote System

3.1.2.6.1 Associated Real World Activity

RadWorks 5.0 can query for a Modality Worklist to aid in merging patient demographics into DICOM images. This prevents the need to enter patient demographics manually and consequently eliminates a source of typing errors.

3.1.2.6.2 Proposed Presentation Contexts

Presentation Context Table for Modality Worklist Management					
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	SCU	None

3.1.2.6.3 SOP Specific Conformance Statement for SOP Class Modality Worklist Management

RadWorks 5.0 provides standard conformance.

The following keys are supported for the Modality Worklist Management:

Supported keys for Modality Worklist Management			
Module	Description	Tag	Type
Scheduled Procedure Step	Scheduled Procedure Step Sequence	(0040,0100)	R
	>Scheduled Station AE Title	(0040,0001)	R
	>Scheduled Procedure Step Start Date	(0040,0002)	R
	>Scheduled Procedure Step Start Time	(0040,0003)	R
	>Modality	(0008,0060)	R
	>Scheduled Performing Physician	(0040,0006)	R
	>Scheduled Procedure Step Description	(0040,0007)	O
	>Scheduled Station Name	(0040,0010)	O
	>Scheduled Procedure Step Location	(0040,0011)	O
	>Pre-Medication	(0040,0012)	O
	>Scheduled Procedure Step ID	(0040,0009)	O
	>Requested Contrast Agent	(0032,1070)	O
Requested Procedure	Requested Procedure ID	(0040,1001)	O
	Requested Procedure Description	(0032,1060)	O
	Study Instance UID	(0020,000D)	O
	Requested Procedure Priority	(0040,1003)	O
	Patient Transport Arrangements	(0040,1004)	O
Imaging Service Request	Accession Number	(0008,0050)	O
	Requesting Physician	(0032,1032)	O
	Referring Physician's Name	(0008,0090)	O
	Study Status ID	(0032,000A)	O
	Study Priority ID	(0032,000C)	O
Visit Identification	Admission ID	(0038,0010)	O
Visit Status	Current Patient Location	(0038,0300)	O
Patient Identification	Patient's Name	(0010,0010)	R

	Patient ID	(0010,0020)	R
	Issuer of Patient ID	(0010,0021)	O
	Other Patient IDs	(0010,1000)	O
	Other Patient Names	(0010,1001)	O
	Patient's Birth Name	(0010,1005)	O
	Patient's Mother's Birth Name	(0010,1060)	O
	Medical Record Locator	(0010,1090)	O
Patient Demographic	Patient's Birth Date	(0010,0030)	O
	Patient's Birth Time	(0010,0032)	O
	Patient's Sex	(0010,0040)	O
	Patient's Size	(0010,1020)	O
	Patient's Weight	(0010,1030)	O
	Patient's Address	(0010,1040)	O
	Military Rank	(0010,1080)	O
	Branch of Service	(0010,1081)	O
	Country of Residence	(0010,2150)	O
	Region of Residence	(0010,2152)	O
	Patient's Telephone Numbers	(0010,2154)	O
	Ethnic Group	(0010,2160)	O
	Patient's Religious Preference	(0010,21F0)	O
	Patient Comments	(0010,4000)	O
Patient Medical	Medical Alerts	(0010,2000)	O
	Contrast Allergies	(0010,2110)	O
	Pregnancy Status	(0010,21C0)	O
	Special Needs	(0038,0050)	O
	Patient State	(0038,0500)	O

RadWorks may fill no, one, or multiple attributes in the query request with a non-empty value. RadWorks may thus request matching on Optional Matching Key Attributes.

All fields listed above are always included in the query request to ask the SCP to return them for each response. RadWorks expects the SCP to return values for all 'R' attributes whereas the attributes marked with 'O' may be optionally filled. Therefore RadWorks treats these attributes as Type 3 Return Key Attributes.

3.1.2.7 Verify the Committed Storage of Images on a Remote System

3.1.2.7.1 Associated Real World Activity

When RadWorks 5.0 completes a transmission of images it can optionally verify whether the images have not only been received but also been stored successfully (committed) at the other end.

3.1.2.7.2 Proposed Presentation Contexts

Presentation Context Table for Storage Commitment Push Model					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR, Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.7.3 SOP Specific Conformance Statement for SOP Class Storage Commitment Push Model

RadWorks 5.0 provides standard conformance.

After the images and the storage commitment request have been sent, RadWorks will immediately close the association and will not wait for a reply from the SCP. Instead the SCP must open a new association to RadWorks in order to transmit the response. Thus the N-EVENT-REPORT must occur on a different association than the N-ACTION operation.

3.1.2.7.3.1 Operations

RadWorks can request storage commitment for all SOP classes as listed in the table in section 3.1.2.2.2.

RadWorks supports the Referenced Study Component Sequence Attribute by including the Study Instance UID (0020,000D) of the requested objects. When storage commitment is requested for multiple studies, multiple requests are made, each on a separate association.

The validity of the Transaction UID that is generated for the storage commitment request is based on the system configuration. By default an answer must be obtained from the SCP within 6 hours. After this the Transaction UID is no longer valid.

RadWorks does not support the optional Storage Media File-Set ID & UID attributes.

3.1.2.7.3.2 Notifications

When RadWorks receives a success status the status of the job that requested the storage commitment is changed from “Sent, waiting for storage commitment” to “Sent, storage commitment succeeded” and the job is finished. When deletion of the previously transmitted images is requested as part of the job they will be deleted.

When RadWorks receives a failure status the status of the job that requested the storage commitment is changed from “Sent, waiting for storage commitment” to “Error”. The job remains in the send queue in an error state and the specific reason for the error can be seen in the Details dialog. When deletion of the previously transmitted images is requested as part of the job this will not be done.

3.1.3 Association Acceptance Policy

The RadWorks 5.0 Connection Service accepts associations for the following activities:

- Verification of the DICOM communication between a remote system and RadWorks.
- Transfer of images from a remote system to RadWorks.
- Processing of a query from a remote system.
- Initiation of a transfer of images to a remote system when a retrieve request is received.
- Commit the storage of images on a RadWorks system.

Association requests from applications whose AE title is unknown may be rejected by the RadWorks 5.0 Connection Service depending on how it is configured. The same applies to the case in which the AE title for the RadWorks 5.0 Connection Service is incorrectly configured on the remote system.

3.1.3.1 Verify Communication with a Remote System

3.1.3.1.1 Associated Real World Activity

The RadWorks 5.0 Connection Service will respond to verification request made by remote systems.

3.1.3.1.2 Accepted Presentation Contexts

Presentation Context Table					
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

3.1.3.1.3 SOP Specific Conformance Statement for SOP Class Verification

The RadWorks 5.0 Connection Service provides standard conformance.

3.1.3.1.4 Presentation Context Acceptance Criterion

There are no specific rules for acceptance and prioritization of presentation contexts and the RadWorks 5.0 Connection Service will accept all presentation contexts that match those listed in the table shown above.

3.1.3.2 Receive Images from a Remote System

3.1.3.2.1 Associated Real World Activity

A remote system wants to send images to the RadWorks system via the RadWorks 5.0 Connection Service. Once the transfer is completed the new images will automatically be included in the user's view of the local database of RadWorks and can be selected for display.

3.1.3.2.2 Accepted Presentation Contexts

Presentation Context Table for Receive from Remote System				
Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
Name	UID			
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	See below	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	See below	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	See below	SCP	None
US Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	See below	SCP	None
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	See below	SCP	None
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	See below	SCP	None
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	See below	SCP	None
NM Image Storage	1.2.840.10008.5.1.4.1.1.20	See below	SCP	None
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	See below	SCP	None
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	See below	SCP	None

Transfer Syntaxes for Receive from Remote System	
Name	UID
Implicit VR, Little Endian	1.2.840.10008.1.2
Explicit VR, Little Endian	1.2.840.10008.1.2.1
Explicit VR, Lossy JPEG 8-Bit Image Compression	1.2.840.10008.1.2.4.50
Explicit VR, Lossy JPEG 12-Bit Image Compression	1.2.840.10008.1.2.4.51
Explicit VR, JPEG Lossless, Non-Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70

3.1.3.2.3 SOP Specific Conformance Statement for SOP Class Storage

The RadWorks 5.0 Connection Service conforms to the full (level 2) conformance of the Storage SOP class. All Type 1, Type 2 and Type 3 attributes will be retained. In addition private attributes will be stored and included when the image is sent out again.

Upon successful storage of images of a study or series it may automatically be transferred to another system. The RadWorks system can be configured such to automatically delete studies or series from its local database when certain criteria are met.

For unsuccessful storage requests the RadWorks 5.0 Connection Service returns the following error status codes:

- A700 - The local RadWorks database is full and is therefore unable to store the image.
- A900 - The SOP class of the image does not match the abstract syntax of the current presentation context.
- C000 - The image cannot be parsed successfully.

When an image is received that has a SOP Instance UID (0008,0018) that is already present in the RadWorks database the transfers itself will complete successfully but the existing image in the database will be kept and the newly received image will be discarded.

When receiving lossy JPEG compressed images they will by default be stored in compressed form and be only decompressed for display purposes. Upon further transmission of such images to another DICOM system this system has to support the same DICOM Lossy JPEG transfer syntax with which the image was received by the RadWorks system. If this is not the case the image will not be transmitted. This guarantees that the image will not be transmitted in uncompressed form without the receiving DICOM system knowing that the image has been lossy compressed previously. RadWorks will display the contents of attribute "Derivative Description" (0008,2111) along with the images so that the user is aware of the fact that derived pixel data is shown.

There is an option to automatically decompress lossy JPEG compressed images upon receiving which opens the possibility to transmit the images further as regular uncompressed DICOM images. The attribute "Derivative Description" (0008,2111) keeps its original contents and should still be displayed while viewing the images.

RadWorks 5.0 offers support for Key Images. When an image is received that contains the attribute "Image Type" (0008,0008) which includes "KEY_IMAGE" as one of the multiple values then RadWorks will treat it as a natively marked Key Image.

3.1.3.2.4 Presentation Context Acceptance Criterion

There are no specific rules for acceptance and prioritization of presentation contexts and the RadWorks 5.0 Connection Service will accept all presentation contexts that match those listed in the table shown above. It will however limit a certain SCU to only one association at a time. This means that when a SCU tries to initiate a request while any previous associations that it made are not completely processed that association will be accepted but actual data transfer will be postponed until all previous associations are completed.

RadWorks will prefer the "Explicit VR, Lossy JPEG 8/12-Bit Image Compression" above the "Explicit VR, Little Endian" above the "Implicit VR, Little Endian" transfer syntaxes. When "Explicit VR, Little Endian" leads to problems RadWorks offers a configuration option to turn acceptance of "Explicit VR, Little Endian" off and thereby effectively going back to the default transfer syntax of "Implicit VR, Little Endian".

3.1.3.3 Query the RadWorks Database

3.1.3.3.1 Associated Real World Activity

A remote system wants to see which studies are available on the RadWorks system and issues a query.

3.1.3.3.2 Accepted Presentation Contexts

Presentation Context Table for local Database Query					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Patient Root Query/ Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR, Little Endian	1.2.840.10008.1.2	SCP	None
Study Root Query/ Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR, Little Endian	1.2.840.10008.1.2	SCP	None

3.1.3.3.3 SOP Specific Conformance Statement for SOP Class Query

The RadWorks 5.0 Database Service does not support Relational Queries. The following keys are supported for the Patient Root Query/Retrieve:

Supported keys for Patient Root Query/Retrieve			
Level	Description	Tag	Type
Patient	Patient's Name	(0010,0010)	R
Patient	Patient ID	(0010,0020)	U
Patient	Patient's Birth Date	(0010,0030)	O
Patient	Patient's Sex	(0010,0040)	O
Study	Study Date	(0008,0020)	R
Study	Study Time	(0008,0030)	R
Study	Accession Number	(0008,0050)	R
Study	Study ID	(0020,0010)	R
Study	Study Instance UID	(0020,000D)	U
Study	Referring Physician's Name	(0008,0090)	O
Study	Study Description	(0008,1030)	O
Series	Modality	(0008,0060)	R
Series	Series Number	(0020,0011)	R
Series	Series Instance UID	(0020,000E)	U
Image	Image Number	(0020,0013)	R
Image	SOP Instance UID	(0008,0018)	U
Image	Rows	(0028,0010)	O
Image	Columns	(0028,0011)	O
Image	Bits Stored	(0028,0101)	O

The following keys are supported for the Study Root Query/Retrieve:

Supported keys for Study Root Query/Retrieve			
Level	Description	Tag	Type
Study	Study Date	(0008,0020)	R
Study	Study Time	(0008,0030)	R
Study	Accession Number	(0008,0050)	R
Study	Patient's Name	(0010,0010)	R
Study	Patient ID	(0010,0020)	R
Study	Study ID	(0020,0010)	R
Study	Study Instance UID	(0020,000D)	U
Study	Referring Physician's Name	(0008,0090)	O
Study	Study Description	(0008,1030)	O
Study	Patient's Birth Date	(0010,0030)	O
Study	Patient's Sex	(0010,0040)	O
Series	Modality	(0008,0060)	R
Series	Series Number	(0020,0011)	R
Series	Series Instance UID	(0020,000E)	U
Image	Image Number	(0020,0013)	R
Image	SOP Instance UID	(0008,0018)	U
Image	Rows	(0028,0010)	O
Image	Columns	(0028,0011)	O
Image	Bits Stored	(0028,0101)	O

The following types of attribute matching are supported:

- Single Value Matching
- Universal Matching
- Wild Card Matching
- Range Matching

In addition to the attributes listed above for querying following attributes are offered in replies:

Additional attributes for Study Root Query		
Level	Description	Tag
Study	Number of Study Related Series	(0020,1206)
Study	Number of Study Related Images	(0020,1208)
Series	Number of Series Related Images	(0020,1209)

3.1.3.3.4 Presentation Context Acceptance Criterion

There are no specific rules for acceptance and prioritization of presentation contexts and the RadWorks 5.0 Connection Service will accept all presentation contexts that match those listed in the table shown above.

3.1.3.4 Retrieve from the RadWorks Database

3.1.3.4.1 Associated Real World Activity

A remote system wants to receive data available on the RadWorks system and issues a retrieve command.

3.1.3.4.2 Accepted Presentation Contexts

Presentation Context Table for local Database Query					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Patient Root Query/ Retrieve 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 Query/ Retrieve 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

3.1.3.4.3 SOP Specific Conformance Statement for SOP Class Retrieve

The RadWorks 5.0 Connection Service provides standard conformance.

In addition to this it offers relational retrieve whereby for the Patient Root Query/Retrieve Model all studies of a patient can be retrieved by providing a single Patient ID. Also for both the Patient Root Query/Retrieve Model and the Study Root Query/Retrieve Model all images of a study or series can be retrieved by providing a single Study or Series Instance UID.

3.1.3.4.4 Presentation Context Acceptance Criterion

RadWorks 5.0 Connection Service will only accept retrieve requests from DICOM systems for which it has been configured. There are no specific rules for acceptance and prioritization of presentation contexts.

3.1.3.5 Commit Storage of Images in the RadWorks Database

3.1.3.5.1 Associated Real World Activity

RadWorks 5.0 can confirm the storage (availability) of images on the local system when it is asked to do so. Note however that RadWorks does not provide long term archiving and that therefore there is no guarantee that the committed images will remain on the system for a longer period of time (see also below).

3.1.3.5.2 Accepted Presentation Contexts

Presentation Context Table for Storage Commitment Push Model					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR, Little Endian	1.2.840.10008.1.2	SCP	None

3.1.3.5.3 SOP Specific Conformance Statement for SOP Class Storage Commitment Push Model

RadWorks 5.0 provides standard conformance.

RadWorks will open a new association to the SCU for transmitting the response back and will not transmit the response using the association over which the storage commitment request was sent by the SCU (even if it is still open at the time of sending the response back). Thus the N-EVENT-REPORT will occur on a different association than the N-ACTION operation.

3.1.3.5.3.1 Operations

To date RadWorks only provides temporary commitment for the storage of images. It can therefore thus not be treated as a long term archive.

RadWorks supports the Referenced Study Component Sequence Attribute by treating it as a Study Instance UID (0020,000D) which is used to speed up the search for the requested objects. When no objects are found with this Study UID, or the Referenced Study Component Sequence Attribute was not present in the request, the complete database is searched for the requested objects.

Committed images can be retrieved via the normal Query/Retrieve mechanism.

RadWorks does not support the optional Storage Media File-Set ID & UID attributes.

3.1.3.5.3.2 Notifications

Upon receiving a storage commitment RadWorks will first wait for a configurable interval (4 seconds by default). It will then verify up to configurable number of retries (3 by default), separated by a configurable interval (15 seconds by default), whether the requested objects are stored on the system. After a fully successful verification (all requested objects could be verified) it will send a successful reply back to the requestor. If, after the last retry, not all

objects could be verified a reply is sent back with a list of committed objects and a list of uncommitted objects.

RadWorks does not support the optional Storage Media File-Set ID & UID attributes.

RadWorks does not support the optional Retrieve AE Title (0008,0054).

3.1.3.5.4 Presentation Context Acceptance Criterion

There are no specific rules for acceptance and prioritization of presentation contexts and RadWorks 5.0 will accept all presentation contexts that match those listed in the table shown above.

3.2 RadWorks DICOM Media Server AE

RadWorks provides standard conformance to the DICOM Media Storage Service and File Format (PS 3.10) and the Media Storage Application Profiles (PS 3.11) as far as the reading of uncompressed and JPEG Lossless Non-Hierarchical First Order Prediction compressed images on CD-Recordable medium is concerned.

RadWorks does not support writing of multi session CD-R disks.

Radworks supports the following application profile:

Supported Application Profile	
Description	Identifier
General Purpose CD-R Image Interchange profile	STD-GEN-CD

RadWorks supports the following Real World Activities within the profile mentioned above:

Real World Activities and roles ¹		
Real World Activity	Role	SC Option
Display Directory of CD-R disk	FSR	Interchange
Read image(s) from CD-R disk	FSR	Interchange
Write image(s) on CD-R disk	FSC	Interchange

3.2.1 Real World Activity: Display Directory of CD-R disk

RadWorks will act as a FSR when reading the directory of the medium. This will result in an overview of the patients, studies, series and images in the RadWorks Remote View area.

The display is structured in one of the following ways:

¹ The RadWorks software allows for more flexibility than this profile. For more information please contact Applicare

Type of queries	
Type of query	Levels
Study Root Query	Study, Series
Patient Root Query	Patient, Study, Series.

At least the Patient Name and Patient ID fields are necessary for a correct display of the directory information. The following DICOMDIR keys are used for the user to be able to distinguish between the objects.

DICOMDIR Keys displayed in RadWorks			
Type of query	Level	Displayed fields	Tag
Patient root	Patient	Patient Name	(0010,0010)
Patient root	Patient	Patient ID	(0010,0020)
Patient root	Patient	Patient Date of Birth	(0010,0030)
Patient root	Patient	Patient Sex	(0010,0040)
Study root	Study	Patient Name	(0010,0010)
Study root	Study	Patient ID	(0010,0020)
Study root	Study	Patient Date of Birth	(0010,0030)
Study root	Study	Patient Sex	(0010,0040)
Both	Study	Study Date	(0008,0020)
Both	Study	Study Time	(0008,0030)
Both	Study	Modality ¹	
Both	Study	Accession Number	(0008,0050)
Both	Study	Study ID	(0020,0010)
Both	Study	Study Instance UID	(0020,000D)
Both	Study	Referring Physician	(0008,0090)
Both	Study	Study Description	(0008,1030)
Both	Study	Rows ²	
Both	Study	Columns ²	
Both	Series	Modality	(0008,0060)
Both	Series	Series Number	(0020,0011)
Both	Series	Series UID	(0020,000E)
Both	Series	Rows ³	
Both	Series	Columns ³	

Reading of the directory contents is a standard feature of RadWorks.

3.2.2 Real World Activity Read images from CD-R disk

RadWorks will act as a FSR when reading all/selected images from the CD-R medium. This feature will be available through the Import command from the Remote View area.

The following mandatory Attributes of the DICOM images are required for the correct storage of the images in the RadWorks Local Database.

¹ The field Modality on study level is copied from the field Modality (0008,0060) from the series level, only if it's equal over all series in the study

² The fields *Rows* and *Columns* on Study level are copied from the fields *Rows* (0028,0010) and *Columns* (0028,0011) from the image level, only if they are equal over all images in the study.

³ The fields *Rows* and *Columns* on Series level are copied from the fields *Rows* (0028,0010) and *Columns* (0028,0011) from the image level, only if they are equal over all images in the series.

Mandatory keys in DICOM Part 10 files for importing		
IOD	Field description	Tag
PATIENT	Patient.Name	(0010.0010)
PATIENT	Patient ID	(0010.0020)
STUDY	Study Date	(0008.0020)
STUDY	Study Time	(0008.0030)
STUDY	Study ID	(0020.0010)
STUDY	Accession Number	(0008.0050)
STUDY	Study UID	(0020.000D)
SERIES	Modality	(0008.0060)
SERIES	Series UID	(0020.000E)
SERIES	Series Number	(0020.0011)
IMAGE	Referenced SOP Class UID In File	(0004,1510)
IMAGE	Referenced SOP Instance UID In File	(0004,1511)
IMAGE	Referenced Transfer Syntax UID In File	(0004,1512)
IMAGE	Referenced File ID	(0004,1500)
IMAGE	Image Number	(0020.0013)

RadWorks is able to read images only if they belong to one of the following SOP classes:

SOP classes for import of DICOM Part 10 images	
Name	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
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
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
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
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

RadWorks is able to read images only if they have one of the following transfer syntaxes:

Transfer syntaxes for import of DICOM Part 10 images	
Name	UID
Explicit VR, Little Endian	1.2.840.10008.1.2.1
Explicit VR, JPEG Lossless, Non-Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70

Importing of studies from a DICOM Part 10 Volume is a standard feature of RadWorks.

3.2.3 Real World Activity: Write images

RadWorks will act as a FSC when writing all or selected patients, studies or series from the local database view to random access archive media (like MODs). RadWorks does not write CD-R's itself, but it is able to prepare the contents for a Single session CD-R in a way that third party software could create a DICOM Part 10 compliant CD-R volume, merely by copying the contents of a designated directory on the PC's harddisk to the CD-R. In addition to this RadWorks provides facilities

- to start this CD-creation process,
- to temporarily lock the database in order to keep the archive stable during the process, and
- to check the contents of the CD after it has been created.

The Implementation Class UID is 1.2.528.1.1001.

RadWorks is able to write images of the following SOP classes:

SOP classes for writing DICOM Part 10 images	
Name	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
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
NM Image Storage	1.2.840.10008.5.1.4.1.1.20
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

RadWorks is able to write images in one of the following transfer syntaxes (configurable):

Transfer syntaxes for writing DICOM Part 10 images	
Name	UID
Explicit VR, Little Endian	1.2.840.10008.1.2.1
Explicit VR, JPEG Lossless, Non-Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70

If images are stored non-compressed in the RadWorks local database, and JPEG Lossless compression is configured for writing DICOM Part 10 studies, the compression is performed prior to saving the images. If this compression is not possible for some reason, the image will be saved non-compressed with Explicit VR and Little Endian transfer syntax.

Importing of studies from a DICOM Part 10 Volume is an optional feature of RadWorks, which requires a separate license.

RadWorks creates DICOMDIR files for the DICOM Part 10 Volumes, containing the following keys:

Keys exported to the DICOMDIR File			
Directory Record Type	Key description	Tag	Type
PATIENT	Referenced SOP Class UID In File	(0004,1510)	1C
PATIENT	Referenced SOP Instance UID In File	(0004,1511)	1C
PATIENT	Referenced Transfer Syntax UID In File	(0004,1512)	1C
PATIENT	Referenced File ID	(0004,1500)	1C
PATIENT	Patient Name	(0010,0010)	2
PATIENT	Patient ID	(0010,0020)	1
PATIENT	Patient Date of Birth	(0010,0030)	3
PATIENT	Sex	(0010,0040)	3
PATIENT	Patient Time of Birth	(0010,0032)	3
PATIENT	Referenced Patient Sequence	(0008,1120)	3
PATIENT	Other Patient IDs	(0010,1000)	3
PATIENT	Other Patient Names	(0010,1001)	3
PATIENT	Ethnic Group	(0010,2160)	3
PATIENT	Comments	(0010,4000)	3
STUDY	Referenced SOP Class UID In File	(0004,1510)	1C
STUDY	Referenced SOP Instance UID In File	(0004,1511)	1C
STUDY	Referenced Transfer Syntax UID In File	(0004,1512)	1C

STUDY	Referenced File ID	(0004,1500)	1C
STUDY	Study Date	(0008,0020)	1
STUDY	Study Time	(0008,0030)	1
STUDY	Study ID	(0020,0010)	1
STUDY	Accession Number	(0008,0050)	2
STUDY	Study UID	(0020,000D)	1C
STUDY	Study Description	(0008,1030)	3
STUDY	Referring Physician	(0008,0090)	3
STUDY	Reading Physician	(0008,1060)	3
STUDY	Referenced Study Sequence	(0008,1110)	3
SERIES	Referenced SOP Class UID In File	(0004,1510)	1C
SERIES	Referenced SOP Instance UID In File	(0004,1511)	1C
SERIES	Referenced Transfer Syntax UID In File	(0004,1512)	1C
SERIES	Referenced File ID	(0004,1500)	1C
SERIES	Modality	(0008,0060)	1
SERIES	Series UID	(0020,000E)	1
SERIES	Series Number	(0020,0011)	1
SERIES	Laterality	(0020,0060)	3
SERIES	Series Date	(0008,0021)	3
SERIES	Series Time	(0008,0031)	3
SERIES	Performing Physician	(0008,1050)	3
SERIES	Protocol	(0018,1030)	3
SERIES	Description	(0008,103E)	3
SERIES	Operator	(0008,1070)	3
SERIES	Body Part	(0018,0015)	3
SERIES	Patient Position	(0018,5100)	3
SERIES	Smallest Pixel	(0028,0108)	3
SERIES	Largest Pixel	(0028,0109)	3
IMAGE	Referenced SOP Class UID In File	(0004,1510)	1C
IMAGE	Referenced SOP Instance UID In File	(0004,1511)	1C
IMAGE	Referenced Transfer Syntax UID In File	(0004,1512)	1C
IMAGE	Referenced File ID	(0004,1500)	1C
IMAGE	Image Type	(0008,0008)	3
IMAGE	Referenced Image Sequence	(0008,1140)	3
IMAGE	Image Number	(0020,0013)	1
IMAGE	Rows	(0028,0010)	3
IMAGE	Columns	(0028,0011)	3

RadWorks is not able to update DICOMDIR files originally created by other vendors.

4 COMMUNICATION PROFILE

4.1 Supported Communication Stacks

The RadWorks 5.0 DICOM services provide DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.2 OSI Stack

Not supported.

4.3 TCP/IP Stack

The RadWorks 5.0 DICOM services use the TCP/IP stack from the Microsoft Windows NT™ operating system upon which it executes.

4.3.1 Physical Media Support

The RadWorks 5.0 DICOM services are not dependent on the physical medium over which the TCP/IP executes.

4.4 Point-to-Point Stack

Not supported.

5 EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS

5.1 Standard Extended/Specialized/Private SOPs

Not applicable.

5.2 Private Transfer Syntaxes

Not applicable.

6 CONFIGURATION

The configuration of the RadWorks 5.0 DICOM services are stored in the Windows NT™ Registry. Only accounts (secured by passwords) with the right level of security will be able to change the configuration. This will typically be done by support personnel.

6.1 AE Title/Presentation Address Mapping

The AE title shared by the RadWorks 5.0 DICOM services is configurable and defaults to AMI_DICOM40. The port on which the Connection Service listens is also configurable and defaults to 3140.

All remote systems that want to communicate with the RadWorks 5.0 Connection Service have to be configured. For systems that want to act as SCUs of the Connection Service SCP SOP classes the following information may be needed:

- The AE title.
- The host name.
- The port number.

For systems with which the RadWorks 5.0 DICOM services want to act as SCU the following information is needed:

- The AE title.
- The host name.
- The port number.

6.2 Configurable Parameters

Not applicable.

7 SUPPORT OF EXTENDED CHARACTER SETS

RadWorks offers no support for extended character sets. Only the default character repertoire of ISO-IR 6 is supported.

8 APPENDIX: RADWORKS PRIVATE IODS

RadWorks 5.0 has the capability of attaching Annotations and Measurements to images as well as Transformation matrices that described how images are viewed (flipped or rotated). In order to preserve this information when these images are sent to DICOM Archives RadWorks uses private attributes to include it in the DICOM images it sends out as an SCU of a storage class.

In order to promote the open nature of DICOM systems, Applicare Medical Imaging B.V. describes here the IODs used to store the information mentioned above.

8.1 Annotations module

Tables 8.1.1 and 8.1.2 define the Attributes relevant to annotations and measurements that are added to an image. Table 8.1.1 contains the definition for backwards compatibility with predecessors of RadWorks 5.0 whereas Table 8.1.2 contains a definition with extended functionality.

RadWorks 5.0 sends out annotations and measurements in both formats so that both previous versions and new versions of the software can display and modify (to a certain extent) annotations and measurements interchangeably.

Table 8.1.1 - Annotations module attributes

Attribute Name	Tag	Type	VR	VM	Attribute Description
Annotations Sequence	(3101,xx10)	3	SQ	1	Annotations Sequence
> Type	(3103,xx10)	1	CS	1	Annotation type. Defined term with value: "MARKER", "TEXT", "CUTLINE", "PROBE", "DISTANCE", "PROFILE", "ANGLE", "COBB", "ROI", "ROI_ELLIPSE", "ROI_FREEHAND", "ROI_POLYGON", "SHUTTER", "SHUTTER_ELLIPSE", "SHUTTER_FREEHAND", "SHUTTER_POLYGON"
> UID	(3103,xx20)	1	UI	1	UID generated at saving time. Updated after any change that is stored
> Color	(3103,xx30)	3	US	3	Byte values for Red, Green, and Blue components
> FontSize	(3103,xx40)	3	FD	1	Relative scaling factor for font size

> LineStyle	(3103,xx50)	3	CS	1	Line style used for display. Defined term with value: "SOLID", "DASH", "DOT", "DASH DOT", "DASH DOT DOT"
> Elements	(3103,xx60)	1	SQ	1	Elements Sequence
>> Position	(3105,xx10)	1	DS	6	Position of point
>> Text	(3105,xx20)	3	LT	1	Text related to this position

The following Private Creator Data Element identifiers are used for the private groups listed above:

Attribute Group	Attribute Description
3101	AMI Annotations_01
3103	AMI Sequence Annotations_01
3105	AMI Sequence AnnotElements_01

Table 8.1.2 – Extended Annotations module attributes

Attribute Name	Tag	Type	VR	VM	Attribute Description
Annotations Sequence	(3101,xx10)	3	SQ	1	Annotations Sequence
> Type	(3103,xx10)	1	CS	1	Annotation type. Defined term with value: "MARKER", "TEXT", "CUTLINE", "PROBE", "DISTANCE", "PROFILE", "ANGLE", "COBB", "ROI", "ROI_ELLIPSE", "ROI_FREEHAND", "ROI_POLYGON", "SHUTTER", "SHUTTER_ELLIPSE", "SHUTTER_FREEHAND", "SHUTTER_POLYGON"
> UID	(3103,xx20)	1	UI	1	UID generated at saving time. Updated after any change that is stored
> Color	(3103,xx30)	3	US	3	Byte values for Red, Green, and Blue components
> FontSize	(3103,xx40)	3	FD	1	Relative scaling factor for font size
> LineStyle	(3103,xx50)	3	CS	1	Line style used for display. Defined term with value: "SOLID", "DASH", "DOT", "DASH DOT", "DASH DOT DOT"
> Elements	(3103,xx60)	1	SQ	1	Elements Sequence
>> Position	(3105,xx10)	1	DS	6	Position of point
>> Text	(3105,xx20)	3	LT	1	Text related to this position

> Label	(3103,xx70)	3	SH	1	Label of the annotation
> Creator	(3103,xx80)	3	PN	1	Person who created the annotation
> Modifiers	(3103,xx90)	3	PN	1-n	Persons who modified the annotation
> CreationDate	(3103,xxA0)	3	DA	1	Date of creation
> CreationTime	(3103,xxB0)	3	TM	1	Time of creation
> ModificationDates	(3103,xxC0)	3	DA	1-n	Dates of modification
> ModificationTimes	(3103,xxD0)	3	TM	1-n	Times of modification
> FrameNo	(3103,xxE0)	3	US	1	Frame number to which annotation applies

The following Private Creator Data Element identifiers are used for the private groups listed above:

Attribute Group	Attribute Description
3101	AMI Annotations_01
3103	AMI Sequence Annotations_02
3105	AMI Sequence AnnotElements_01

8.2 Image Transformation module

Table 8.2 defines the Attributes relevant to the transformation matrix that is used to view an image.

Table 8.2 - Image Transformation module attributes

Attribute Name	Tag	Type	VR	VM	Attribute Description
Transformation matrix	(3107,xx10)	1	DS	6	Transformation matrix
Center offset	(3107,xx20)	3	DS	3	Offset between center of image and viewport
Magnification	(3107,xx30)	3	DS	1	Magnification factor
Magnification Type	(3107,xx40)	3	CS	1	Type of magnification. Defined term: "RELATIVE", "ABSOLUTE"
DisplayArea	(3107,xx50)	3	DS	2	Respectively width and height of actually displayed area in viewport specified in pixels or milli-meters (mm).
CalibrationFactor	(3107,xx60)	3	DS	1	Factor to convert pixel sizes in milli-meters (mm).

The following Private Creator Data Element identifier is used for the private group listed above:

Attribute Group	Attribute Description
3107	AMI ImageTransform_01