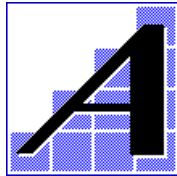


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## DICOM Conformance Statement RadWorks™ 2.1 Product Line

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# 1 INTRODUCTION

## 1.1 Scope and Field of Application

This document is the DICOM Conformance Statement for the RadWorks™ 2.1 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 12 (NEMA PS 3.1-12).

## 1.3 Definitions

See Digital Imaging and Communications in Medicine (DICOM), parts 1 through 12 (NEMA PS 3.1-12).

## 1.4 Symbols and Abbreviations

See Digital Imaging and Communications in Medicine (DICOM), parts 1 through 12 (NEMA PS 3.1-12).

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

The name RadWorks™ used in this document refers to version 2.1.

## 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

## **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**

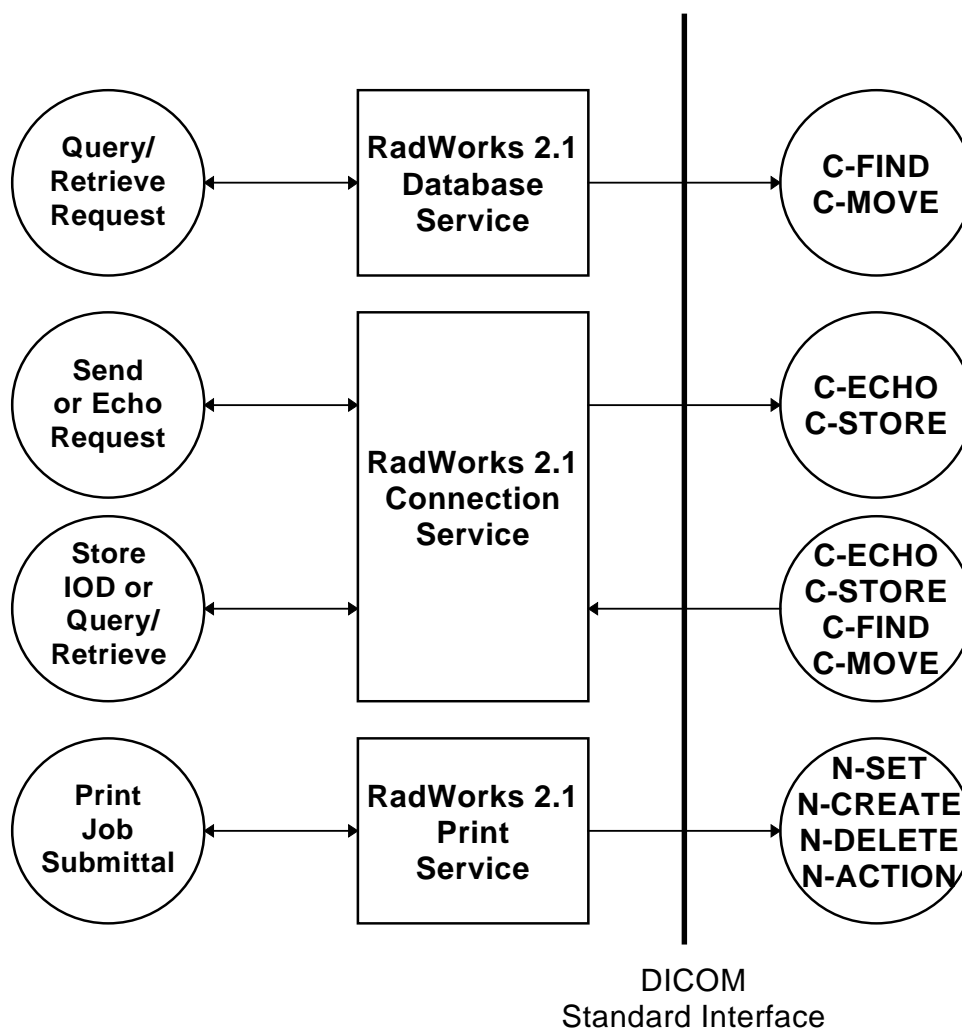
All tradenames mentioned in this document are recognized.

## 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™ 2.1 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™ 2.1 application is active or not.

The RadWorks™ 2.1 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™ 2.1 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™ 2.1 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™ 2.1 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.

## **2.2 Functional Definitions of Application Entities**

The Application Entity of the RadWorks™ 2.1 Connection Service acts as an SCU for the verification and storage SOP classes and as an SCP for verification, storage, query, and retrieve SOP classes.

The Application Entity of the RadWorks™ 2.1 Database Service acts as an SCU for the query and retrieve SOP classes.

The Application Entity of the RadWorks™ 2.1 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™ 2.1 DICOM services AE Specifications

The RadWorks™ 2.1 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
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

The RadWorks™ 2.1 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
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
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

### **3.1.1 Association Establishment Policies**

#### **3.1.1.1 General**

The configuration of the RadWorks™ 2.1 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™ 2.1 Connection Service supports multiple associations both as an SCU and SCP. 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™ 2.1 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™ 2.1 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™ 2.1 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: 1.2.528.1.1001.2.19961101.1

The version name is: AMI\_DICOM\_20

### 3.1.2 Association Initiation Policy

The RadWorks™ 2.1 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™ 2.1 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™ 2.1 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™ 2.1 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™ 2.1 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
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

#### 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 3<sup>rd</sup> 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’.

### 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™ 2.1 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 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:

<b>Supported keys for Study Root Query/Retrieve</b>			
<b>Level</b>	<b>Description</b>	<b>Tag</b>	<b>Type</b>
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

### 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™ 2.1 Database Service performs the C-MOVE operation while the destination of the resulting C-STORE operation is the RadWorks™ 2.1 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™ 2.1 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

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

The RadWorks™ 2.1 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™ 2.1 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™ 2.1 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 <sup>1</sup>
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 <sup>2</sup>
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.

<sup>1</sup> A means the attribute is always sent

<sup>2</sup> 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™ 2.1 Print Service includes the following attributes in the N-SET for the Basic Grayscale Image SOP class:

Attributes for Basic Grayscale Image SOP 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	(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

### 3.1.2.5.3.4 Conformance for SOP Class Basic Color Image Box

The RadWorks™ 2.1 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

### 3.1.2.5.3.5 Conformance for SOP Class Printer

The RadWorks™ 2.1 Print Service shall accept N-EVENT-REPORT and return confirmation accordingly.

The RadWorks™ 2.1 Print Service uses N-GET for the Basic Printer SOP class to get information from the SCP.

**3.1.2.5.4 Optional SOP Classes for Basic Grayscale Print Management Meta**

Currently these are not supported by the RadWorks™ 2.1 Print Service.

**3.1.2.5.5 Optional SOP Classes for Basic Color Print Management Meta**

Currently these are not supported by the RadWorks™ 2.1 Print Service.

### 3.1.3 Association Acceptance Policy

The RadWorks™ 2.1 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.

Association requests from applications whose AE title is unknown may be rejected by the RadWorks™ 2.1 Connection Service depending on how it is configured. The same applies to the case in which the AE title for the RadWorks™ 2.1 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™ 2.1 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™ 2.1 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™ 2.1 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™ 2.1 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
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

#### 3.1.3.2.3 SOP Specific Conformance Statement for SOP Class Storage

The RadWorks™ 2.1 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™ 2.1 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 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.

#### **3.1.3.2.4 Presentation Context Acceptance Criterion**

There are no specific rules for acceptance and prioritization of presentation contexts and the RadWorks™ 2.1 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		
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™ 2.1 Database Service does not support Relational Queries. 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 Sex	(0010,0030)	O
Study	Patient's Birth Date	(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:

<b>Additional attributes for Study Root Query</b>	
<b>Description</b>	<b>Tag</b>
Number of Study Related Series	(0020,1206)
Number of Study Related Series	(0020,1208)

#### **3.1.3.3.4 Presentation Context Acceptance Criterion**

There are no specific rules for acceptance and prioritization of presentation contexts and the RadWorks™ 2.1 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		
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™ 2.1 Connection Service provides standard conformance. In addition to this it offers relational retrieve whereby 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™ 2.1 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.

## **4 COMMUNICATION PROFILE**

### **4.1 Supported Communication Stacks**

The RadWorks™ 2.1 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™ 2.1 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™ 2.1 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™ 2.1 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™ 2.1 DICOM services is configurable and defaults to AMI\_DICOM20. The port on which the Connection Service listens is also configurable and defaults to 3120.

All remote systems that want to communicate with the RadWorks™ 2.1 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™ 2.1 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**

Not supported.

## 8 APPENDIX: RADWORKS™ PRIVATE IODS

RadWorks™ 2.1 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

Table 8.1 defines the Attributes relevant to annotations and measurements that are added to an image.

**Table 8.1 - 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", "ROI", "ROI_ELLIPSE", "ROI_FREEHAND", "ROI_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

## 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