

CODONICS

Virtua[®] *Medical Disc Publisher*

Powered by...

DICOM[®] Connectivity Framework



LAUREL BRIDGE

Providing DICOM Connectivity for the Medical Community

DICOM Conformance Statement

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0. INTRODUCTION

The Codonics Virtua Medical Disc Publisher (MDP) supports storage of medical images and other instances via the DICOM 3.0 protocol, and recording of these same entities to optical disc using the DICOM Connectivity Framework (DCF) software. The DCF software is a modular software component system used for storage, processing, printing or otherwise communicating medical image data, in this case, primarily for the purpose of media exchange.

0.1 Scope and Intended Audience

Conformance of the Virtua MDP to the DICOM 3.0 Standard is discussed in this document. It specifies the Service Classes, Information Objects, and Communication Protocols supported by the implementation. This statement is intended to aid the system integrator in connecting the Codonics Virtua to other components which make use of the DICOM 3.0 Standard for inter-network communication and media exchange. The reader of this document should be familiar with the DICOM 3.0 Standard, the components being interconnected, and other references listed in Section 0.3 and Section 8 of this document.

0.2 Laurel Bridge Software Components

The Laurel Bridge Software DCF Storage Server component is a software function of the Codonics Virtua product. It typically interfaces a modality or other device on a TCP/IP network with the Codonics Virtua via the DCF Storage Server (SCP) software, allowing the Virtua to accept medical images and related data from the modality or other device—a DICOM Storage Client (SCU)—for the purpose of recording to an optical disc(s). This recording is accomplished, in part, via the DCF File Set Creator (FSC) component, which aids in the creation of the DICOM directory file (DICOmdir) on the disc(s).

In addition, the DCF Query/Retrieve Client (SCU) component is used to communicate with a Query/Retrieve Server (SCP) over a TCP/IP network, for the purpose of retrieving studies to the Virtua device, and subsequently, for recording to optical disc(s).

This conformance statement represents the functionality of Codonics' DCF-based system.

Because the DCF is highly configurable, the OEM conformance claim for a particular realization of the DCF should not be construed to completely represent the functions or limitations of the complete DCF software package. *Once customized, the OEM conformance claim only applies to the specific OEM implementation described within, in this case, that of the Codonics Virtua products.*

For further information on the complete DCF package, one should contact Laurel Bridge Software, Inc., 409 White Clay Center Drive, Newark, DE 19711, Telephone: 302-453-0222, <http://www.laurelbridge.com>. Under the terms of the DCF Software License Agreement, this notice is required to be present in all DICOM conformance claims covering the DCF software functionality.

0.3 References

ACR-NEMA DICOM 3.0 Standard, Parts 1 through 14 (PS 3.1–PS 3.14); ©2004.

See Section 8 of this document for additional reference information.

0.4 Important Considerations for the Reader

There is no concept in DICOM of a singular “monolithic” compliance with the Standard. The DICOM Conformance Statement, is a document whose organization and content are mandated by the Standard (PS 3.2-2004, Annex A through F) and which allows users to communicate how they comply with the Standard in their implementations. The presence of specific DICOM functionality in a Conformance Statement is not sufficient to guarantee inter-operability between components. When evaluating network

inter-operability between the DCF and some other DICOM component, the following should be considered:

- The DCF Conformance Claim is an appropriate starting point for ascertaining whether the DCF software can communicate with a particular component on a protocol level.
- The only way to know for certain whether the DCF can inter-operate with other DICOM components is to perform a connectivity test. This test must be completed before a field installation can occur. The OEM normally does such testing in cooperation with the suppliers of other DICOM components.
- The DCF Conformance Claim represents a best effort at documenting the DICOM functionality of commercial versions of the Codonics Virtua, but is not a functional specification of any DCF component or product. Laurel Bridge Software reserves the right to make changes at any time to the functionality of DCF components described herein. Both Laurel Bridge Software and Codonics are committed to following the evolution of the DICOM Standard with either modifications or additions to the Codonics Virtua's DICOM functionality provided by the DCF.

Note: The section numbering in this document is fixed and conforms to the numbering scheme prescribed in DICOM PS 3.2-1999, Annex A and Annex B.

0.5 Revision History

Revision	Date	Author	Description of Changes
0.90	6 February 2006	Rich Edwards	Adapted from the DCF Conformance Statement Template as first pre-release version.
1.0.0	19 July 2006	Rich Edwards	Updated to Rev. B for first release
1.2.0	4 December 2006	Rich Edwards	Updated for Query/Retrieve functionality and internationalization support; corrected supported SOP Class table for StoreSCP
2.0.1	6 August 2007	Glenn Burke	Updated Supported SOP Class table for StoreSCP.
2.1.0	13 September 2007	Glenn Burke	Clarified Dicom Store Behavior in regards to matching currently Stored records. Updated Query/Retrieve Association handling Behavior Updated Query/Retrieve C-FIND Request Identifier Updated Query/Retrieve C-MOVE-SCU Behavior
2.2.0	6 November 2007	Glenn Burke	Added notes about Custom SOP Class support, Structured Report configuration, and multiple simultaneous C-Find and C-Move operations.
2.3.0	24 June 2008	Glenn Burke	Added Compressed Transfer Syntax Support Updated on-Media Transfer Syntax determination. Added Report-FIND-SCU. Added note about Latin 1 in QR Queries.
5.0.0	28 July 2016	Glenn Burke	Added additional supported SOP classes. Updated for Configurable Anonymization and Copy to USB functionality.

0.6 Symbols, Abbreviations and Definitions

Abstract Syntax: A DICOM term which is identical to a DICOM SOP Class; it identifies a set of SOPs which, when taken together, represent a logical grouping. An Abstract Syntax identifies one SOP Class or Meta SOP Class.

ACR: American College of Radiology.

Annotation Box: A DICOM name for annotation text printed on the film or other media.

ANSI: American National Standards Institute.

Application Entity (AE): A DICOM term for defining a particular user at an IP address.

Association: A DICOM term for a communication context which is used by two Application Entities that communicate to one another.

Association Negotiation: The software handshaking that occurs between two DICOM Application Entities to set up an Association.

Attribute: Each DICOM information object has its own set of characteristics or attributes. Each attribute has a name and may have a value (see IOD), depending on its category.

Big Endian: A term for encoding data where the most-significant byte appears first and remaining bytes follow in descending order of significance; sometimes known as "Motorola" format (see Little Endian). (The term is used because of an analogy with the story Gulliver's Travels, in which Jonathan Swift imagined a never-ending fight between the kingdoms of the Big-Endians and the Little-Endians, whose only difference is in where they crack open a hard-boiled egg.)

Calling (Requesting) AE Title: The name used by the receiver in a DICOM Association to indicate which Application Entity it received the data from. It is the AE Title of the AE that is initiating the transfer.

Called (Receiving) AE Title: The name used by the sender in a DICOM Association to indicate which Application Entity it wants to transmit its data to. It is the AE Title of the AE that is receiving the transfer.

Command Element: An encoding of a parameter of a command which conveys this parameter's value.

Command Stream: The result of encoding a set of DICOM Command Elements using the DICOM encoding scheme.

Composite Information Object: A DICOM information object (see IOD) whose attributes contain multiple real world objects.

Conformance: Conformance in the DICOM sense means to be in compliance with the parts of the DICOM Standard.

Conformance Statement: A document whose organization and content are mandated by the DICOM Standard, which allows users to communicate how they have chosen to comply with the Standard in their implementations (see Section 8).

Combined Print Image: a pixel matrix created by superimposing an image and an overlay, the size of which is defined by the smallest rectangle enclosing the superimposed image and overlay.

Data Dictionary: A registry of DICOM Data Elements which assigns a unique tag, a name, value characteristics, and semantics to each Data Element (see the DICOM Data Element Dictionary in DICOM PS 3.6-1999).

Data Element: A unit of information as defined by a single entry in the data dictionary. An encoded Information Object Definition (IOD) Attribute that is composed of, at a minimum, three fields: a

Data Element Tag, a Value Length, and a Value Field. For some specific Transfer Syntaxes, a Data Element also contains a VR Field where the Value Representation of that Data Element is specified explicitly.

Data Set: Exchanged information consisting of a structured set of Attribute values directly or indirectly related to Information Objects. The value of each Attribute in a Data Set is expressed as a Data Element.

Data Stream: The result of encoding a Data Set using the DICOM encoding scheme (Data Element Numbers and representations as specified by the Data Dictionary).

DICOM: Digital Imaging and Communications in Medicine.

DICOM File: A DICOM File is a file with a content formatted according to the requirements of DICOM PS 3.10-1999.

DICOM File Format: The DICOM File Format provides a means to encapsulate in a File the Data Set representing a SOP Instance related to a DICOM Information Object.

DIMSE: DICOM Message Service Element. This represents an abstraction of a common set of things that a user would do to a data element, would likely use over and over, and would appear in various different contexts.

DIMSE-C: DICOM Message Service Element—Composite.

DIMSE-C services: A subset of the DIMSE services which supports operations on Composite SOP Instances related to composite Information Object Definitions with peer DIMSE-service-users.

DIMSE-N: DICOM Message Service Element—Normalized.

DIMSE-N services: A subset of the DIMSE services which supports operations and notifications on Normalized SOP Instances related to Normalized Information Object Definitions with peer DIMSE-service-users.

File Set Creator (FSC): Creates or modifies a DICOM file set (DICOMDIR file) and its corresponding DICOM data files.

File Set Reader (FSR): Reads a DICOM file set (DICOMDIR file) and its corresponding DICOM data files.

File Set Updater (FSU): Creates, modifies or deletes a DICOM file set (DICOMDIR file) and its corresponding DICOM data files.

Film Box: A Normalized Information Object which is the DICOM name for the equivalent of a sheet of physical film.

Film Session: A Normalized Information Object which is the DICOM name for the equivalent of a typical “study” or “series”.

Image Box: A Normalized Information Object which is the DICOM name for the equivalent of a typical “frame” or “image”.

Imager: A term synonymous with printer, meaning a hardcopy output device.

Information Object Class or

Information Object [Definition] (IOD): A software representation of a real object (e.g., CT Image, Study, etc.). An Information Object is generally a list of characteristics (Attributes) which completely describe the object as far as the software is concerned. The formal description of an Information Object generally includes a description of its purpose and the Attributes it possesses.

Information Object Instance or

Instance (of an IOD): A software representation of a specific occurrence of a real object or entity, including values for the Attributes of the Information Object Class to which the entity belongs..

IP (Internet Protocol) Address: A unique identifier for the network interface of a computer on a TCP/IP network. An IP address is typically comprised of four octets, separated by dots (.), with each octet capable of representing a number from 0 to 255. For example: 192.168.10.1

Little Endian: A term for encoding data where the least-significant byte appears first and remaining bytes follow in ascending order of significance; sometimes known as "Intel" format (see Big Endian).

LUT: Lookup Table.

Message: A data unit of the Message Exchange Protocol exchanged between two cooperating DICOM Application Entities. A Message is composed of a Command Stream followed by an optional Data Stream.

Meta SOP Class: A collection or group of related SOP Classes identified by a single Abstract Syntax UID, which, when taken together, represent a logical grouping and which are used together to provide a high-level functionality, e.g., for the purpose of negotiating the use of the set with a single item.

Module: A logical group of the valid attributes of DICOM information objects.

NEMA: National Electrical Manufacturers Association.

Normalized Information Object: A DICOM Information Object (see IOD) whose attributes contain a single real world object. *Note: the differentiation of normalized versus composite information object definitions is not strongly enforced in DICOM 3.0.*

Presentation Context: A Presentation Context consists of an Abstract Syntax plus a list of acceptable Transfer Syntaxes. The Presentation Context defines both what data will be sent (Abstract Syntax) and how the data are encoded to be sent (Transfer Syntax).

Print Job SOP Class: A DICOM representation of a Print Job which consists of a set of IODs which describe a Print Job and a set of services which can be performed on those IODs.

Print Management Service Class or

Print Service Class (PSC): A DICOM term for a logical grouping of Service Classes which all involve printing, also referred to as Print Management Service Class (an example of a Meta SOP Class).

Printer SOP Class: A DICOM representation of a Printer which consists of a set of IODs which describe a Printer and a set of services which can be performed on those IODs.

Protocol Data Unit (PDU): A data object which is exchanged by software protocol devices (entities, machines) within a given layer of the protocol stack.

Real-World Activity: Something which exists in the real world and which pertains to specific area of information processing within the area of interest of the DICOM Standard. A Real-World Activity may be represented by one or more SOP Classes.

Real-World Object: Something which exists in the real world and upon which operations may be performed which are within the area of interest of the DICOM Standard. A Real-World Object may be represented through a SOP Instance.

Service Class: A group of operations that a user might want to perform on particular Information Objects. Formally, a structured description of a service which is supported by cooperating DICOM Application Entities using specific DICOM Commands acting on a specific class of Information Object.

Service Class Provider (SCP, Provider, Server): A device which provides the services of a DICOM Service Class or Classes which are utilized by another device (SCU) and which performs operations and invokes notifications on a specific Association.

Service Class User (SCU, User, Client): A device which utilizes the DICOM Service Class or Classes which are provided by another device (SCP) and which invokes operations and performs notifications on a specific Association.

Service-Object Pair (SOP): The combination of a DICOM Information Object and the Service Class which operates upon that object.

SOP Class: A DICOM term which is identical to an Abstract Syntax; it identifies a set of SOPs which, when taken together, represent a logical grouping (see Meta SOP Class).

Storage Service Class (SSC): A DICOM term for a logical grouping of Service Classes which all involve storage of images and other DICOM instances.

Tag: A unique identifier for an element of information composed of an ordered pair of numbers (a Group Number followed by an Element Number), which is used to identify Attributes and corresponding Data Elements.

TCP/IP: Transmission Control Protocol / Internet Protocol.

Transfer Syntax: A part of the DICOM Presentation Context which specifies a set of encoding rules that allow Application Entities to unambiguously negotiate the encoding techniques (e.g., Data Element structure, byte ordering, compression) they are able to support, thereby allowing these Application Entities to communicate.

Unique Identifier (UID): A globally unique identifier (based on the structure defined by ISO 8824 for OSI Object Identifiers) which is assigned to every DICOM information object as specified by the DICOM Standard (see Section 2.1.1.4) and which guarantees global unique identification for objects across multiple countries, sites, vendors and equipment.

Value Representation (VR): A VR is the defined format of a particular data element.

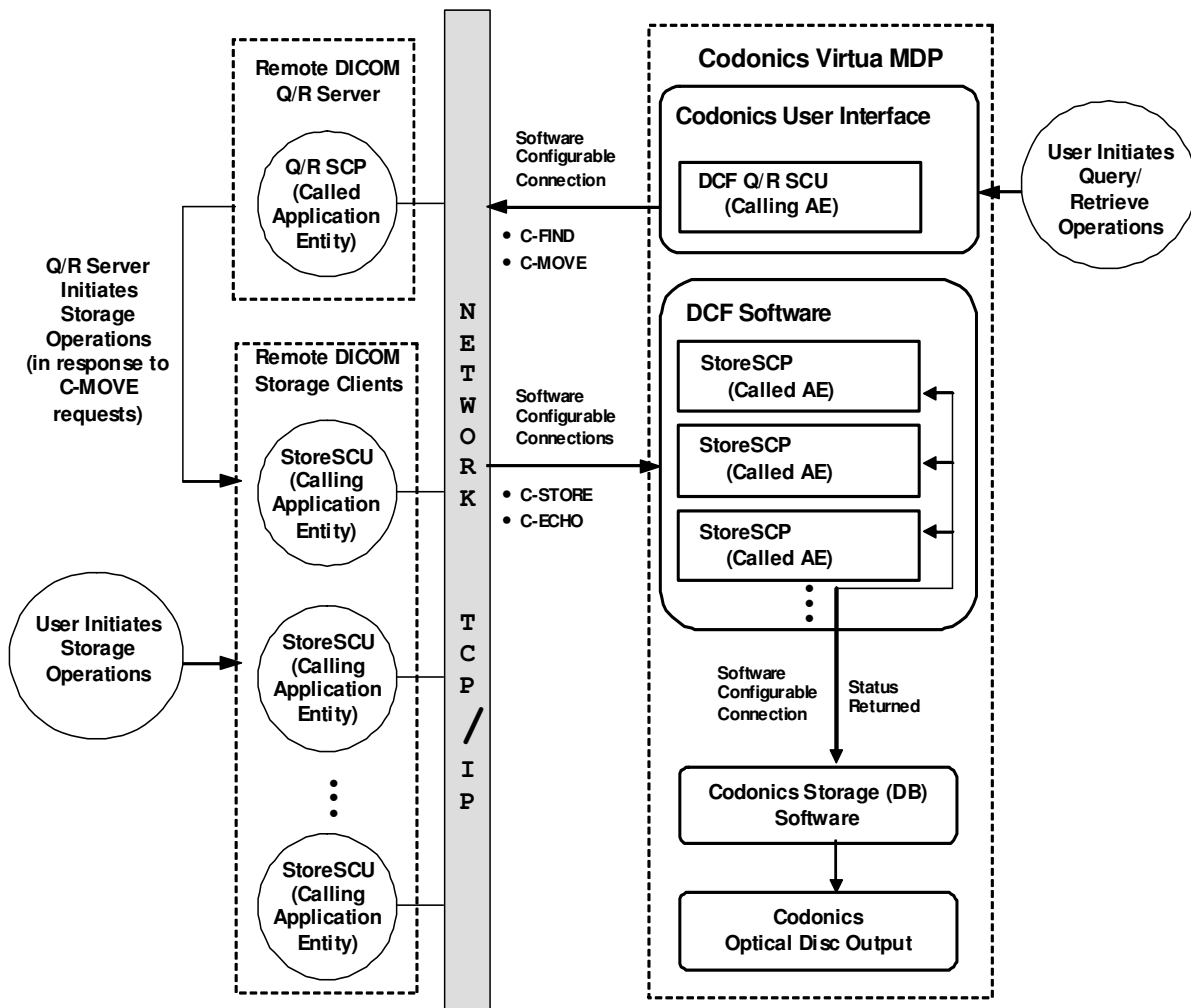
1. IMPLEMENTATION MODELS

The DCF Storage Server is implemented as independent, functional, and configurable components. The DCF Storage Server supports multiple Application Entities. Multiple DICOM Storage Clients may concurrently initiate and/or maintain associations to the DCF Storage Server. The number of associations to the DCF Storage Server that can be simultaneously active is limited to 24.

The DCF Query/Retrieve Client (Q/R SCU) is implemented as independent, functional, and configurable components. The Codonics User Interface (UI) is web-based, and allows multiple users to simultaneously execute query and retrieve operations via the Q/R SCU. The number of associations initiated at one time by the Q/R SCU is limited to the maximum number of results returned in a query, which defaults to 100.

1.1 Application Data Flow Diagram—Virtua MDP

The implementation model of the Virtua MDP is depicted in the following figure:



1.2 Functional Definitions of Application Entities (AEs)

The DCF Storage Server creates a StoreSCP (Application Entity or AE) to handle each requested association (unless the configurable maximum associations is exceeded). Each StoreSCP can be configured independently, based on a flexible policy that takes both Called and Calling AE Titles into account.

Once the configuration for the StoreSCP is selected and the StoreSCP is created, the StoreSCP continues with the association negotiation, independent of the DCF Storage Server. The StoreSCP's configuration specifies which SOP classes are to be supported, which transfer syntaxes are to be supported, as well as many other parameters, such as what type of validation is to be performed on incoming messages.

If the StoreSCP accepts the association, then it will service requests from the client SCU until the association is ended. As the StoreSCPs receive storage requests from their corresponding SCUs they commit the stored entities to an internal database, grouping them by Patient, Study, Series and Instance identities. Once the SCU has completed its set of storage requests, it can close the association, or keep the association open for subsequent storage requests.

The association ends when either the SCU releases the association or there is an unrecoverable error. Optionally, if the SCU does not send a request for a period in excess of the StoreSCP configurable timeout, then the StoreSCP will terminate the association.

1.3 Sequencing of Real World Activities—DCF Storage Server

The sequence of events for a typical transaction are listed below:

- Storage Client (modality, workstation, or other device) requests association with Storage Server.
- Storage Client stores DICOM Instances to Storage Server.
- Storage Client terminates the association.
- Storage Server releases any resources allocated during association.

1.4 Sequencing of Real World Activities—DCF Query/Retrieve Client

The sequence of events for a typical query/retrieve transaction are listed below:

- User initiates a query operation from the user interface of the Virtua device.
- Q/R Client requests association with Q/R Server.
- Q/R Client queries for matching studies from Q/R Server.
- Q/R Server returns matching studies to Q/R Client.
- User interface is updated with list of matching studies.
- Q/R Client terminates the association.
- User selects one or more matching studies, and initiates retrieve operation from the user interface of the Virtua device. This is referred to as a retrieve session.
- For each selected study in this retrieve session:
 - Q/R Client requests association with Q/R Server.
 - Q/R Client requests that study be stored (moved) to the Storage Server on the Virtua device.
 - Q/R Client can be configured to either:
 - Leave the association open for the next study of the session to be retrieved on, or terminates the association if no more studies are left in this session. (default configuration)
 - Terminates the association.

2. AE SPECIFICATIONS

The DCF Storage Server supports multiple Application Entities or AEs. Each AE in this case is an instance of StoreSCP using a particular configuration.

2.1 DCF StoreSCP AE Specification

The DCF Storage Server provides standard conformance to the following DICOM 3.0 SOP Classes as an SCP. The SOP classes that are supported by a particular installation are configurable, as described in Section 5. (For example, for a given AE Title, a configuration might be selected that does not support the various RT SOP classes.)

The StoreSCP Profile allows configuration for Storage support of Custom SOP Classes. Any SOP Class UIDs that are added to this profile will be accepted for Storage by the Virtua MDP.

Note: The Basic, Enhanced, and Comprehensive Structured Report SOP Classes are always accepted, but will only be Stored if the proper Report Profile option has been enabled.

Table 2.1.1 – StoreSCP Supported SOP Classes

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
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2
Enhanced MR Color Image Storage	1.2.840.10008.5.1.4.1.1.4.3
Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Enhanced US Volume Storage	1.2.840.10008.5.1.4.1.1.6.2
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Multi-frame Single Bit Secondary Capture	1.2.840.10008.5.1.4.1.1.7.1

Image Storage	
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9
ECG 12-Lead Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1
ECG General Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
ECG Ambulatory Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1
Basic Void Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
General Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.2
Arterial Pulse Waveform Storage	1.2.840.10008.5.1.4.1.1.9.5.1
Respiratory Waveform Storage	1.2.840.10008.5.1.4.1.1.9.6.1
Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10
Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Color Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.2
Pseudo-Color Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.3
Blending Softcopy Presentation State Storage SOP Class	1.2.840.10008.5.1.4.1.1.11.4
XA/XRF Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.5
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1
X-Ray Angiographic Bi-Plane Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.12.3
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3
Intravascular Optical Coherence Tomography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.14.1
Intravascular Optical Coherence Tomography Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.14.2
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1
Spatial Fiducials Storage	1.2.840.10008.5.1.4.1.1.66.2
Deformable Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.3
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4

Surface Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.5
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2
Stereometric Relationship Storage	1.2.840.10008.5.1.4.1.1.77.1.5.3
VL Whole Slide Microscopy Image Storage	1.2.840.10008.5.1.4.1.1.77.1.6
Lensometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.1
Autorefractometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.2
Keratometry Measurements Storage	1.2.840.10008.5.1.4.1.1.78.3
Subjective Refraction Measurements Storage	1.2.840.10008.5.1.4.1.1.78.4
Visual Acuity Measurements Storage	1.2.840.10008.5.1.4.1.1.78.5
Spectacle Prescription Reports Storage	1.2.840.10008.5.1.4.1.1.78.6
Ophthalmic Axial Measurements Storage	1.2.840.10008.5.1.4.1.1.78.7
Intraocular Lens Calculations Storage	1.2.840.10008.5.1.4.1.1.78.8
Macular Grid Thickness and Volume Report Storage	1.2.840.10008.5.1.4.1.1.79.1
Ophthalmic Visual Field Static Perimetry Measurements Storage	1.2.840.10008.5.1.4.1.1.80.1
Text SR storage (Retired)	1.2.840.10008.5.1.4.1.1.88.1
Audio SR storage (Retired)	1.2.840.10008.5.1.4.1.1.88.2
Detail SR storage (Retired)	1.2.840.10008.5.1.4.1.1.88.3
Comprehensive SR storage (Retired)	1.2.840.10008.5.1.4.1.1.88.4
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11
Enhanced SR Storage	1.2.840.10008.5.1.4.1.1.88.22
Comprehensive SR Storage	1.2.840.10008.5.1.4.1.1.88.33
Procedure Log Storage	1.2.840.10008.5.1.4.1.1.88.40
Mammography CAD SR Storage	1.2.840.10008.5.1.4.1.1.88.50
Key Object Selection Document Storage	1.2.840.10008.5.1.4.1.1.88.59
Chest CAD SR Storage	1.2.840.10008.5.1.4.1.1.88.65
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67
Colon CAD SR Storage	1.2.840.10008.5.1.4.1.1.88.69
Implantation Plan SR Storage	1.2.840.10008.5.1.4.1.1.88.70
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129
Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.130
Basic Structured Display Storage	1.2.840.10008.5.1.4.1.1.131

RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
DICOS CT Image Storage	1.2.840.10008.5.1.4.1.1.501.1
DICOS Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.501.2.1
DICOS Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.501.2.2
DICOS Threat Detection Report Storage	1.2.840.10008.5.1.4.1.1.501.3
Eddy Current Image Storage	1.2.840.10008.5.1.4.1.1.601.1
Eddy Current Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.601.2
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.7
Color Palette Storage	1.2.840.10008.5.1.4.39.1
Generic Implant Template Storage	1.2.840.10008.5.1.4.43.1
Implant Assembly Template Storage	1.2.840.10008.5.1.4.44.1
Implant Template Group Storage	1.2.840.10008.5.1.4.45.1

2.1.1 Association Establishment Policies

2.1.1.1 General

The DCF Storage Server (SCP) listens to the transport (TCP) port which has been configured and accepts associations from DICOM Storage Clients (SCUs). If the maximum number of unique IP addresses is exceeded then the association is refused and the A-ASSOCIATE-RJ PDU will specify result = rejected-transient, reason = temporary-congestion. An accepted association remains connected until the client disconnects by sending either an A-RELEASE-RQ or A-ABORT PDU, or there is an unrecoverable error detected by the Storage Server. If the association remains idle for a configurable period of time, the association will be broken by the DCF Storage Server. In the event of an idle timeout, the Storage Server will close the transport connection, but will not send any notification (e.g., P-ABORT PDU).

The maximum PDU size which can be received by the DCF Storage Server is configurable, with a default value of 16,384 (16K) bytes (see Table 5.3.3).

2.1.1.2 Number of Concurrent Associations

The DCF Storage Server can support multiple concurrent associations from multiple unique hosts. The total number of concurrent associations is limited to 24. Once this limit is reached, association requests are rejected until the number of active associations drops below this limit.

2.1.1.3 Asynchronous Nature

The DCF Storage Server does not support asynchronous operations.

2.1.1.4 Implementation Identifying Information

The implementation UID for the DCF Storage Server is returned in the A-ASSOCIATE-AC PDU. The value for that UID will be "1.2.840.114089.1.1.0.X.Y.Z", where X.Y.Z is the version number (for example, 1.5.0). The implementation version name is also returned and has the form "DCF X.Y.Zz" where X.Y.Zz is the full version identifier (for example, 1.4.0b for beta version 1.4.0).

All internally generated UID's will be prefixed 1.2.840.xxxxxx, where the identification code "xxxxxx"="114089.1.1" is Laurel Bridge Software's ANSI registered organization identification code for the DCF software. See DICOM PS 3.5-1999, Section 9 for further information.

2.1.1.5 Called Titles

The DCF Storage Server operates in a "promiscuous" mode, accepting any valid called title (as defined by the AE VR type). If the called title matches the name of a Codonics Job Profile, then the parameters from that Job Profile are used to determine the manner in which stored items within that association are handled. See Section 5.4 for more details on this aspect of system configuration.

If no special behavior is required through the use of the called title, then it is customary to use the title "STORE_SCP", although this is arbitrary, and holds no special meaning to the Storage Server.

2.1.2 Association Initiation by Real-World Activity

The DCF Storage Server does not initiate associations.

2.1.3 Association Acceptance Policy

2.1.3.1 Real-World Activity—Verification

2.1.3.1.1 Associated Real World Activity—Verification

The Verification Service Class is a feature used for network diagnostic purposes to verify application level communication between peer DICOM AEs. The DCF Storage Server responds to Verification requests to provide an SCU with the ability to determine if the DCF Storage Server is receiving DICOM requests. This verification is accomplished on an established Association using the C-ECHO DIMSE-C service.

An example of a typical real world activity to initiate a Verification association is a service person invoking a DICOM-Echo client on a remote host, specifying the transport address and AE Title of an instance of the DCF Storage Server as the target.

2.1.3.1.2 Presentation Context Table—Verification

Table 2.1.3.1.2.1 – Supported Verification 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
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None

2.1.3.1.3 SOP Specific Conformance—Verification

The DCF Storage Server provides standard conformance to the DICOM Verification Service Class.

The Verification SOP Class consists of the C-ECHO DIMSE-C service. No associated Information Object Definition is defined. No Specialized SOP Classes and/or Meta SOP Classes are defined for the Verification SOP Class.

2.1.3.1.4 Presentation Context Acceptance Criterion

The Verification SOP class can be requested on its own, or in combination with other supported SOP classes.

2.1.3.1.5 Transfer Syntax Selection Policies

The transfer syntax for each DICOM presentation context is negotiated independently. The DCF Storage Server can be configured to support any or all of the transfer syntaxes listed in Table 2.1.3.1.2.1. The order of preference for selecting a transfer syntax is also configurable. This configuration may vary between associations; however, for a given association, it is shared between all SOP classes or presentation contexts.

2.1.3.2 Real-World Activity—Storage

2.1.3.2.1 Associated Real World Activity—Storage

As instances are received they are copied to the local file system and a record inserted into the local database. If the received instance is a duplicate of a previously received instance, the old file and database record will be overwritten with the new one.

2.1.3.2.2 Presentation Context Table—Storage

The DCF Storage Server will accept association establishment, using one of the presentation contexts listed below. Support for JPEG Compressed syntaxes is configurable in Virtua Job Profiles. See User's Manual for configuration options.

Table 2.1.3.2.2.1 - Supported Storage Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
See Table 2.1.1	See Table 2.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
		JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50	SCP	None
		JPEG Extended (Process 2 & 4)	1.2.840.10008.1.2.4.51	SCP	None
		JPEG Lossless (Process 14)	1.2.840.10008.1.2.4.57	SCP	None
		JPEG Lossless First-Order Prediction	1.2.840.10008.1.2.4.70	SCP	None

	JPEG 2000 Lossless	1.2.840.10008.1.2.4.90	SCP	None
	JPEG 2000	1.2.840.10008.1.2.4.91	SCP	None

2.1.3.2.3 SOP Specific Conformance—Storage

The DCF Storage Server incorporates a configurable validation service. It utilizes reasonable default values for any attribute which is not valid for a given destination and will, in general, always try to complete a storage job rather than failing it. Section 5 lists attributes which are Virtua dependent and configurable.

The Virtua Storage Server organizes received SOP Instances into its internal database based on the Patient, Study, Series, and Instance level header information in the received SOP Instances. Virtua organizes SOP Instances into Study entities based on the Study Instance UID included in the SOP Instances. Virtua imposes the following restraint on Stored SOP Instances in order to prevent unintended combination of data for different Patients: received SOP Instances with the same Study UID must contain the exact same Dicom header information for 3 of the following 4 fields: Patient Name, Patient ID, Patient Birth Date, and Patient Sex. Which 3 fields of the 4 that are matched on is configurable. If a SOP Instance for a Study UID is received that has header information in any of the 3 configured fields that is different than header information in an existing (already Stored) Study, the SOP Instance will be rejected and the current Association will be aborted by the Virtua.

For every operation requested on a SOP class of the Storage Service Classes, a status code is returned. They are grouped into success, warning or failure categories (see DICOM PS 3.7-1999):

Success - Indicates that the SCP performed the requested operation as requested.

Warning - Indicates that the SCP has received the request and will process it. However, immediate processing of the request, or processing in the way specified by the SCU, may not be possible. The SCP expects to be able to complete the request without further action by the SCU across the DICOM interface. The exact behavior of the SCP is described within this Conformance Statement.

Failure - Indicates that the SCP is unable to perform the request. The request will not be processed unless it is repeated successfully by the SCU at a later time. The exact behavior of the SCP is described in this Conformance Statement.

Certain errors may be reported for any DIMSE message sent to any SOP Class, in some cases, failures or warnings will only be generated if the Storage Server has message validation enabled. Status codes that are unique to a particular DIMSE message for particular SOP classes are described for each SOP Class in its sub-section entitled DIMSE Specific Behavior. Statuses include:

<u>Status</u>	<u>Code</u>	<u>Description</u>
INVALID_ATTRIBUTE	0106H	Failure status—Indicates an attribute has been received that is not valid for this message. Processing of the message will fail.
UNRECOGNIZED_ATTRIBUTE	0107H	Warning status—Indicates an attribute has been received that is not valid for this message. The attribute will be discarded and processing of the message will continue
DUPLICATE_INSTANCE	0111H	Failure status—The SCU has specified an instance UID for an object that already exists (N-CREATE only). Processing of the message will fail
NO_SUCH_INSTANCE	0112H	Failure status—No object with this instance UID exists. Processing of the message will fail
ATTRIBUTE_OUT_OF_RANGE	0116H	Warning status—An attribute has been received

<u>Status</u>	<u>Code</u>	<u>Description</u>
INVALID_OBJECT_INSTANCE	0117H	whose value is not within the legal set of possible values (see tables below). If a default has been configured, it will be substituted for the offending value. The validation component can be configured to treat a missing attribute in this manner (i.e. warn and apply default) Failure status—The SOP instance UID field in the message is invalid. Processing of the message will fail
NO_SUCH_CLASS	0118H	Failure status—The SOP class UID field in the message is invalid. Processing of the message will fail
MISSING_ATTRIBUTE	0120H	Failure status—A required attribute was not included in the message data set. Processing of the message will fail.
UNRECOGNIZED_OP	0211H	Failure status—The received DIMSE message is not valid for the specified presentation context (see SOP class specific interpretations for this error code below). Processing of the message will fail

2.2 DCF Query Client (FIND-SCU) AE Specification

The DCF FIND-SCU provides Standard Conformance to the following SOP Class. The Virtua MDP supports multiple simultaneous C-Find operations to different C-Find SCPs. Each operation is handled in its own thread by a unique C-Find SCU.

Table 2.2.1 – FIND-SCU Supported SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No

2.2.1 Association Establishment Policies

2.2.1.1 General

The DCF FIND-SCU initiates but never accepts associations.

The maximum PDU size which can be received by the DCF FIND-SCU is configurable, with a default value of 16,384 (16K) bytes (see Table 5.3.3).

2.2.1.2 Number of Associations

Each FIND-SCU instance initiates a single association at a time.

2.2.1.3 Asynchronous Nature

FIND-SCU will only allow a single outstanding operation on an Association. Therefore, FIND-SCU will not perform asynchronous operations window negotiation.

2.2.1.4 Implementation Identifying Information

The implementation UID for the DCF FIND-SCU will be “1.2.840.114089.1.1.0.X.Y.Z”, where X.Y.Z is the version number (for example, 1.5.0). The implementation version name is also included and has the form “DCF X.Y.Zz” where X.Y.Zz is the full version identifier (for example, 1.4.0b for beta version 1.4.0).

2.2.2 Association Initiation by Real-World Activity

The DCF FIND-SCU attempts to initiate a new association when the user performs the query action from the user interface.

2.2.3 Real-World Activity – Query Remote AE

2.2.3.1 Description and Sequencing of Activities

A single attempt will be made to query the remote AE. If the query fails, for whatever reason, no retry will be performed.

2.2.3.2 Presentation Context Table – FIND-SCU

Table 2.2.3.2.1 – Supported FIND-SCU Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Study Root Query/Retrieve Information 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
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

FIND-SCU will propose multiple Presentation Contexts, one for each of the supported Transfer Syntaxes, and an additional Presentation Context with all of the supported Transfer Syntaxes, in order to determine which Transfer Syntaxes the remote SCP supports, and which it prefers.

2.2.3.3 Extended Negotiation

No extended negotiation is performed.

In particular, relational queries are not supported.

2.2.3.4 SOP Specific Conformance – FIND-SCU

2.2.3.4.1 SOP Specific Conformance to C-FIND SOP Classes

FIND-SCU provides standard conformance to the supported C-FIND SOP Classes.

Only a single information model, Study Root, is supported.

All queries are initiated at the highest level of the information model (the STUDY level).

No CANCEL requests are ever issued.

Unexpected attributes returned in a C-FIND response (those not requested) are ignored. Requested return attributes not returned by the SCP are ignored. Non-matching responses returned by the SCP due to unsupported (hopefully optional) matching keys are not filtered locally by the FIND-SCU and thus will still be presented to the user. No attempt is made to filter out duplicate responses.

Specific Character Set is only specified by the FIND-SCU if Latin 1 (IR 100) is specified in the QR configuration. If present in the response, Specific Character Set will be used to identify character sets other than the default character set for display of strings on the user interface.

Table 2.2.3.4.1.1 - Study Root Request Identifier for FIND-SCU

Name	Tag	Types of Matching
STUDY Level		
Patient's ID	(0010,0020)	S,*,U
Patient's Name	(0010,0010)	S,*,U

Patient's Birth Date	(0010,0030)	S,R
Study Date	(0008,0020)	S,R
Accession Number	(0008,0050)	S,* ,U

Types of Matching supported by the C-FIND SCU:

An 'S' indicates the identifier attribute uses Single Value Matching, an 'R' indicates Range Matching, an '*' indicates wildcard matching, a 'U' indicates Universal Matching, and an 'L' indicates that UID lists are sent. "NONE" indicates that no matching is supported, but that values for this Element are requested to be returned (i.e. universal matching), and "UNIQUE" indicates that this is the Unique Key for that query level, in which case Universal Matching or Single Value Matching is used depending on the query level.

2.2.3.4.2 Presentation Context Acceptance Criterion

FIND-SCU does not accept associations.

2.2.3.4.3 Transfer Syntax Selection Policies

FIND-SCU prefers explicit Transfer Syntaxes. If offered a choice of Transfer Syntaxes in the accepted Presentation Contexts, it will apply the following priority to the choice of Presentation Context to use for the C-FIND operation:

1. first encountered explicit Transfer Syntax,
2. default Transfer Syntax.

2.2.3.4.4 Response Status Behavior

FIND-SCU will behave as described in Table 2.2.3.4.4.1 in response to the status returned in the C-FIND response command message(s).

Table 2.2.3.4.4.1 Response Status Behavior for FIND-SCU and Query Remote AE

Service Status	Further Meaning	Status Codes	Behavior
Refused	Out of Resources	A700	Current query is terminated
Error	Identifier does not match SOP Class	A900	Current query is terminated
	Unable to process	Cxxx	Current query is terminated
Cancel	Matching terminated due to Cancel request	FE00	Ignored (should never occur, since cancels never issued)
Success	Matching is complete - No final Identifier is supplied	0000	Current query is terminated
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Current query continues

	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier	FF01	Current query continues
--	--	------	-------------------------

2.2.3.4.5 Association Acceptance Policy

FIND-SCU does not accept associations.

2.3 DCF Retrieve Client (MOVE-SCU) AE Specification

The DCF MOVE-SCU provides Standard Conformance to the following SOP Class. The Virtua MDP supports multiple simultaneous C-Move operations to the same and to different C-Move SCPs. Each operation is handled in its own thread by a unique C-Move SCU.

Table 2.3.1 – MOVE-SCU Supported SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No

2.3.1 Association Establishment Policies

2.3.1.1 General

The DCF MOVE-SCU initiates but never accepts associations.

The maximum PDU size which can be received by the DCF MOVE-SCU is configurable, with a default value of 16,384 (16K) bytes (see Table 5.3.3).

2.3.1.2 Number of Associations

Table 2.3.1.2.1 – MOVE-SCU Maximum Associations

Maximum number of simultaneous associations	100
---	-----

2.3.1.3 Asynchronous Nature

MOVE-SCU will only allow a single outstanding operation on an Association. Therefore, MOVE-SCU will not perform asynchronous operations window negotiation.

2.3.1.4 Implementation Identifying Information

The implementation UID for the DCF MOVE-SCU will be “1.2.840.114089.1.1.0.X.Y.Z”, where X.Y.Z is the version number (for example, 1.5.0). The implementation version name is also included and has the form “DCF X.Y.Zz” where X.Y.Zz is the full version identifier (for example, 1.4.0b for beta version 1.4.0).

2.3.2 Association Initiation by Real-World Activity

MOVE-SCU attempts to initiate a new association when the user performs the retrieve action from the user interface.

2.3.3 Real-World Activity – Retrieve From Remote AE

2.3.3.1 Description and Sequencing of Activities

For the entity (study) selected from the user interface to be retrieved, a single attempt will be made to retrieve it from the selected remote AE. If the retrieve fails, for whatever reason, no retry will be performed.

2.3.3.2 Presentation Context Table – MOVE-SCU

Table 2.3.3.2.1 – Supported MOVE-SCU Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Study Root Query/Retrieve Information 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
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

MOVE-SCU will propose multiple Presentation Contexts, one for each of the supported Transfer Syntaxes, and an additional Presentation Context with all of the supported Transfer Syntaxes, in order to determine which Transfer Syntaxes the remote SCP supports, and which it prefers.

2.3.3.3 Extended Negotiation

No extended negotiation is performed.

In particular, relational retrievals are not supported.

2.3.3.4 SOP Specific Conformance – MOVE-SCU

2.3.3.4.1 SOP Specific Conformance to C-MOVE SOP Classes

MOVE-SCU provides standard conformance to the supported C-MOVE SOP Classes.

Only a single information model, Study Root, is supported.

A retrieval will be performed at the STUDY level only.

No CANCEL requests are ever issued.

The retrieval is performed from the AE that was specified in the Retrieve AE attribute returned from the query performed by FIND-SCU. The instances are retrieved to the current application's local database by

specifying the destination as the AE Title of the STORE-SCP AE of the local application. This implies that the remote C-MOVE SCP must be preconfigured to determine the presentation address corresponding to the STORE-SCP AE. The STORE-SCP AE will accept storage requests addressed to it from anywhere, so no pre-configuration of the local application to accept from the remote AE is necessary (except in so far as it was necessary to configure FIND-SCU).

Table 2.3.3.4.1.1 - Study Root Request Identifier for MOVE-SCU

Name	Tag	Unique, Matching or Return Key
Study Instance UID	(0020,000D)	U

2.3.3.4.2 Presentation Context Acceptance Criterion

MOVE-SCU does not accept associations.

2.3.3.4.3 Transfer Syntax Selection Policies

MOVE-SCU prefers explicit Transfer Syntaxes. If offered a choice of Transfer Syntaxes in the accepted Presentation Contexts, it will apply the following priority to the choice of Presentation Context to use for the C-MOVE operation:

1. first encountered explicit Transfer Syntax,
2. default Transfer Syntax

2.3.3.4.4 Response Status Behavior

MOVE-SCU will behave as described in the Table below in response to the status returned in the C-MOVE response command message(s).

Table 2.3.3.4.4.1 Response Status Behavior for MOVE-SCU and Retrieve Remote AE

Service Status	Further Meaning	Status Codes	Related Fields	Behavior
Refused	Out of Resources - Unable to calculate number of matches	A701	(0000,0902)	Retrieval is terminated
	Out of Resources - Unable to perform sub-operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)	Retrieval is terminated
	Move Destination unknown	A801	(0000,0902)	Retrieval is terminated
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)	Retrieval is terminated
	Unable to process	Cxxx	(0000,0901) (0000,0902)	Retrieval is terminated
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)	Retrieval is terminated (should never occur, since cancels never issued)
Warning	Sub-operations	B000	(0000,1020)	Retrieval is terminated

	Complete - One or more Failures		(0000,1022) (0000,1023)	
Success	Sub-operations Complete - No Failures	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)	Retrieval is terminated
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)	Retrieval continues

2.3.3.4.5 Sub-operation dependent behavior

Since the C-MOVE operation is dependent on completion of C-STORE sub-operations that are occurring on a separate association, the question of failure of operations on the other association(s) must be considered.

MOVE-SCU completely ignores whatever activities are taking place in relation to the STORAGE-SCP AE that is receiving the retrieved instances. MOVE-SCU monitors the C-MOVE response DIMSE Messages that are sent back to it by the MOVE-SCP. If the MOVE-SCP reports that it encountered an error while processing the C-MOVE request, MOVE-SCU will abort the association, and it will flag the Study that is being Stored to the Virtua STORE-SCP as having a transfer error. This error will be visible on the Virtua's User Interface. MOVE-SCU can be configured to treat Warnings reported by the MOVE-SCP in the same manner. There is no attempt by MOVE-SCU to confirm that instances have actually been successfully received or locally stored.

Whether or not completely or partially successful retrievals are made available in the local database to the user is purely dependent on the success or failure of the C-STORE sub-operations, not on any explicit action by MOVE-SCU.

Whether or not the remote AE attempts to retry any failed C-STORE sub-operations is beyond the control of MOVE-SCU.

If the association on which the C-MOVE was issued is aborted for any reason, whether or not the C-STORE sub-operations continue is dependent on the remote AE; the local STORAGE-SCP will continue to accept associations and storage operations regardless.

2.3.3.4.6 Association Acceptance Policy

MOVE-SCU does not accept associations.

2.3 Report Query Client (FIND-SCU) AE Specification

The Report FIND-SCU provides Standard Conformance to the following Private SOP Class.

Table 2.3.1 – FIND-SCU Supported SOP Classes

SOP Class Name	SOP Class UID	SCU	SCP
Mitra Report Management – FIND	1.2.840.113532.3500.8	Yes	No

2.3.1 Association Establishment Policies

2.3.1.1 General

The Report FIND-SCU initiates but never accepts associations.

The maximum PDU size which can be received by the Report FIND-SCU is configurable, with a default value of 16,384 (16K) bytes (see Table 5.3.3).

2.3.1.2 Number of Associations

Each FIND-SCU instance initiates a single association at a time.

2.3.1.3 Asynchronous Nature

FIND-SCU will only allow a single outstanding operation on an Association. Therefore, FIND-SCU will not perform asynchronous operations window negotiation.

2.3.1.4 Implementation Identifying Information

The implementation UID for the Report FIND-SCU will be “1.2.840.114089.1.1.0.X.Y.Z”, where X.Y.Z is the version number (for example, 1.5.0). The implementation version name is also included and has the form “DCF X.Y.Zz” where X.Y.Zz is the full version identifier (for example, 1.4.0b for beta version 1.4.0).

2.3.2 Association Initiation by Real-World Activity

The Report FIND-SCU attempts to initiate a new association when the Virtua receives a Study.

2.3.3 Real-World Activity – Query Remote AE

2.3.3.1 Description and Sequencing of Activities

A single attempt will be made to query the remote AE. If the query fails, for whatever reason, no retry will be performed.

2.3.3.2 Presentation Context Table – FIND-SCU

Table 2.3.3.2.1 – Supported FIND-SCU Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Mitra Report Management – FIND	1.2.840.113532.3500.8	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

FIND-SCU will propose multiple Presentation Contexts, one for each of the supported Transfer Syntaxes, and an additional Presentation Context with all of the supported Transfer Syntaxes, in order to determine which Transfer Syntaxes the remote SCP supports, and which it prefers.

2.3.3.3 Extended Negotiation

No extended negotiation is performed.

In particular, relational queries are not supported.

2.3.3.4 SOP Specific Conformance – FIND-SCU

2.3.3.4.1 SOP Specific Conformance to C-FIND SOP Classes

FIND-SCU provides standard conformance to the supported C-FIND SOP Class.

No CANCEL requests are ever issued.

Unexpected attributes returned in a C-FIND response (those not requested) are ignored. Requested return attributes not returned by the SCP are ignored. Non-matching responses returned by the SCP due to unsupported (hopefully optional) matching keys are not filtered locally by the FIND-SCU. No attempt is made to filter out duplicate responses.

Specific Character Set is only specified by the FIND-SCU if Latin 1 (IR 100) is specified in the QR configuration. If present in the response, Specific Character Set will be used to identify character sets other than the default character set for display of strings on the user interface.

Table 2.3.3.4.1.1 - Study Root Request Identifier for FIND-SCU

Name	Tag	Types of Matching
STUDY Level		
Study Instance UID	(0020,000D)	S
Interpretation Text	(4008,0115)	S
Interpretation Author	(4008,010C)	S
Interpretation ID	(4008,0200)	S
Interpretation Recorder	(4008, 0102)	S
Interpretation Type	(4008,0210)	S
Requested Procedure Description	(0032,1060)	S
Referring Physicians Name	(0008,0090)	S
Study Description	(0008,1030)	S
Study Date	(0008,0020)	S
Reason For Study	(0032,1030)	S
Impressions	(4008, 0300)	S
Interpretation Diagnosis Description	(4008,0115)	S

Types of Matching supported by the C-FIND SCU:

An 'S' indicates the identifier attribute uses Single Value Matching, an 'R' indicates Range Matching, an '*' indicates wildcard matching, a 'U' indicates Universal Matching, and an 'L' indicates that UID lists are sent. "NONE" indicates that no matching is supported, but that values for this Element are requested to be returned (i.e. universal matching), and "UNIQUE" indicates that this is the Unique Key for that query level, in which case Universal Matching or Single Value Matching is used depending on the query level.

2.3.3.4.2 Presentation Context Acceptance Criterion

FIND-SCU does not accept associations.

2.3.3.4.3 Transfer Syntax Selection Policies

FIND-SCU prefers explicit Transfer Syntaxes. If offered a choice of Transfer Syntaxes in the accepted Presentation Contexts, it will apply the following priority to the choice of Presentation Context to use for the C-FIND operation:

1. first encountered explicit Transfer Syntax,
2. default Transfer Syntax.

2.3.3.4.4 Response Status Behavior

FIND-SCU will behave as described in Table 2.3.3.4.4.1 in response to the status returned in the C-FIND response command message(s).

Table 2.3.3.4.4.1 Response Status Behavior for FIND-SCU and Query Remote AE

Service Status	Further Meaning	Status Codes	Behavior
Refused	Out of Resources	A700	Current query is terminated
Error	Identifier does not match SOP Class	A900	Current query is terminated
	Unable to process	Cxxx	Current query is terminated
Cancel	Matching terminated due to Cancel request	FE00	Ignored (should never occur, since cancels never issued)
Success	Matching is complete - No final Identifier is supplied	0000	Current query is terminated
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Current query continues
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this Identifier	FF01	Current query continues

2.3.3.4.5 Association Acceptance Policy

FIND-SCU does not accept associations.

3. COMMUNICATION PROFILES

3.1 TCP/IP Stack

The DCF Storage Server and Query/Retrieve Client provide DICOM 3.0 TCP/IP Network Communication Support as defined in part 8 of the standard.

3.2 Physical Media Support

The DCF Storage Server and Query/Retrieve Client support DICOM over any IP network supported by the Operating System running on the Codonics device (computer) where the DCF Storage Server is installed and running. The typical medium is Ethernet.

4. EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS

The DCF does not define any private elements.

5. CONFIGURATION

See Section 1.2 for an overview of the DCF Storage Server start-up and configuration process.

5.1 AE Title Presentation Address Mapping

AE Titles are used only during association negotiation with the DCF Storage Server. That is, no DIMSE messages or data sets reference other hosts or servers using AE Titles as is common with certain other SOP classes. There is no need for AE Title to presentation address mapping with the Storage SOP classes.

5.2 DCF Storage Server Configurable Parameters—Global

The following items are configurable on a global basis and apply to all associations serviced by the DCF Storage Server.

Table 5.2.1 - Global Configuration Parameters

Parameter Name	Range	Defaults	Comments
tcp_port	1–32767	104	The TCP port on which the DCF Storage Server will listen for incoming DICOM Association requests.
first_pdu_read_timeout	N/A	30	Association request timeout period—the time is measured from socket accept until an a-assoc-rq PDU is read. Functions as the ARTIM (Association/Request/Reject/Release Timer) timer from DICOM PS 3.8-9.1.2
debug_flags	N/A	0x00000	This parameter is intended for Codonics developer and field-service use only.

5.3 DCF Storage Server Configurable Parameters—Per Association

The following items are configurable on a per association basis and apply to an association based on the Calling AE Title. Each software component has debug flags that may be set for diagnostic purposes; these flags may be dynamically accessed via a browser based interface, but are not listed below. Other configuration parameters which are used to control SCP internal behavior are omitted from the lists as well.

The SOP Classes that the DCF Storage Server supports are configured by their presence in the appropriate configuration file. See Section 1.2 for additional description of the configuration process. Any of the SOP Classes from Table 2.1.1 can be individually enabled or disabled in this way.

The transfer syntax for each DICOM presentation context is negotiated independently. The DCF Storage Server can be configured to support any or all of the transfer syntaxes listed in Table 2.1.3.2.2.1. The order of preference for selecting a transfer syntax is also configurable. This configuration may vary between associations; however, for a given association, it is shared between all SOP classes or presentation contexts.

Table 5.3.3 - Per Association Configuration Parameters—DCF Components

Parameter Name	Range	Defaults	Comments
DPS			
scp_association_options:			
dvs_enable	YES NO	NO	Enables or disables the DICOM Validation Services component.
dvs_configuration_group		/dicom/dvs/ StoreSCP.dvs /dicom/dvs/ DicomDefs.dvs	Filename of the configuration group for the DICOM Validation Service component.
DCS:			
pdu_read_timeout	0 .. 2**32	30	Association request timeout period—number of seconds to block trying to read a PDU fragment, after a connect or read-data-ready poll notification. Functions as the ARTIM (Association/Request/Reject/Release Timer) timer from DICOM PS 3.8-9.1.2.
association_idle_timeout_period	-1, 0, 1..3600	3600	-1 = Never release association unless the SCU requests it, or an error has occurred. 0 = Time-out immediately 1–3600 (seconds) Maximum number of seconds that the DCF Storage Server will allow an idle client to maintain an association when no print jobs are pending.
max_pdu_length	1K–16K Bytes (1024–16384)	16K Bytes (16384 Bytes)	The largest PDU that will be sent.
pre_association_script	Shell command	None	Command line of program to be run at the start of an association.

Parameter Name	Range	Defaults	Comments
post_association_script	Shell command	None	Command line of program to be run at the end of an association.

5.4 Called AE Titles and Codonics Job Profiles

The Codonics Virtua supports multiple parameter sets known as Job Profiles, which affect the parameters associated with a given recording job. These are general-purpose, configurable parameter sets that are described in detail in the Virtua User's Manual. When a recording job is submitted, a Job Profile parameter set is selected via the Called AE Title used to establish the storage association.

6. MEDIA INTERCHANGE

6.1 IMPLEMENTATION MODEL

6.1.1 Application Data Flow

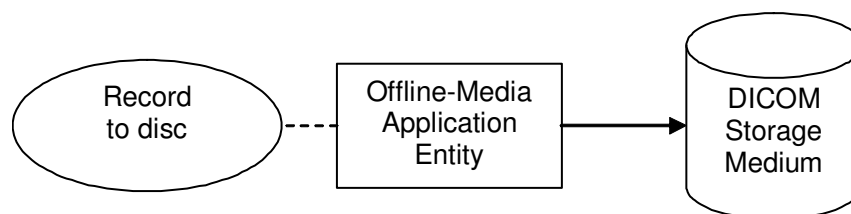


Figure B.5.1-1
APPLICATION DATA FLOW DIAGRAM FOR MEDIA STORAGE

- The Offline-Media Application Entity exports images and Presentation States to an optical disc Storage medium (CD or DVD) or USB Storage medium. It is associated with the local real-world activity “Record to Disc”. “Record to Disc” is performed upon user request for selected patients, studies, series or instances (images or presentation states). It may optionally be performed on a Study boundary, based on a Study storage timeout value.

6.1.2 Functional Definition of AEs

6.1.2.1 Functional Definition of Offline-Media Application Entity

Activation of the “Record to Disc” function will pass the currently selected Study instances (images and/or presentation states) to the Offline-Media Application Entity. The SOP Instances associated with the selection will be collected into one or more record jobs. The contents of each record job will be written to one or more of the selected disc media (CD or DVD) or USB media.

6.1.3 Sequencing of Real-World Activities

At least one Study must exist and be selected before the Offline-Media Application Entity can be invoked. The user interface allows selection of the optical disc type, or can optionally select the appropriate type

based on the size of the record request. Entity will wait indefinitely for an optical media to be inserted before starting to write to the disc if it is not currently loaded in the system, but will only write to a USB drive if a USB drive is currently inserted. If no media is available the record job can be canceled from the job queue.

6.1.4 File Meta Information Options

The implementation information written to the File Meta Header in each file is detailed in section 2.1.1.4.

6.2 AE SPECIFICATIONS

6.2.1 Offline-Media Application Entity Specification

The Offline-Media Application Entity provides standard conformance to the DICOM Interchange Option of the Media Storage Service Class. The Application Profiles and roles are listed below:

**Table B.5.2-1
APPLICATION PROFILES, ACTIVITIES AND ROLES FOR OFFLINE-MEDIA**

Application Profiles Supported	Real World Activity	Role	SC Option
STD-GEN-CD	Record to CD-R	FSC/FSU	Interchange
STD-GEN-DVD-RAM	Record to DVD-R or USB	FSC/FSU	Interchange

Note: The Application Profile PS 3.11 J.3 STD-GEN-USB is not supported since the Entity writes DICOM data to subfolders of the USB medium rather than the root of the USB medium.

6.2.1.1 File Meta Information for the Application Entity

The Source Application Entity Title included in the File Meta Header is configurable (see section 5.4).

6.2.1.2 Real-World Activities

6.2.1.2.1 Activity – Record to Disc

The Offline-Media Application Entity acts as an FSC using the interchange option when requested to export SOP Instances from the local database to an optical disc or USB medium.

For optical media, a dialogue will be presented allowing the user to modify the suggested media label and provides control over the available media capacity. If the contents of the current selection do not fit on a single media an automatic separation into multiple export jobs will be accomplished.

For optical media, the system will use preloaded optical media blanks as available, or the user will be prompted to insert an empty disc for each record job that can not be fulfilled based on the currently loaded media. The contents of the record job will be written together with a corresponding DICOMDIR to a single-session disc. Writing in multi-session mode is not supported. The user can cancel a record job in the job queue.

For USB media, the system will only record to a single USB medium that is already inserted in the system at the time the job is manually requested. The contents of the record job will be written together with a corresponding DICOMDIR to a uniquely named subfolder of the USB medium. Updating an existing DICOMDIR in the root of a USB medium is not supported. The user can cancel an active copy-to-USB job in the job queue.

6.2.1.2.1.1 Media Storage Application Profiles

The Offline-Media Application Entity supports the STD-GEN-CD and STD-GEN-DVD-RAM Application Profiles, and uses the constraints of the STD-GEN-DVD-RAM Application Profile to write to subfolders of USB media.

6.2.1.2.1.1.1 Options

The Offline-Media Application Entity supports the SOP Classes listed in the Table 2.1.1. The Transfer Syntax of entities stored on optical disc shall be whatever transfer syntax they were stored to Virtua in. See table 2.1.3.2.2.1 for a list of supported Transfer syntaxes.

6.3 AUGMENTED AND PRIVATE APPLICATION PROFILES

Virtua does not support any augmented or private application profiles.

6.4 MEDIA CONFIGURATION

Media selection is available via the user interface, and through Codonics Job Profiles. Media can be auto-selected for a particular record job, or can be overridden at the time of job submission.

7. SUPPORT OF EXTENDED CHARACTER SETS

7.1 Overview

The Virtua MDP supports all extended character sets defined in the DICOM 2002 standard, including single-byte and multi-byte character sets as well as code extension techniques using ISO 2022 escapes.

Support extends to correctly decoding and displaying the correct symbol for all names and strings found in the storage instances received over the network, and in the local database.

7.2 Character Sets

In addition to the default character repertoire, the Defined Terms for Specific Character Set in Table 7.2.1 are supported:

Table 7.2.1
SUPPORTED SPECIFIC CHARACTER SET DEFINED TERMS

Character Set Description	Defined Term
Latin alphabet No. 1	ISO_IR 100
Latin alphabet No. 2	ISO_IR 101
Latin alphabet No. 3	ISO_IR 109
Latin alphabet No. 4	ISO_IR 110
Cyrillic	ISO_IR 144
Arabic	ISO_IR 127
Greek	ISO_IR 126
Hebrew	ISO_IR 138
Latin alphabet No. 5	ISO_IR 148
Japanese	ISO_IR 13

Thai	ISO_IR 166
Default repertoire	ISO 2022 IR 6
Latin alphabet No. 1	ISO 2022 IR 100
Latin alphabet No. 2	ISO 2022 IR 101
Latin alphabet No. 3	ISO 2022 IR 109
Latin alphabet No. 4	ISO 2022 IR 110
Cyrillic	ISO 2022 IR 144
Arabic	ISO 2022 IR 127
Greek	ISO 2022 IR 126
Hebrew	ISO 2022 IR 138
Latin alphabet No. 5	ISO 2022 IR 148
Japanese	ISO 2022 IR 13
Thai	ISO 2022 IR 166
Japanese	ISO 2022 IR 87
Japanese	ISO 2022 IR 159
Korean	ISO 2022 IR 149

7.3 Character set Configuration

Whether or not characters are displayed correctly depends on the proper locale configuration of the Virtua MDP. Consult the Virtua User's Manual for information on configuring the locale setting.

8. CODES AND CONTROLLED TERMINOLOGY

The DCF uses the Baseline Context Groups defined in DICOM PS 3.3-1999. No alternative or private Context Groups or Coding Schemes are used.

9. SECURITY

9.1 Security Profiles

The Virtua MDP is configurable to support the following required bullet items from PS3.15-2011 E.1.1 Basic Security Profile, but not Optional items 1,4, and 5 (using the Encrypted Attributes Sequence for later recovery of data):

- Item 2) Each Attribute to be protected shall then either be removed from the dataset, or have its value replaced by a different “replacement value” which does not allow identification of the patient.
- Item 3) Each Attribute specified to be retained shall be retained.
- Item 6) The attribute Patient Identity Removed (0012,0062) shall be replaced or added to the dataset with a value of YES, and one or more codes from PS 3.16 CID 7050 De-identification Method corresponding to the profile and options used shall be added to De-identification Method Code Sequence (0012,0064). A text string describing the method used may also be inserted in or added to De-identification Method (0012,0063), but is not required.
 - The De-identification method(s) in the De-identification Method Code Sequence must be configured by the user in the Anonymization profile. The following options are available for De-identification methods (they are internally mapped to IDs as specified in the DICOM standard):
 - Basic Application Confidentiality Profile
 - Retain Longitudinal Temporal Information With Full Dates Option
 - Retain Patient Characteristics Option
 - Retain Device Identity Option
 - Retain UIDs Option
 - Retain Safe Private Option
 - Basic Anonymization (this is not a value specified by the DICOM Standard, it is an extensible value (which is allowed for this Code Sequence according to the DICOM Standard) to indicate how the Virtua MDP has historically anonymized data)
 - This value must be manually configured in each anonymization profile to accurately describe (according to the DICOM Standard) the set of Dicom Tags configured to be anonymized. If the user creates a custom profile, or modifies the stock ones, they must determine if the De-identification Methods need to be reconfigured.
- Item 7) If the Dataset being de-identified is being stored within a DICOM File, then the File Meta Information including the 128 byte preamble, if present, shall be replaced with a description of the de-identifying application.

The Virtua MDP supports the following Basic Security Profile Options:

- Retain Longitudinal Temporal Information With Full Dates Option
- Retain UIDs Option

The Virtua MDP is configurable to support the following Basic Security Profile Options:

- Retain Patient Characteristics Option
- Retain Device Identity Option
- Retain Safe Private Option.

9.2 Association level security

None supported.

Any Calling AE Titles and/or IP addresses may open an Association.

9.3 Application level security

None supported.

10. REFERENCES

Quoted below are references to and portions of the sections of DICOM PS 3.0-1999 that relate to the preparation of a conformance statement. In addition, a list of DICOM Change Proposals that have been incorporated within this release of the DCF Storage Server is provided.

10.1 DICOM PS 3.2-1999, Annex A (Normative) DICOM Conformance Statement Template

This Annex is a template which shall be used to generate a DICOM Conformance Statement. A DICOM Conformance Statement shall begin with an introduction which sets the framework. The introduction shall describe the implementation and how, in general terms, it uses DICOM to achieve its purposes. ...

10.2 DICOM PS 3.2-1999, Annex B (Informative) DICOM Conformance Statement Sample

This Annex is a sample DICOM Conformance Statement for a fictitious DICOM Implementation. It is presented as an example only. The viability of such an implementation should not be assumed as the purpose of this Annex is only to guide the writer of DICOM Conformance Statements by providing a Conformance Statement example. ...

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