

# WebAiMS

# DICOM Conformance Statement

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## 1 Introduction

WebAiMS is an information management system designed to receive data from a Picture Archiving and Communications System (PACS) or other DICOM archives and to store them for subsequent retrieval and manipulation.

### 1.1 Revision History

Rev. 1	March 2003	Initial release for WebAiMS 1.1
Rev. 2	April 2010	Updated for WebAiMS 9

### 1.2 Audience

This document is written for the people that need to understand how WebAiMS will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader may understand how this product implements DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features.

### 1.3 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between WebAiMS and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability.

The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

- The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between the product and other DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.
- With regard to the future evolution of the DICOM 3.0 standard Aimsability reserves the right to make changes to the WebAiMS architecture, related to the issues described in this document. The user (or user's agent) should ensure that any equipment connected via DICOM to WebAiMS also follows the future evolution of the DICOM 3.0 standard. Failure to do so may result in loss of connectivity.

## 1.4 Terms and Definitions

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

**Abstract Syntax** – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples : Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

**Application Entity (AE)** – an end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

**Application Entity Title** – the externally known name of an *Application Entity*, used to identify a DICOM application to other DICOM applications on the network.

**Application Context** – the specification of the type of communication used between *Application Entities*. Example: DICOM network protocol.

**Association** – a network communication channel set up between *Application Entities*.

**Attribute** – a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

**Information Object Definition (IOD)** – the specified set of *Attributes* that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The *Attributes* may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

**Joint Photographic Experts Group (JPEG)** – a set of standardized image compression techniques, available for use by DICOM applications.

**Media Application Profile** – the specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

**Module** – a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

**Negotiation** – first phase of *Association* establishment that allows *Application Entities* to agree on the types of data to be exchanged and how that data will be encoded.

**Presentation Context** – the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

**Protocol Data Unit (PDU)** – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

**Security Profile** – a set of mechanisms, such as encryption, user authentication, or digital signatures, used by an *Application Entity* to ensure confidentiality, integrity, and/or availability of exchanged DICOM data

**Service Class Provider (SCP)** – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another Application Entity (Service Class User). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

**Service Class User (SCU)** – role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

**Service/Object Pair (SOP) Class** – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

**Service/Object Pair (SOP) Instance** – an information object; a specific occurrence of information exchanged in a SOP Class. Examples: a specific x-ray image.

**Tag** – a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the “group” and the “element”. If the “group” number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

**Transfer Syntax** – the encoding used for exchange of DICOM information objects and messages. Examples: JPEG compressed (images), little endian explicit value representation.

**Unique Identifier (UID)** – a globally unique “dotted decimal” string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

**Value Representation (VR)** – the format type of an individual DICOM data element, such as text, an integer, a person’s name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

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## 1.5 Basics of DICOM Communication

This section describes terminology used in this Conformance Statement for the non-specialist. The key terms used in the Conformance Statement are highlighted in *italics* below. This section is not a substitute for training about DICOM, and it makes many simplifications about the meanings of DICOM terms.

Two *Application Entities* (devices) that want to communicate with each other over a network using DICOM protocol must first agree on several things during an initial network “handshake”. One of the two devices must initiate an *Association* (a connection to the other device), and ask if specific services, information, and encoding can be supported by the other device (*Negotiation*).

DICOM specifies a number of network services and types of information objects, each of which is called an *Abstract Syntax* for the Negotiation. DICOM also specifies a variety of methods for encoding data, denoted *Transfer Syntaxes*. The Negotiation allows the initiating Application Entity to propose combinations of Abstract Syntax and Transfer Syntax to be used on the Association; these combinations are called *Presentation Contexts*. The receiving Application Entity accepts the Presentation Contexts it supports.

For each Presentation Context, the Association Negotiation also allows the devices to agree on *Roles* – which one is the *Service Class User* (SCU - client) and which is the *Service Class Provider* (SCP - server). Normally the device initiating the connection is the SCU, i.e., the client system calls the server, but not always.

The Association Negotiation finally enables exchange of maximum network packet (*PDU*) size, security information, and network service options (called *Extended Negotiation* information).

The Application Entities, having negotiated the Association parameters, may now commence exchanging data. Common data exchanges include queries for worklists and lists of stored images, transfer of image objects and analyses (structured reports), and sending images to film printers. Each exchangeable unit of data is formatted by the sender in accordance with the appropriate *Information Object Definition*, and sent using the negotiated Transfer Syntax. There is a Default Transfer Syntax that all systems must accept, but it may not be the most efficient for some use cases. Each transfer is explicitly acknowledged by the receiver with a *Response Status* indicating success, failure, or that query or retrieve operations are still in process.

Two Application Entities may also communicate with each other by exchanging media (such as a CD-R). Since there is no Association Negotiation possible, they both use a *Media Application Profile* that specifies “pre-negotiated” exchange media format, Abstract Syntax, and Transfer Syntax.

## 1.6 Abbreviations

<b>AE</b>	Application Entity
<b>AET</b>	Application Entity Title
<b>CAD</b>	Computer Aided Detection
<b>CDA</b>	Clinical Document Architecture
<b>CD-R</b>	Compact Disk Recordable
<b>CR</b>	Computed Radiography
<b>CT</b>	Computed Tomography
<b>DHCP</b>	Dynamic Host Configuration Protocol
<b>DICOM</b>	Digital Imaging and Communications in Medicine
<b>DIT</b>	Directory Information Tree (LDAP)
<b>DN</b>	Distinguished Name (LDAP)
<b>DNS</b>	Domain Name System
<b>DX</b>	Digital X-ray
<b>FSC</b>	File-Set Creator
<b>FSU</b>	File-Set Updater
<b>FSR</b>	File-Set Reader
<b>GSDF</b>	Grayscale Standard Display Function
<b>GSPS</b>	Grayscale Softcopy Presentation State
<b>HIS</b>	Hospital Information System
<b>HL7</b>	Health Level 7 Standard
<b>IHE</b>	Integrating the Healthcare Enterprise
<b>IOD</b>	Information Object Definition
<b>IPv4</b>	Internet Protocol version 4
<b>IPv6</b>	Internet Protocol version 6
<b>ISO</b>	International Organization for Standards
<b>IO</b>	Intra-oral X-ray
<b>JPEG</b>	Joint Photographic Experts Group
<b>LDAP</b>	Lightweight Directory Access Protocol
<b>LDIF</b>	LDAP Data Interchange Format
<b>LUT</b>	Look-up Table
<b>MAR</b>	Medication Administration Record
<b>MPEG</b>	Moving Picture Experts Group
<b>MG</b>	Mammography (X-ray)
<b>MPPS</b>	Modality Performed Procedure Step
<b>MR</b>	Magnetic Resonance Imaging
<b>MSPS</b>	Modality Scheduled Procedure Step
<b>MTU</b>	Maximum Transmission Unit (IP)
<b>MWL</b>	Modality Worklist
<b>NM</b>	Nuclear Medicine
<b>NTP</b>	Network Time Protocol
<b>O</b>	Optional (Key Attribute)
<b>OP</b>	Ophthalmic Photography
<b>OSI</b>	Open Systems Interconnection
<b>PACS</b>	Picture Archiving and Communication System
<b>PET</b>	Positron Emission Tomography

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<b>PDU</b>	Protocol Data Unit
<b>R</b>	Required (Key Attribute)
<b>RDN</b>	Relative Distinguished Name (LDAP)
<b>RF</b>	Radiofluoroscopy
<b>RIS</b>	Radiology Information System.
<b>RT</b>	Radiotherapy
<b>SC</b>	Secondary Capture
<b>SCP</b>	Service Class Provider
<b>SCU</b>	Service Class User
<b>SOP</b>	Service-Object Pair
<b>SPS</b>	Scheduled Procedure Step
<b>SR</b>	Structured Reporting
<b>TCP/IP</b>	Transmission Control Protocol/Internet Protocol
<b>U</b>	Unique (Key Attribute)
<b>UL</b>	Upper Layer
<b>US</b>	Ultrasound
<b>VL</b>	Visible Light
<b>VR</b>	Value Representation
<b>XA</b>	X-ray Angiography

### 1.7 References

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>.

## 2 Implementation Model

### 2.1 Application Data Flow Diagram

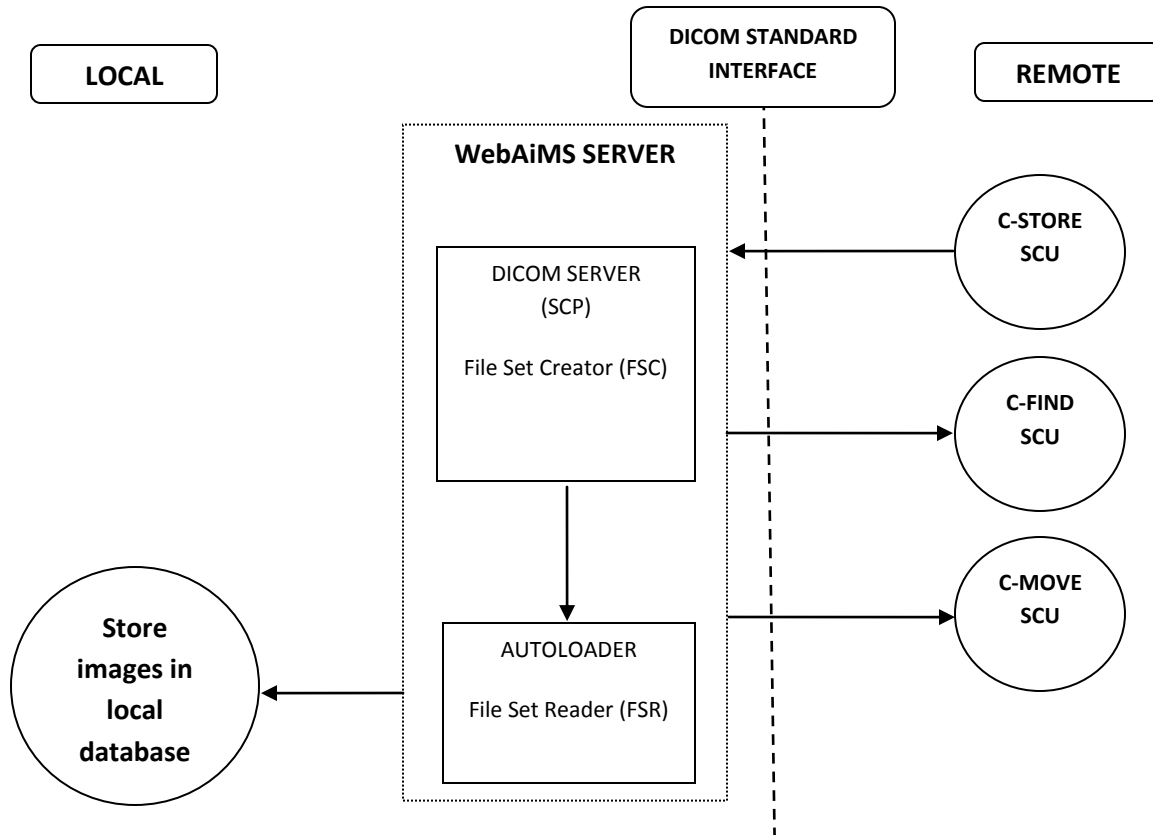


Figure 1: The WebAiMS server processing model

## 2.2 Functional Definition of Application Entities

### 2.2.1 Application Entity – DICOM Server

The WebAiMS DICOM Server accepts an association with a remote DICOM AE when the remote system requests image storage using the DICOM Storage service class. The images are transmitted to the local file system for subsequent processing by the Autoloader. A log event is generated recording that the image data have been received.

### 2.2.1 Application Entity – Autoloader

The WebAiMS Autoloader has the following functionality:

- Monitors the folder to which the WebAiMS DICOM server has written received DICOM data as disk files.

- At a configurable interval, processes these data to rationalize them into the DICOM hierarchy structure (Patient, Study, Series, Image).
- Anonymizes the DICOM data according to configurable rules, including the removal of private DICOM tags by default.
- Creates a new WebAiMS database record based on a configurable unit of information (e.g. Patient ID, Study Instance UID, Series Instance UID) or, if a database record already exists modifies it.
- Updates the WebAiMS Media Server with references to the newly processed image data.
- Moves the processed DICOM data to a configurable archive folder.

For a full description of the functionality of the Autoloader, please refer to the appropriate WebAiMS technical documentation.

### **2.3 Sequencing of Real World Activities**

All Real World Activities as specified in Figure 1 may occur independently from each other.

### 3 AE Specifications

#### 3.1 WebAiMS Server

The WebAiMS server provides standard conformance to the following SOP classes as SCU:

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
CR 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
NM Image Storage	1.2.840.10008.5.1.4.1.1.5
US Image Storage	1.2.840.10008.5.1.4.1.1.6
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1
RF Image Storage	1.2.840.10008.5.1.4.1.1.12.2
PT Image Storage	1.2.840.10008.5.1.4.1.1.128
Patient Root Query/Retrieve – FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve – MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve – FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve – MOVE	1.2.840.10008.5.1.4.1.2.2.2

This AE also provides standard conformance to the following SOP classes as SCP:

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
CR 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
NM Image Storage	1.2.840.10008.5.1.4.1.1.5
US Image Storage	1.2.840.10008.5.1.4.1.1.6
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1
RF Image Storage	1.2.840.10008.5.1.4.1.1.12.2
PT Image Storage	1.2.840.10008.5.1.4.1.1.128

#### 3.1.1 Association Establishment Policies

##### 3.1.1.1 General

The DICOM 3.0 standard Application Context Name (ACN) with UID 1.2.840.10008.3.1.1.1 is always proposed when WebAiMS initiates an association.

The maximum length PDU negotiation is included in all association establishment requests. The default maximum length PDU for an association initiated by WebAiMS is 64 Kb.

##### 3.1.1.2 Number of Associations

The number of associations that may be active simultaneously is 1.

### 3.1.1.3 Asynchronous Nature

The WebAiMS DICOM server will accept a new command only after the previous command has been completed and the status response communicated to the requester.

### 3.1.1.4 Implementation Identifying Information

Implementation Class UID: 1.2.826.0.1.3680043.1.1.4.2.169.2  
 Implementation Version Name: DCMOBJ4.2.169.2

### 3.1.2. Association Initiation Policies

WebAiMS initiates associations for the following activities:

- Verification of DICOM communication between the WebAiMS SCU and a remote DICOM system.
- Querying of database contents of a remote DICOM server.
- Retrieval of images from a remote DICOM server.

#### 3.1.2.1 Associated Real World Activity

SOP Class	Associated Real World Activity
Verification	Performed automatically before attempting association.
Patient Root Query - FIND	Performed within the WebAiMS user interface (web browser)
Patient Root Retrieve - MOVE	Performed within the WebAiMS user interface (web browser)
Study Root Query - FIND	Performed within the WebAiMS user interface (web browser)
Study Root Retrieve - MOVE	Performed within the WebAiMS user interface (web browser)

### 3.1.2.2 Proposed Presentation Contexts

<b>Presentation Context Table</b>					
<b>Abstract Syntax</b>		<b>Transfer Syntax</b>		<b>Role</b>	<b>Ext. Neg.</b>
<b>Name</b>	<b>UID</b>	<b>Name</b>	<b>UID</b>		
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian  Explicit VR Little Endian  Explicit VR Big Endian	1.2.840.10008.1.2	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2		1.2.840.10008.1.2.1		
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1		1.2.840.10008.1.2.2		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4				
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1				
SC Image Storage	1.2.840.10008.5.1.4.1.1.7				
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1				
RF Image Storage	1.2.840.10008.5.1.4.1.1.12.2				
NM Image Storage	1.2.840.10008.5.1.4.1.1.20				
PT Image Storage	1.2.840.10008.5.1.4.1.1.128				
Patient Root Query - FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	
Patient Root Retrieve - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	
Study Root Query - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	
Study Root Retrieve - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	

### 3.1.3 Association Acceptance Policies

#### 3.1.3.1 Receive image data

##### 3.1.3.1.1 Associated Real World Activity

The WebAiMS DICOM server is always available to accept a new transport connection and process the image storage request. The WebAiMS DICOM server will accept the presentation context associated with the image storage request and reply with a C-STORE response when the complete image has been received on the established association.

#### 3.1.3.2 Presentation Context Acceptance Criterion

Not applicable.

## 4 Communication Profile

### 4.1 Supported Communication Stacks

TCP/IP is the only protocol stack supported.

### 4.2 TCP/IP Stack

The TCP/IP stack is inherited from the host operating system (Windows 2003/XP).

**5. Extensions/Specializations/Privatizations**

No extensions, specializations or privatizations are defined.