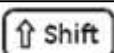
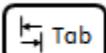
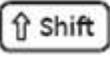


Keyboard Shortcuts and Tips

Export shortcuts	
F1	Send the image behind the mouse cursor to the Filmer <i>[AW and AW Server only]</i> .
F2	Send the screen behind the cursor to the Filmer <i>[AW and AW Server only]</i> .
F3	Send the screen behind the cursor to the Filmer as a unique page <i>[AW and AW Server only]</i> .
F4	Perform a quick Export of the active viewport.
S Alt + S	<S>: Save image (with default series description). <Alt>+<S>: Save image as.
Display shortcuts	
F5	Preset W/L 1 : <ul style="list-style-type: none"> • CT: Abdomen [WL 40 WW 400] • XA: Abdomen [WL 40 WW 400] • MR: Preset1 [WL 20 WW 40] • PET/NM: Predef1 [min 0 Max 1024] <p>Note: Use <F6> on GE CT, MR & PET scanners. Note: Values can be customized from 2D Viewer <i>[AW and AW Server]</i> Note: PET presets can be also customized in Volume Viewer, by clicking the SUV unit in bottom left of the PET viewport and selecting "Edit Preferences".</p>
F6	Preset W/L 2 : <ul style="list-style-type: none"> • CT: Head [WL 35 WW 100] • XA: Head [WL 35 WW 150] • MR: Preset2 [WL 50 WW 100] • PET/NM: Predef2 [min 0 Max 1000] <p>Note: Use <F7> on GE CT, MR & PET scanners. Note: Values can be customized from 2D Viewer <i>[AW and AW Server]</i>. Note: PET presets can be also customized in Volume Viewer, by clicking the SUV unit in bottom left of the PET viewport and selecting "Edit Preferences".</p>
F7	Preset W/L 3 : <ul style="list-style-type: none"> • CT: Lung [WL -600 WW 1500]

	<ul style="list-style-type: none"> • XA: Lung [WL -600 WW 1500] • MR: Preset3 [WL 100 WW 200] • PET/NM: Predef3 [min 0 Max 2000] <p><i>Note: Use <F8> on GE CT, MR & PET scanners.</i></p> <p><i>Note: Values can be customized from 2D Viewer [AW and AW Server].</i></p> <p><i>Note: PET presets can be also customized in Volume Viewer, by clicking the SUV unit in bottom left of the PET viewport and selecting “Edit Preferences”.</i></p>
<div style="border: 1px solid black; border-radius: 10px; width: 40px; height: 40px; display: flex; align-items: center; justify-content: center; margin: 10px auto;">F8</div>	<p>Preset W/L 4:</p> <ul style="list-style-type: none"> • CT: Mediastin [WL 40 WW 350] • XA: Tissues 1 [WL 50 WW 600] • MR: Preset4 [WL 500 WW 1000] • PET/NM: Predef4 [min 0 Max 4000] <p><i>Note: Use <F9> on GE CT, MR & PET scanners.</i></p> <p><i>Note: Values can be customized from 2D Viewer [AW and AW Server].</i></p> <p><i>Note: PET presets can be also customized in Volume Viewer, by clicking the SUV unit in bottom left of the PET viewport and selecting “Edit Preferences”.</i></p>
<div style="border: 1px solid black; border-radius: 10px; width: 40px; height: 40px; display: flex; align-items: center; justify-content: center; margin: 10px auto;">F9</div>	<p>Preset W/L 5:</p> <ul style="list-style-type: none"> • CT: Spine [WL 35 WW 300] • XA: Spine [WL 35 WW 300] • MR: Preset5 [WL 1000 WW 2000] • PET/NM: Predef5 [min 500 Max 4500] <p><i>Note: Use <F10> on GE CT, MR & PET scanners.</i></p> <p><i>Note: Values can be customized from 2D Viewer [AW and AW Server].</i></p> <p><i>Note: PET presets can be also customized in Volume Viewer, by clicking the SUV unit in bottom left of the PET viewport and selecting “Edit Preferences”.</i></p>
<div style="border: 1px solid black; border-radius: 10px; width: 40px; height: 40px; display: flex; align-items: center; justify-content: center; margin: 10px auto;">F10</div>	<p>Preset W/L 6:</p> <ul style="list-style-type: none"> • CT: Vertebrae [WL 350 WW 2000] • XA: Tissues 2 [WL 350 WW 2000] • MR: Preset6 [WL 2000 WW 4000] • PET/NM: Predef6 [min 1000 Max 5000] <p><i>Note: Use <F11> on GE CT, MR & PET scanners.</i></p> <p><i>Note: Values can be customized from 2D Viewer [AW and AW Server].</i></p> <p><i>Note: PET presets can be also customized in Volume Viewer, by clicking the SUV unit in bottom left of the PET viewport and selecting “Edit Preferences”.</i></p>
<div style="border: 1px solid black; border-radius: 10px; width: 40px; height: 40px; display: flex; align-items: center; justify-content: center; margin: 10px auto;">W</div>	<p>Apply automatic windowing based on the pixel density of the image displayed on the viewport.</p>

	Optimize VR settings based on voxel value of 3D cursor.
	Show/hide measurement and trace (vessels or manual).
	Show/hide the 3D cursor on the viewports.
 	Switch between the loaded volumes (next, previous) in current viewport.
Image Interaction shortcuts	
 	Scroll up & down in slices or rotate 3D models.
	Paging through slices.
	Targeting.
	Hold down the <F> key to move forward in a navigator viewport. Use key to navigate backward.
	In navigator viewport, automatically aligns the orientation of the navigator view to the main axis of the lumen (when a trace is defined).
	In navigator viewport, displays the navigator view in opposite direction (“Turn around”).
Tools shortcuts	
	Swap between mouse modes.
	Delete last point defined on trace.
	Insert a bookmark.
	<i>(Requires the Integrated Registration license)</i> Activate regional registration based on 3D cursor location and using parameters set in Global Preferences.
	<i>(Requires the Integrated Registration license)</i> Activate manual registration mode (opens the Integrated Registration panel if not opened).
	Edit trace.

 + 	Draw Trace.
	Activate 2D measurement tool.
 	Focus on <P>rior or <N>ext measurement.
	Delete active measurement (<Delete> on QWERTY keyboard, <Suppr> on other type of keyboards). <i>This can be done also using the <Backspace> key.</i>
 + 	Delete the current Trace.
 + 	In fused viewports, switches the master volume with the overlay volume.
 + 	In fused viewports, set the fusion factor to: <ul style="list-style-type: none"> - 50% when current fusion factor is between 0% and 50% - 100% when current fusion factor is more or equal to 50% - 0% when current fusion factor is 100%
	When a tool panel is opened, press space bar to minimize the panel, without closing it.

- Hover the cursor over a button and a tool tip appears describing the button function.
- Watch the progress bar at the bottom of the desktop. It shows the task progress when loading data or processing images.
- Double click on the viewport to enlarge it and display it as full screen. Double Click again to come back to the original display. This will not apply when in **Select** mouse mode.
- Typically click **(Next)** and **(Back)** to navigate through the wizard panels.

Measurement Accuracy

Voxel Dimensions

The image set resolution, i.e., the dimensions of the voxels (volume elements) that constitute the image set, is determined by the size of the field-of-view, the pixel size, and the inter-slice distance.

Ideally, voxels should be isotropic (with the same dimensions along all three axes), i.e., the inter-slice distance should be the same as the voxel dimension in the acquisition plane. In practice, however, considerations such as patient irradiation dose levels will usually lead to the choice of a larger inter-slice distance.

You should be aware that details with dimensions in the order of or less than the inter-slice distance cannot be identified or measured with any degree of reliability.

Geometrical accuracy

The largest dimension of a voxel (normally the inter-slice distance) determines the maximum geometrical accuracy:

- The maximum geometrical accuracy of the displayed length is equal to \pm largest voxel dimension,
- For an angle measurement, the maximum geometrical accuracy depends on the length of the segments and improves as the length of the segments increases. As an example, for an angle measured between segments, which are five times larger than the largest voxel dimension, the geometrical accuracy of the displayed angle value is equal to ± 10 degrees.
- The maximum geometrical accuracy of the displayed area value is equal to \pm the circumference of the region of interest multiplied by $(\text{largest voxel dimension})^2 / 2$
- Accuracy of volume measurements is \pm the volume defined by boundary voxels. The volume of a voxel is equal to the distance between slice planes multiplied by the square of the pixel size. As an example, a volume defined as a 10x10x10 cube of voxels would be within 9x9x9 volume_of_voxel and 11x11x11 volume_of_voxel.

Accuracy will be better for large, compact and well-defined shapes like high contrast sphere, worse for small objects with irregular boundaries (spiculated tumors, sponge-like textures).

General good practices when performing measurements involve:

- Using smallest possible field of view (highest magnification factor)
- Ensuring that contrast and brightness are correctly adjusted: values in background and foreground tissues should not be saturated and there should be no bias leading to under or overestimate the location of structure boundaries. Ideally, for CT position “Level” halfway between foreground and background values, “Width” should at least be equal to the difference between foreground and background values. For modalities relying on minimum and maximum values, similar considerations apply.
- Keeping partial volume effects in mind (avoid performing measurements on the most inferior and superior slices of an object scanned with axial slices for instance). Large slice thicknesses should also be avoided.

The maximum *geometrical* accuracy defines a lower bound on the overall accuracy that can be obtained. Further limiting factors are the vessel analysis quantification algorithm, acquisition accuracy, partial volume effects, display settings and display resolution.

Acquisition Accuracy

Any errors resulting from the acquisition process that are present in the original image set (calibration and slice interpolation errors, motion artifacts) will be added to the same extent to the measurement error.

Partial Volume Effects

In X-ray exams (CT and 3DXR), the value of a voxel is the weighted average for all materials in the voxel. Because of the high attenuation coefficient of calcium, even a small amount of calcium in a voxel will weigh its value towards that of calcifications or bone, so that the entire voxel appears to be calcifications or bone.

Display Settings and Display Resolution

Since anatomical features are rarely of a uniform density, the apparent dimension of an anatomical feature can change when you change the display settings (window width and level).

However, when you place the measurement points yourself, (e.g., for an additional diameter measurement), the apparent diameter can differ by one or more voxels depending on the W/L settings, thereby adding another factor of uncertainty.

The display resolution of each view depends on the screen split and the screen resolution, and you obviously cannot place a manual measurement point with a precision better than a single pixel.

Revision History

Revision	Date	Reason for change	Pages
1	2021-07	Initial release based on 5853601 rev1	108
2	2022-08	Safety and regulatory updates	102
3	2023-03	New GE HealthCare branding	103
4	2024-02	Safety and regulatory updates	102
5	2024-08	Safety and regulatory updates	102



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**Direction 5479848-1EN
Revision 8**

AW VolumeShare 7 (version: AW4.7) DICOM CONFORMANCE STATEMENT

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CONFORMANCE STATEMENT OVERVIEW

The Advantage Workstation AW4.7 is a Networked Medical Imaging Console dedicated to Examination Review and Diagnosis on film. The workstation uses DICOM services to import images for possible further analysis or processing and to export images to other DICOM implementations, DICOM printers or DICOM Interchange media. It also uses the DICOM Storage Commitment service to transfer ownership of images to a remote workstation supporting storage commitment such as an archive system. Advantage Workstation is not an archive workstation.

Table 0.1 provides an overview of the network services supported by AW4.7.

Table 0.1 – NETWORK SERVICES

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Computed Radiography Image Storage	Yes	Yes
Digital X-Ray Image Storage – For Presentation	Yes	Yes
Digital X-Ray Image Storage – For Processing	Yes	Yes
Digital Mammography X-Ray Image Storage – For Presentation	Yes	Yes
Digital Mammography X-Ray Image Storage – For Processing	Yes	Yes
CT Image Storage	Yes	Yes
Ultrasound Multi-frame Image Storage	Yes	Yes
Ultrasound Multi-frame Image Storage (Retired)	Yes	Yes
MR Image Storage	Yes	Yes
Ultrasound Image Storage	Yes	Yes
Ultrasound Image Storage (Retired)	Yes	Yes
Secondary Capture Image Storage	Yes	Yes
Standalone Overlay Storage	No	Yes
X-Ray Angiographic Image Storage	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	Yes	Yes
Nuclear Medicine Image Storage	Yes	Yes
Spatial Registration Storage	Yes	Yes
Basic Text SR	Yes	Yes
Enhanced SR	Yes	Yes
Comprehensive SR	Yes	Yes
Mammography CAD SR	Yes	Yes
Key Object Selection Document	Yes	Yes
X-Ray Radiation Dose SR	Yes	Yes
Encapsulated PDF Storage	Yes	Yes
Positron Emission Tomography Image Storage	Yes	Yes

Standalone Curve Storage	Yes	Yes
Standalone PET Curve Storage	Yes	Yes
RT Image Information Storage	Yes	Yes
RT Dose Storage	Yes	Yes
RT Structure Set Storage	Yes	Yes
RT Plan Storage	Yes	Yes
GE Private DICOM 3D Object	Yes	Yes
NM Genie Private Data	Yes	Yes
PET Advance Private Data	Yes	Yes
Verification SOP Class	Yes	Yes
Query/Retrieve		
Patient Root Query/Retrieve Information Model – MOVE	No	Yes
Study Root Query/Retrieve Information Model – FIND	Yes	Yes
Study Root Query/Retrieve Information Model – MOVE	Yes	Yes
Print Management		
Basic Film Session SOP Class	Yes	No
Basic Film Box SOP Class	Yes	No
Basic Grayscale Image Box SOP Class	Yes	No
Basic Color Image Box SOP Class	Yes	No
Basic Grayscale Print Management Meta SOP Class	Yes	No
Basic Color Print Management Meta SOP Class	Yes	No
Printer SOP Class	Yes	No
Workflow Management		
Storage Commitment Push Model SOP Class	Yes	No

Option*: This means that this service can be purchased separately

Table 0.2 provides an overview of the Media Storage Application Profiles supported by AW4.7.

Table 0.2 - MEDIA SERVICES

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
Compact Disk - Recordable		
Basic Cardiac X-Ray Angiographic CD-R	Yes: FSC	Yes
Augmented Basic Cardiac X-Ray Angiographic CD-R	Yes: FSC	Yes
General Purpose CD-R	Yes: FSC	Yes
DVD		
General Purpose JPEG DVD	Yes: FSC	Yes
General Purpose JPEG 2000 DVD	No	Yes

USB		
General Purpose JPEG USB	FSC: Yes	Yes
General Purpose JPEG 2000 USB	No	Yes

Option*: This means that this service can be purchased separately

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1. INTRODUCTION

1.1 OVERVIEW

This DICOM Conformance Statement is divided into Sections as described below:

Section 1 (Introduction), which describes the overall structure, intent, and references for this Conformance Statement

Section 2 (Network Conformance Statement), which specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Networking features.

Section 3 (Media Storage Conformance Statement), which specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Media Storage features.

Section 4 (Storage Commitment Push Model Implementation) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Storage Commitment Push feature.

Section 5 (Basic Directory Information Object Implementation) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Media Storage Directory Information Object.

Section 6 (Network Print SCU Conformance Statement) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Network Print features.

Section 7 (Network Print Management SOP Class definition) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Network Print Management SOP Class.

Section 8 (SC Information Object Implementation) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of SC Information Object Implementation feature.

Section 9 (Enhanced SR Object Implementation) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Enhanced SR Information Object Implementation feature.

Section 10 (Key Object Selection Object Implementation) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Key Object Selection Information Object Implementation feature.

Section 11 (XA Image Object Implementation) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of XA Image Information Object Implementation feature.

Section 12 (DPO Information Object Implementation) specifies that AW4.7 does not support DPO any more.

Section 13 (XA Downscan Information Object Implementation) specifies the DICOM attributes that are modified when reducing the resolution of GE XA Cardiac images to 512x512.

Section 14 (Tool to modify first and last name of patients) specifies the DICOM attributes that are modified to create anonymous images from existing images.

Section 15 (Query Implementation) specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Network Query feature.

This document specifies the DICOM implementation. It is entitled:

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Conformance Statement for DICOM
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This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required to interoperate with the GEHC network interface.

The GEHC Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM Part 8 standard.

For more information regarding DICOM, copies of the Standard may be obtained on the Internet at <http://medical.nema.org>. Comments on the Standard may be addressed to:

DICOM Secretariat
NEMA
1300 N. 17th Street, Suite 1752
Rosslyn, VA 22209
USA
Phone: +1.703.841.3200

1.3 INTENDED AUDIENCE

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM Standard and with the terminology and concepts which are used in that Standard.

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document to provide an unambiguous specification for GEHC implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEHC medical data exchanged using DICOM. The GEHC Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEHC devices are capable of using different Information Object Definitions. For example, a GEHC CT Scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this DICOM Conformance Statement are the Module Definitions which define all data elements used by this GEHC implementation. If the user encounters unspecified private data elements while parsing a GEHC Data Set, the user is well advised to ignore those data elements (per the DICOM standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements which are sent by GEHC devices.

1.5 IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be**

successful. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non-GE systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.
- **Validation** - Testing the complete range of possible interactions between any GE device and non-GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non-GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non-GE device and the stability of the image data for the intended applications.

Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEHC protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) described by these DICOM Conformance Statements.** The **user** should ensure that any non-GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.
- **Interaction** - It is the sole responsibility of the **non-GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1.6 REFERENCES

Document	Reference
NEMA PS3	Digital Imaging and Communications in Medicine (DICOM) Standard, available free at http://medical.nema.org/
GE DICOM Conformance Statements	https://www.gehealthcare.com/products/interoperability/dicom

1.7 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.

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
AET	Application Entity Title
CAD	Computer Aided Detection
CDA	Clinical Document Architecture
CD-R	Compact Disk Recordable
CSE	Customer Service Engineer
CR	Computed Radiography
CT	Computed Tomography

DHCP	Dynamic Host Configuration Protocol
DICOM	Digital Imaging and Communications in Medicine
DIT	Directory Information Tree (LDAP)
DN	Distinguished Name (LDAP)
DNS	Domain Name System
DX	Digital X-ray
FSC	File-Set Creator
FSU	File-Set Updater
FSR	File-Set Reader
GEHC	General Electric Healthcare
GSDf	Grayscale Standard Display Function
GSPS	Grayscale Softcopy Presentation State
HIS	Hospital Information System
HL7	Health Level 7 Standard
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Organization for Standards
IO	Intra-oral X-ray
JPEG	Joint Photographic Experts Group
LDAP	Lightweight Directory Access Protocol
LDIF	LDAP Data Interchange Format
LUT	Look-up Table
MAR	Medication Administration Record
MPEG	Moving Picture Experts Group
MG	Mammography (X-ray)
MPPS	Modality Performed Procedure Step

MR	Magnetic Resonance Imaging
MSPS	Modality Scheduled Procedure Step
MTU	Maximum Transmission Unit (IP)
MWL	Modality Worklist
NM	Nuclear Medicine
NTP	Network Time Protocol
O	Optional (Key Attribute)
OP	Ophthalmic Photography
OSI	Open Systems Interconnection
PACS	Picture Archiving and Communication System
PET	Positron Emission Tomography
PDU	Protocol Data Unit
R	Required (Key Attribute)
RDN	Relative Distinguished Name (LDAP)
RF	Radiofluoroscopy
RIS	Radiology Information System
RT	Radiotherapy
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
SR	Structured Reporting
TCP/IP	Transmission Control Protocol/Internet Protocol
TLS	Transport Layer Security
U	Unique (Key Attribute)
UL	Upper Layer
US	Ultrasound

GE Healthcare

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VL	Visible Light
VR	Value Representation
XA	X-ray Angiography

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the AW4.7 compliance to DICOM requirements for **Networking** features.

The Advantage Workstation 4.7 is a Networked Medical Imaging Console dedicated to Examination Review and Diagnosis on film. The workstation uses DICOM services to import images for possible further analysis or processing and to export images to other DICOM implementations, DICOM printers or DICOM Interchange media. It also uses the DICOM Storage Commitment service to transfer ownership of images to a remote workstation supporting storage commitment such as an archive system.

The Advantage Workstation 4.7 has the ability to compose films through the use of an application known as FILMER. The Advantage Workstation 4.7 uses DICOM Print Management Service Class to send images to hard copy printers. The films can then be used for possible further analysis.

The station provides a basis for applications built on top of it. These applications can create specific Information Object Definitions that will be described in the conformance statement of the added applications. The added applications can benefit the network facilities provided by the station.

This DICOM conformance statement refers to the DICOM standard PS3.3 for the description of standard IODs.

The EM DICOM Implementation is an optional feature and described below as EM DICOM SERVER AE.

This DICOM conformance statement refers to other DICOM conformance statements for formal descriptions of IODs created by added applications:

- GE Private 3D Model Objects are described in the AW Volume Viewer Applications DICOM Conformance Statement in the Workstation tab, see 1.6.
- GE private DICOM NM images aka Xeleris/eNTEGRA Protocol Data are described in the GENIE ACQUISITION GENIE DICOM Conformance Statement in the Nuclear Medicine DICOM tab, see 1.6.
- GE private DICOM PET images are described in the Discovery 710/610 and Optima 560 DICOM Conformance Statement in the Positron Emission Tomography (PET) DICOM tab see 1.6.

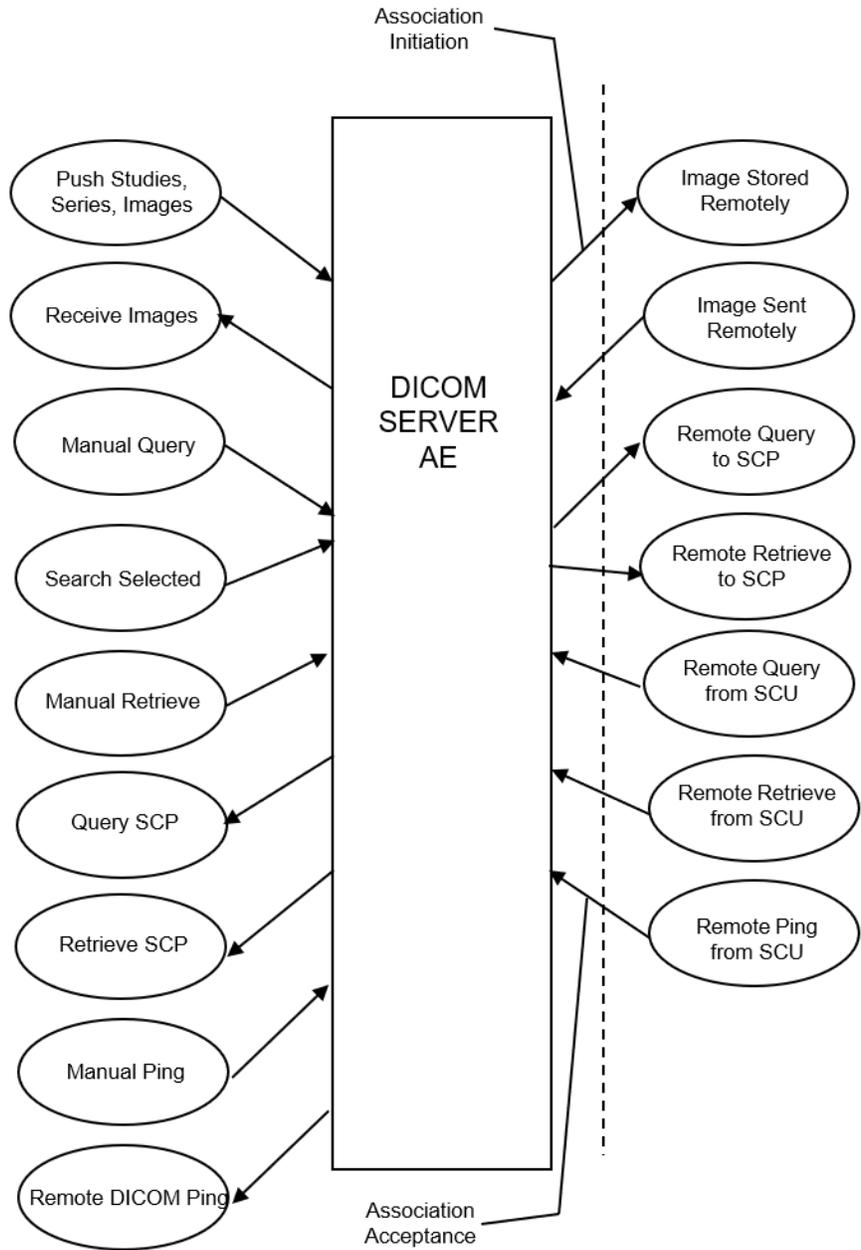
Note that the format of this section strictly follows the format defined in DICOM Standard PS 3.2 (Conformance). Please refer to that part of the standard while reading this section

2.2.1 Application Data Flow Diagram

The network application model for the AW4.7 is shown in the following Illustration :

ILLUSTRATION 2-1
AW4.7 DICOM SERVER AE AND DATA FLOW DIAGRAM

10.9.1, 10.9.2



DICOM Standard Interface

Note: The DICOM SERVER AE plays also the DICOM Verification SOP class as a SCU and SCP. It is not indicated on the illustration above.

The DICOM SERVER Application Entity (AE) is an application that handles DICOM protocol communication. The DICOM SERVER AE is automatically brought up when the Advantage Workstation 4.7 is powered on.

The DICOM SERVER AE is invoked by the following Real World Activities:

- Push Studies/Series/Images.

For this operation, the operator selects:

- some studies, series or images on the console browser and then sends the selected studies, series or images on one or several remote DICOM AE by a drag and drop on the icon that represents the wanted remote DICOM AE.
- a set of studies of the same patient and launches the end of review. A set of series of the patient will be then sent to a set of declared remote DICOM AEs following user defined rules.

The transfer activity is displayed on a specific icon.

The declaration of remote DICOM AE is done through a specific application (known as NETWORK MANAGEMENT).

- Manual Query

For this operation, the operator queries one or a set of remote DICOM databases to obtain a list of data at Study/Series/Image level by clicking on the icon that represents the wanted remote DICOM AE. The query is selective based on criteria described below in the document.

- Search Selected

For this operation, the operator selects a patient and queries one or a set of remote DICOM databases to obtain a list of data corresponding to the selected patient at Study/Series/Image level by clicking on the “Search Selected” icon. The query is selective based on criteria described below in the document.

- Manual Retrieve **9.1.3**

Once the remote browser is displayed (Manual Query), the operator can retrieve the SOP Classes supported by the Advantage Workstation 4.7 from the remote DICOM AE. The data can be retrieved at the Study, Series and Image levels.

- Receive images from a Remote DICOM AE

When images are installed in the local database, the local Patient List displays the content of the Advantage Workstation 4.7 local database.

- Remote Query

For this operation, a remote DICOM AE asks to obtain the list of data at Study/Series/Image level.

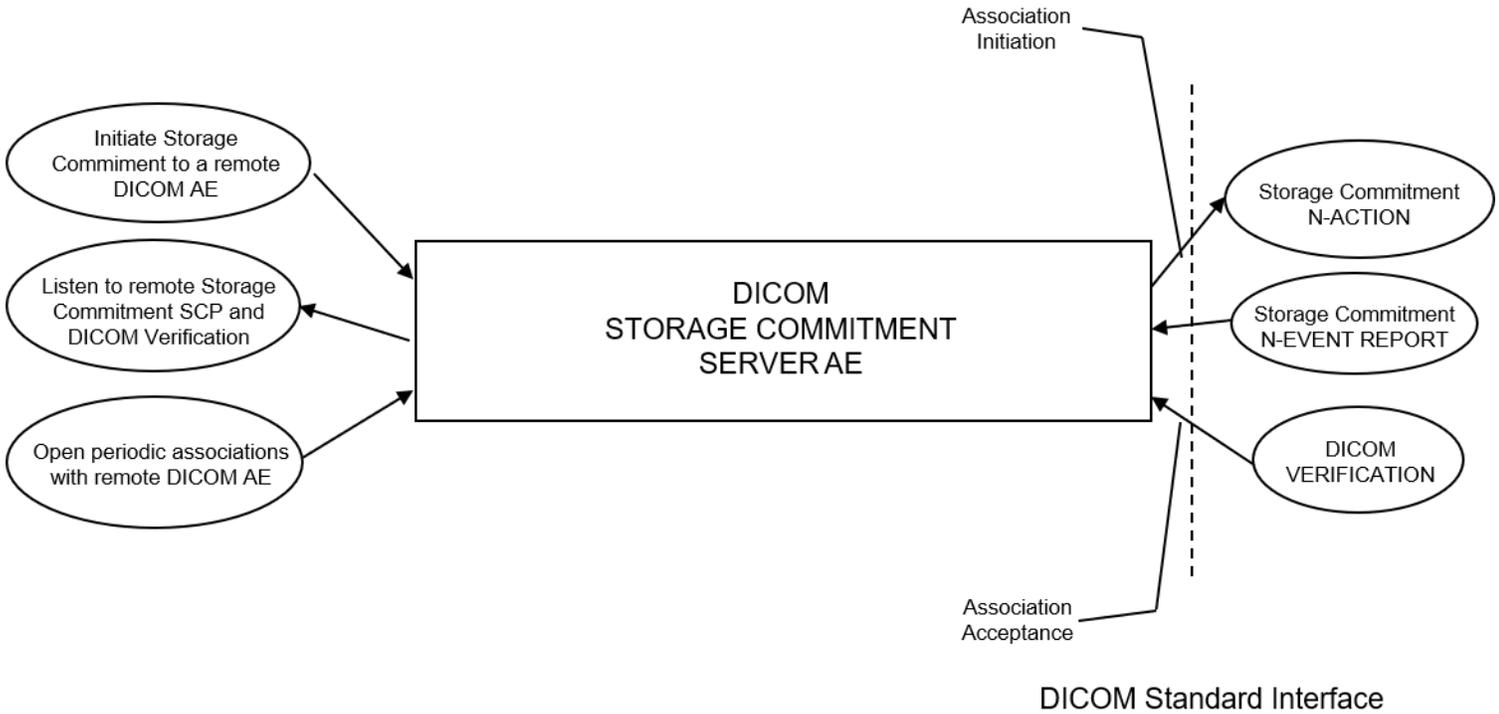
- Remote Retrieve

For this operation, a remote DICOM AE asks to send data at Patient/Study/Series/Image level from the local AE to another DICOM Remote AE. The remote DICOM AE can ask to move the SOP Classes supported by the Advantage Workstation 4.7 at the Patient/Study/Series/Image level. The Remote DICOM AE shall be declared locally on the Advantage Workstation 4.7. The declaration of remote DICOM AE is done through a specific application (known as NETWORK MANAGEMENT).

- Remote Ping

For this operation, a remote DICOM AE sends a VERIFICATION request to the local server

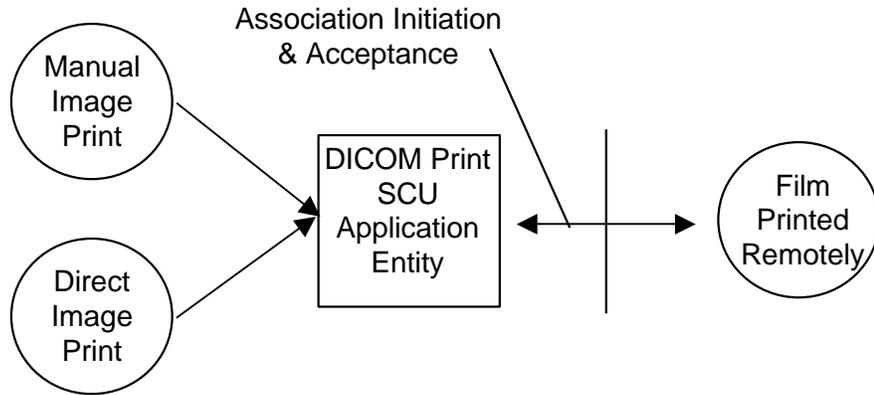
ILLUSTRATION 2-2
AW4.7 DICOM STORAGE COMMITMENT AE AND DATA FLOW DIAGRAM



The DICOM STORAGE COMMITMENT SERVER AE is invoked by the following Real World Activities:

- Initiate Storage Commitment to a Remote DICOM AE.
- Listen to remote Storage Commitment SCP.
- Open periodic associations with remote DICOM AE
- Listen to DICOM Verification request from remote DICOM AE

ILLUSTRATION 2-3
AW4.7 DICOM PRINT SCU AND DATA FLOW DIAGRAM



10.8.1

The DICOM Print SCU Application Entity (AE) is an application that handles the DICOM protocol communication with Remote DICOM Printers. The DICOM Print SCU AE is activated when the user requests for a print.

The DICOM Print SCU AE is invoked by the following Real World Activities:

- Manual Image Print

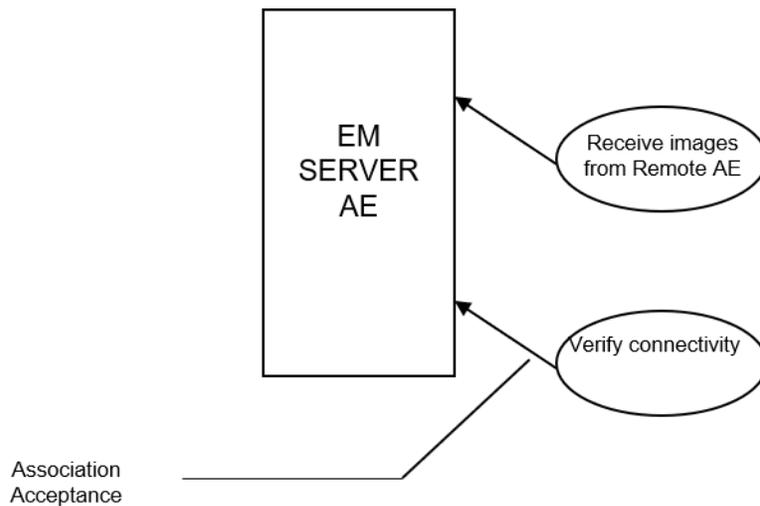
For this operation, the operator uses the *FILMER* application to prepare a layout of images and send the pages to the *PRINT BUILDER*.

- Direct Image Print

For this operation, the operator displays the images in the *VIEWER* and sends the images directly to the *PRINT BUILDER*.

In both cases, the *PRINT BUILDER* receives the “Simple print” request, composes a film then sends the film to the selected Remote DICOM Printer

ILLUSTRATION 2-4
 AW4.7 EM DICOM SERVER AE AND DATA FLOW DIAGRAM



DICOM Standard Interface

The EM DICOM SERVER AE is invoked by the following Real World Activities:

- Receive images from a Remote DICOM AE

When images are received, they are processed by EM and stored on the local AW4.7 database. The local Patient List displays the content of the Advantage Workstation 4.7 local database.

- Listen to DICOM Verification request from remote DICOM AE

Note that the EM DICOM SERVER AE is an optional feature.

2.2.2 Functional Definition of AE's

DICOM SERVER AE

The DICOM SERVER AE initiates the following operations:

- Initiate a DICOM association to send DICOM SOP Classes to a remote DICOM AE.
- Initiate a DICOM association to ask for remote patient demographics.
- Initiate a DICOM association to ask for transmitting images from a remote DICOM AE to Advantage Workstation 4.7.
- Initiate a DICOM association to check if an AET is alive (Verification SOP Class as SCU)

The DICOM SERVER AE waits for association requests from Remote AE:

- Answer to DICOM associations requesting patient, study, series or image information..
- Answer to DICOM associations requesting transmission of DICOM SOP Instances from the Advantage Workstation 4.7.
- Answer to DICOM associations transmitting DICOM SOP Classes to be stored on the Advantage Workstation 4.7.
- Answer to DICOM associations transmitting Verification SOP Class to the Advantage Workstation 4.7.

DICOM STORAGE COMMITMENT SERVER AE:

The STORAGE COMMITMENT SERVER AE initiates the following operations:

- Initiate a DICOM association to ask for the storage commitment of specific images and wait for a Storage Commitment Notification (N-EVENT-REPORT)
- Initiate a DICOM association and wait for a Storage Commitment Notification (N-EVENT-REPORT)

The STORAGE COMMITMENT SERVER AE waits for association requests from Remote Storage Commitment AE:

- Answer to DICOM associations transmitting Storage Commitment Notification (N-EVENT-REPORT)
- Answer to DICOM associations transmitting Verification SOP Class to the Advantage Workstation 4.7.

DICOM PRINT SCU AE:

The DICOM Print SCU AE supports the following functions:

- Access to pixel data
- Initiate a DICOM association to send DICOM SOP Classes (corresponding to the DICOM Print Management service class) to a remote DICOM Printer

EM DICOM SERVER AE:

The EM DICOM SERVER AE supports the following functions:

- Answer to DICOM associations transmitting DICOM SOP Classes to be processed and stored on the Advantage Workstation 4.7.
- Answer to DICOM associations transmitting Verification SOP Class to the EM DICOM SERVER of Advantage Workstation 4.7.

Note that the EM DICOM SERVER AE is an optional feature.

2.2.3 Sequencing of Real-World Activities

DICOM SERVER AE

Not applicable.

DICOM STORAGE COMMITMENT SERVER AE:

This sequence is only applicable for Remote AE where Storage Commitment Option is allowed in Network Manager.

1. The user selects the images and sends them to a remote host.
2. If the remote DICOM AE is associated with a Storage Commitment Provider AE and if the images are successfully sent to the DICOM AE, then a N-ACTION-RQ request is sent automatically to the associated Storage Commitment Provider AE. The Storage Commitment Provider AE can be configured independently from the remote DICOM AE with network address, port, connection encryption flag and AE title.
3. Waits for N-ACTION-RSP from a remote Storage Commitment Provider AE.
4. On reception of failure in N-ACTION-RSP, the Storage Commitment AE logs the error, displays a pop-up and stops.
5. On reception of success, Storage Commitment AE is ready to receive at any time from Storage Commitment Provider the N-EVENT-REPORT-RQ notification.
6. On reception of a successful N-EVENT-REPORT-RQ notification from Storage Commitment Provider, the images are flagged as committed in the database.
7. The Storage Commitment AE sends a N-EVENT-REPORT-RSP to the Storage Commitment Provider

8. The Storage Commitment AE opens periodic association with all the DICOM AE that have been declared as Storage Commitment Provider on the station. The time between these associations is configurable.

DICOM PRINT SCU AE:

The user selects the remote DICOM Printer from Print Builder Graphical User Interface.

1. The images to be printed shall be dragged and drop into the FILMER application either manually or automatically.
2. The PRINT BUILDER receives the “Simple print” request, composes a film then activates the DICOM Print SCU AE that initiates the following actions.
3. The PRINT BUILDER Initiates a DICOM association and selects a Presentation Context.
4. N-GETs printer status from the Printer SOP Instance
 - a. If the Printer Status is FAILURE
 - i. The failure is displayed to the user
 - ii. The association is aborted
 - b. If the Printer Status is a warning
 - i. Just report the warning status and continue
 - c. Else (Ok status)
 - i. The Print goes on
 - d. Endif
5. N-CREATEs a Basic Film Session SOP Instance
6. N-CREATEs a Basic Film Box SOP Instance for the current film
7. N-SETs the Basic Film Box SOP Instance with the Image Box SOP Instance for each image on the film
8. N-ACTIONs on the Basic Film Box SOP Instance
9. N-DELETEs on the Basic Film Box SOP Instance
10. Releases the DICOM association after printing is successful or failure has been signaled to the user

EM DICOM SERVER AE:

Not applicable.

2.3 AE SPECIFICATIONS

2.3.1 DICOM SERVER AE Specification

The DICOM SERVER Application Entity provides Standard Conformance to the following DICOM SOP Classes as an **SCU** and/or as an **SCP**:

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes	Yes
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes	Yes
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	Yes
Digital Mammography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes	Yes
Digital Mammography Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	Yes
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	Yes
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	Yes	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	Yes
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	Yes
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	Yes	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	No	Yes
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	Yes
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1	Yes	Yes
Deformable Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.3	Yes	Yes
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11	Yes	Yes
Enhanced SR Storage	1.2.840.10008.5.1.4.1.1.88.22	Yes	Yes
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Yes	Yes
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	Yes	Yes
Key Object Selection Document Storage	1.2.840.10008.5.1.4.1.1.88.59	Yes	Yes
X-Ray Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67	Yes	Yes
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	Yes
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9	Yes	Yes
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129	Yes	Yes
RT Image Information Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	Yes

RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Yes	Yes
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Yes	Yes
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Yes	Yes
GE Private DICOM 3D Object	1.2.840.113619.4.26	Yes	Yes
PET Advance Private Data	1.2.840.113619.4.30	Yes	Yes
NM Genie Private Data	1.2.840.113619.4.27	Yes	Yes
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	No	Yes
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	Yes
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	Yes

Note: C-FIND is done using Study Root Information Model.

Note: Grayscale Softcopy Presentation State Storage (1.2.840.10008.5.1.4.1.1.11.1) and Blending Softcopy Presentation State Storage (1.2.840.10008.5.1.4.1.1.11.4) abstract syntax is received on network / read from media and some properties (image number, date/time, description and creator's name) are displayed in the BROWSER but the basic Advantage Workstation 4.7 applications cannot display this object in a meaningful way (only black image is visible) and objects content is not taken into account while displaying the referenced images.

2.3.1.1 Association Establishment Policies

2.3.1.1.1 General

The DICOM Application Context Name (ACN), which is always proposed, is:

Application Context Name	1.2.840.10008.3.1.1.1
---------------------------------	------------------------------

The maximum length PDU negotiation is included in all association establishment requests.

The maximum length PDU receive size for the DICOM SERVER AE is:

Maximum Length PDU	64234 Bytes / Configurable
---------------------------	-----------------------------------

Note: The SOP Class Extended Negotiation is not supported.

Note: The user information Items sent by this product are:

- Maximum PDU Length
- Implementation UID

2.3.1.1.2 Number of Associations

The DICOM SERVER AE will initiate only one DICOM association at a time to perform a DICOM store operation as a SCU to a Remote Host AE.

The DICOM SERVER AE will initiate only one DICOM association at a time to perform a DICOM Query/Retrieve operation as a SCU with a Remote Host AE.

The DICOM SERVER AE can have a maximum of 6 open unencrypted DICOM associations and 6 open encrypted DICOM associations at a time to perform a DICOM operation as a SCP.

2.3.1.1.3 Asynchronous Nature

Asynchronous mode is not supported. All operations will be performed synchronously.

2.3.1.1.4 Implementation Identifying Information

The Implementation UID for this DICOM Implementation is:

Advantage Workstation 4.7 Implementation UID	1.2.840.113619.6.350
Advantage Workstation 4.7 Implementation Version Name	The Implementation Version Name represents the canonical version of the AW, for example: AW4_7_01_186_HEL

2.3.1.2 Association Initiation Policy

When the DICOM SERVER AE Application Entity initiates an Association for any Real-World Activity, it will propose the Presentation Contexts for all Real-World Activities; i.e., there is only a single, comprehensive Presentation Context Negotiation proposed for the AE.

The DICOM SERVER AE proposes the transfer syntaxes “Uncompressed Transfer Group” of **Table 2.3–1** in each Presentation Context.

2.3.1.2.1 Real-World Activity: Push Studies/Series/Images

2.3.1.2.1.1 Associated Real-World Activity

The operator can select in the BROWSER one or several Studies (or Series/Images) to be sent. Then, the user can either drag and drop the selection on the icon representing then Remote DICOM AE, or click on the “Push” icon and select a Remote DICOM AE in the LIST OF REMOTE HOST.

The operator can select in the BROWSER one or several studies of the same patient and launch the End of review tool. A set of series of the patient will be then sent to a set of declared remote DICOM AEs following user defined rules.