



# Arc 3D Model Viewer

v.1.0.0

# User Manual

# Arc 3D Model Viewer User Manual

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# Introduction

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## Revision History

Version	Date	Comments
1.0.0	2024.06.25	Initial Release

## Known Issues

- X3D Transformations are automatically utilized with a dataset is imported. A future revision will add a dialogue box to accept/reject Transformations at import.
- The Zoom tool may display unexpected behavior for models with very large bounding boxes.

## Audience

This document is intended for the audience listed below. Elements of the document assume that the reader has a working knowledge of the DICOM Standard. The document structure was designed for facile access to relevant information for different user groups:

- Clinical users (for non-diagnostic use)
- System integrators
- Hospital IT staff
- Research personnel
- Other persons interested in 3D model viewing (e.g., educators, patients, patient-family members, etc.)

## Remarks

The scope of the Partial DICOM Conformance Appendix at the end of this manual is to facilitate integration between Arc 3D Model Viewer and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard [1]. 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 should not replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, it is the user's responsibility to perform the following validation activities:

- The comparison of Conformance Statements from Arc 3D Model Viewer and other DICOM conformant equipment is the first step towards assessing interconnectivity and interoperability between those systems.
- Test procedures should be defined and executed to validate the required level of interoperability with specific DICOM conformant equipment, as established by the healthcare facility.

# Getting Started

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## Regulatory Information

Arc 3D Model Viewer (Lite) is not intended for diagnostic use.

### Minimum/Recommended\* Specifications:

Operating System	Microsoft® Windows® 10 64-bit
CPU	Minimum: Intel Core i5 4460 or AMD FX-8350 Recommended: Intel Core i5 6500 or AMD Ryzen 3 1200
Memory (RAM)	Minimum: 4 GB Recommended: 16 GB
GPU	Minimum: Nvidia GeForce GT 1030 or AMD Radeon RX 550 Recommended: Nvidia GeForce GTX 1050 or AMD RX 560
Disk Space	Minimum: 256 MB Recommended: 5 GB

\*Arc 3D Model Viewer may run on minimum specifications (or even below the specifications provided), but performance of the software may be impacted. Performance can also be impacted by model complexity (e.g., number of polygons).

## Installation Guide

Navigate to the [Webster Foundation 3DI Lab Website](#) to obtain the latest version of Arc 3D Model Viewer.

- 1.** Open the installer. Currently, English is the only supported language.
- 2.** Review and accept the terms of the licensing agreement (or close the installer if you decline to accept the terms).
- 3.** Confirm the desired installation directory and press Next.
- 4.** Review the optional settings. Click Next.
- 5.** Press Install.
- 6.** Press Finish to complete the installation.

## Supported File Formats

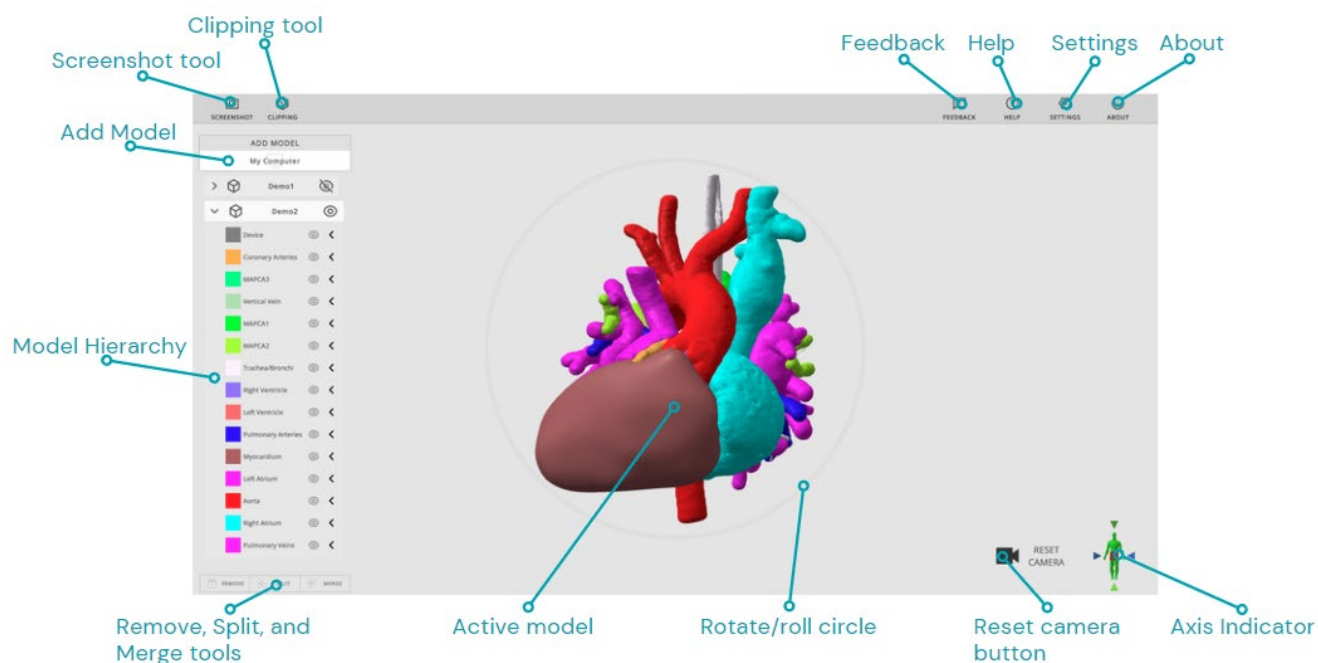
Arc Viewer can open and view the following filetypes:

- 1.** X3D
- 2.** STL (binary and ASCII)
- 3.** OBJ
- 4.** DICOM-Encapsulated STL (see Partial DICOM Conformance Appendix for more information)

Future versions of Arc 3D Model Viewer will support glTF, glB, and DICOM-Encapsulated OBJ.

## Workspace Layout

Below is a labeled image of the Arc 3D Model Viewer's default layout. Each feature is explained in more detail further into this document.

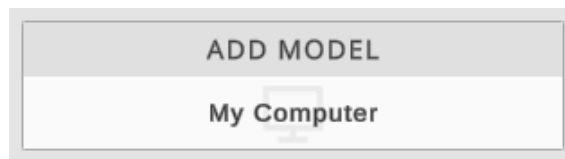


# Models

## Add Models

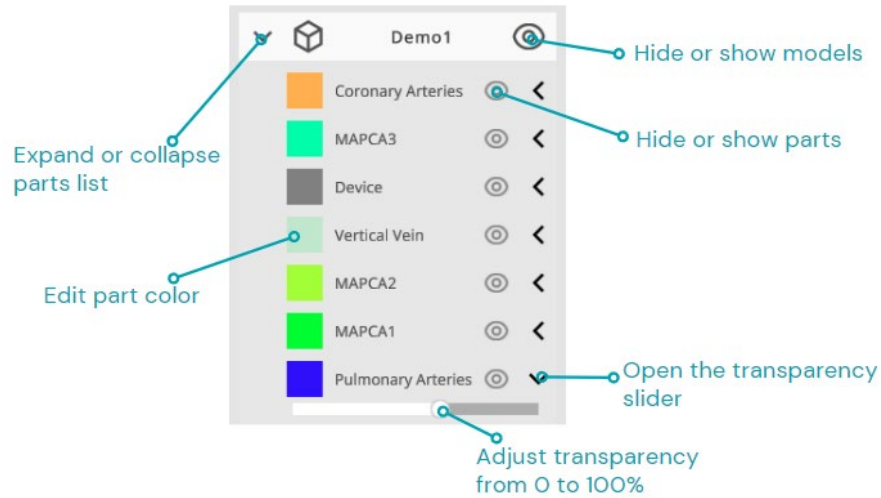
There are a few ways to open models in Arc.

1. Click the "My Computer" button, on the top left of the workspace. A file browser window will appear. Select one or more models and click "Open". After a brief loading period, it will appear in the center of the workspace.
2. Right click on a compatible file, select "Open with..." and select Arc 3D Model Viewer. A window will open, and the model will load into the workspace.
3. At install, supported file extensions (excluding the .DCM extension) can be specified to be associated to Arc 3D Model Viewer. Double clicking on these models in a file browser will launch the model in 3D Arc Model Viewer.



## Model Hierarchy / Object Tree

When importing models, a model hierarchy will appear on the left-hand side of the screen. The name of the complete model will be listed on top; parts (i.e., shapes/components of the model) will be shown in a drop-down list beneath the component name.



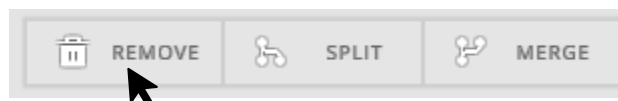
## Edit Part Color

To change the color of a part, click the colored square to the left of its name. A color picker will appear. Set the color by inputting a hex color code, or by scrolling on the color wheel and RGB sliders. Colors assigned are temporary for visualization purposes; the original 3D models are not edited.

Clicking "Reset" will reset the color of the part to its original color on import. Click "Close" to hide the color picker.

## Remove Models

To remove a model from the workspace, first ensure the model is selected by clicking on the model name. Then click the "Remove" button located at the very bottom left of the workspace. The model should disappear from the workspace (n.b., Arc 3D Model Viewer does not have the ability to delete actual files).

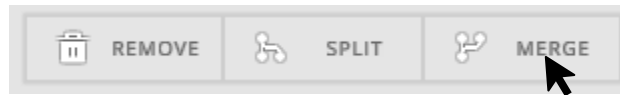




## Splitting and Merging Models

Selected parts may be split off from its parent model by clicking the “Split” tool, located at the bottom left of the workspace. This will create a new model for each part that was selected. Multiple parts can be selected by holding ctrl + left click on the various parts.

To merge parts, select multiple parts by holding ctrl + left click; click the “Merge” tool located at the bottom left of the workspace. This will create a new model containing the selected parts.

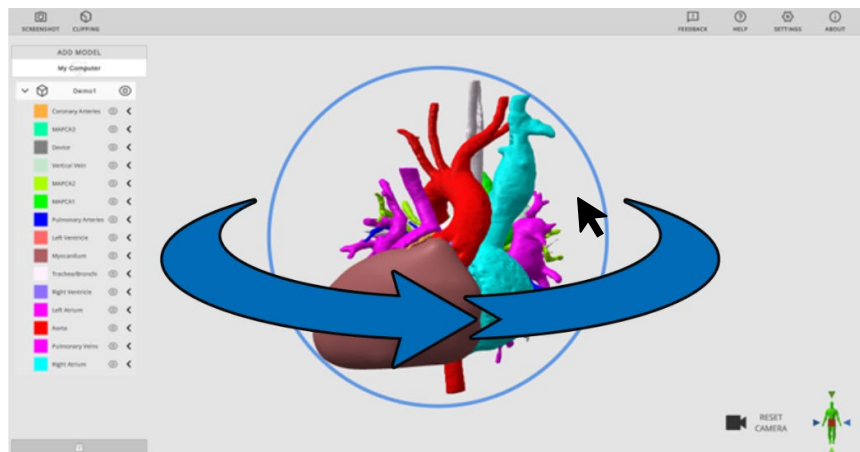


## Camera Controls

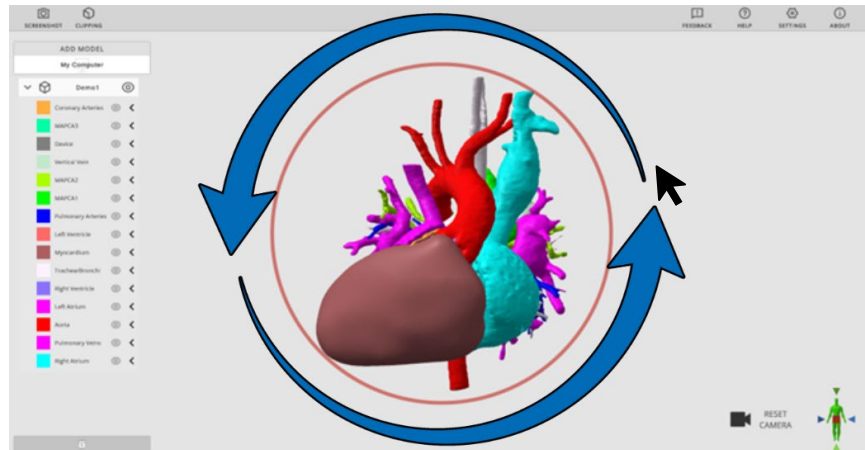
### Rotate and Roll

By default, right mouse click and drag is used to rotate and roll the model. A gray circle is present in the workspace to differentiate the tools, as follows:

**Rotate:** Right-mouse click-and-hold inside the circle. The circle will turn blue while rotating. While rotating, you can turn the model in any direction.



**Roll:** Right-mouse click-and-hold outside the circle. The circle will turn red while rolling. While rolling, you can turn the model while keeping the axis facing the camera locked in place.



## Pan

By default, the pan function is accessible by holding middle-mouse-click (pressing in the mouse wheel). This will slide the model in any direction the cursor is moved while dragging.



## Zoom

By default, the zoom function is accessible with the mouse wheel, as follows.

Zoom in: Scroll up on the mouse wheel.

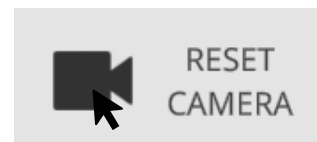
Zoom out: Scroll down on the mouse wheel.



The zoom sensitivity can be adjusted with the “Viewer Sensitivity” slider in [Settings](#).

## Reset Camera

By default, the Reset Camera function will activate with the “R” Key, or by clicking the “Reset Camera” icon on the bottom right of the workspace. This will instantly move the camera to return to the default view, centered on the current active model(s).



## Screenshot

Click the "Screenshot" icon on the top left of the workspace to take a screenshot of the current display, with the UI removed. A prompt will appear to save the generated image to your computer. Rename and save the image by clicking "Save". The default file format is .PNG.



# Clipping Plane

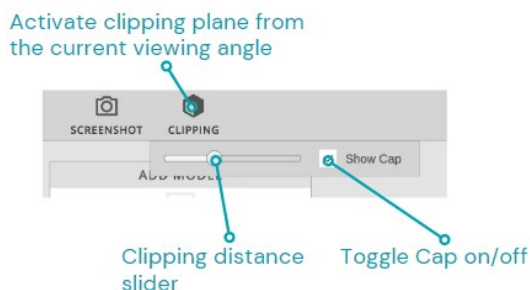
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A clipping plane is an invisible flat plane that slices a 3D model to reveal internal geometry.

## Enable Clipping Plane

Click the "Clipping" icon at the top left of the workspace to activate the clipping plane. The clipping plane will always generate parallel to the current camera view.

While the clipping plane is active, camera controls can be adjusted, and the clipping plane will stay in place related to when the clipping was enabled. To clip into the model from another angle, the clipping plane must be disabled and re-enabled.



## Clipping Distance Slider

With clipping enabled, the clipping distance slider will appear. Move the slider to the right to clip into the model, and move it left to clip out of the model. When multiple models are loaded into the workspace, a bounding box is generated that encloses both models, and the clipping plane will slice through both, beginning from the camera location.

## Show Cap

The "Show Cap" setting will generate a dark gray wall over solid parts of the clipped model. Check or uncheck the box beside the clipping slider to enable and disable this setting.

# Settings

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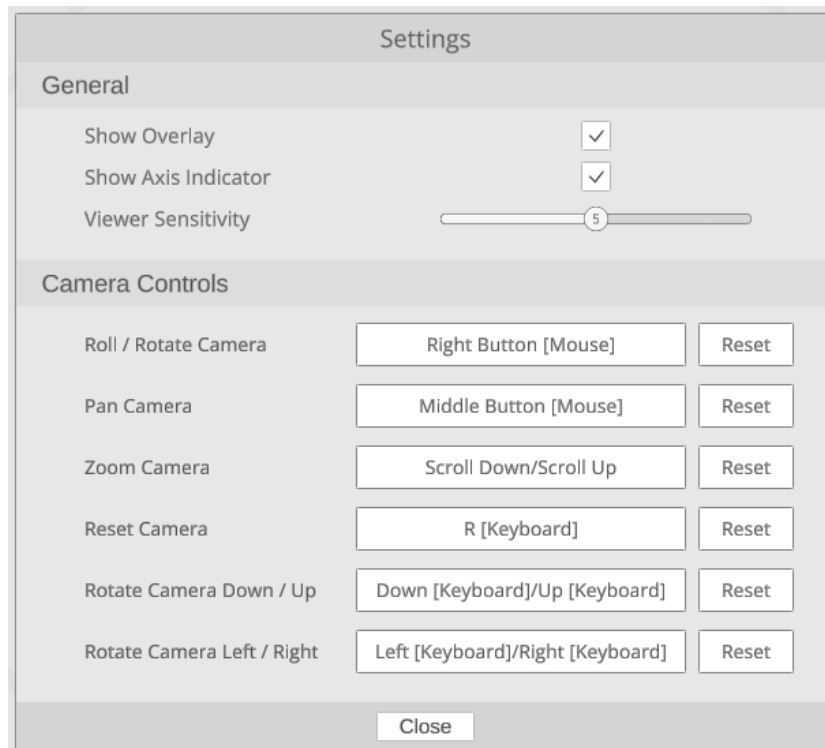
## General

Open the Settings window by clicking the gear icon labeled "Settings" on the top right of the workspace.

**Show Overlay:** Hide or show the Model Hierarchy, Reset Camera button, and Rotate/Roll circle.

**Show Axis Indicator:** Hide or show the Axis Indicator in the workspace.

**Viewer Sensitivity:** Adjust the sensitivity of the zoom function. Increasing the sensitivity (up to a maximum of 20) will increase the zoom amount per input. Decreasing the sensitivity (down to a minimum of 1) will decrease the zoom amount per input. Lower sensitivity may be useful for making fine movements, and a higher sensitivity may be useful for larger models.



## Edit Camera Controls

Set camera controls by clicking the button to the right of the desired function and inputting the new control. It should display the new setting in the box.

To reset the controls to default, click the "Reset" button to the right of it.

# Feedback and Help

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## Submitting Feedback

Click the “Feedback” icon on the top right of the workspace to open an email window directed to the 3D Lab inbox. If any bugs or crashes happen within Arc 3D Model Viewer (Lite), they can be reported directly here. Additionally, any suggestions for features to add are welcome.

## Help

Open the “Help” window by clicking the icon labeled “Help” on the top right of the workspace.

**Tutorials:** Click on the three video titles to navigate to a tutorial video covering the listed topic.

**Features:** Brief descriptions of important controls and features of the viewer are given here.

# Optional Internet Connectivity

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Arc 3D Model Viewer is designed to function with or without internet connectivity. The following are optional features if internet connectivity (port 80) is permitted.

- 1.** Version checker: Arc 3D Model Viewer will check to ensure that the latest version is utilized. If a new version is released and Arc 3D Model Viewer has internet connectivity, a message will display at program launch notifying users of the latest version.
- 2.** Tutorials: The help section will dynamically show tutorials that are appropriate for the current version of Arc 3D Model Viewer. Without connectivity, the Help tool will continue to work, but it will not show links to tutorials.
- 3.** Analytics/Telemetry: Arc 3D Model Viewer does not collect any data on its users. However, the software is built with Unity and may include engine-level anonymous data collection. [For more information, please refer to Unity's FAQ.](#)

# Partial DICOM Conformance Appendix

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## Terms and Definitions

The following list includes DICOM Terms, that are used throughout this conformance statement:

Application Entity (AE)	A representation of the external behavior of an application process in terms of DICOM network services, Web services and/or media exchange capabilities implemented in one or more roles. A single device may have multiple Application Entities.
Application Entity Title (AET)	The externally known name of an Application Entity, used to identify a DICOM application to other DICOM applications on the network.
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. Examples: MR Image IOD, CT Image IOD, Print Job IOD. The Attributes within an IOD 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).
Private SOP Class	A SOP Class that is not defined in the DICOM Standard but is published in an implementation's Conformance Statement.
Service/Object Pair Class (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 Instance (SOP Instance)	An information object; a specific occurrence of information exchanged in a SOP Class. E.g., a specific X-ray image.
Specialized SOP Class	A SOP class that is derived from the Standard that is specialized by additional type 1, 1C, 2, 2C, or 3 attributes by enumeration of specific permitted values for Attributes, or by enumeration of specific permitted

Templates. The additional Attributes may either be drawn from the Data Dictionary in PS3.6 or may be Private Attributes.

Standard SOP Class	A SOP class defined in the Standard, and that is implemented and used without any modifications.
Standard Extended SOP Class	A SOP class that is defined in the standard, and that is extended by additional type 3 attributes. The additional Attributes may either be drawn from the DICOM Data Dictionary in PS3.6 or may be Private Attributes.
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.

The following list includes product specific definitions used throughout this Conformance Statement:

<i>Product-specific Term</i>	<i>This is a product specific term used throughout this Conformance Statement</i>
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STL	A common 3D file format, often intended for 3D printing.
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## Abbreviations

Abbreviations that are used in this DICOM Conformance Statement are listed here.

AE	Application Entity
IOD	Information Object Definition

OID	Object Identifier
SOP	Service-Object Pair
UID	Unique Identifier

## References

[1] NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://www.dicomstandard.org/current>

# DICOM Implementation Model

## Application Entities and Data Flow

The network and media interchange application model for the Arc 3D Model Viewer is shown in Figure A.4.1.

Arc 3D Model Viewer is a standalone component which enables a user to import (through a file browser) a DICOM object. Arc 3D Model Viewer has no ability to Query/Retrieve from PACS/VNAs. Arc 3D Model Viewer does not write any data back to the DICOM Object location.

Arc 3D Model Viewer is intended to be installed onto a client Windows machine.

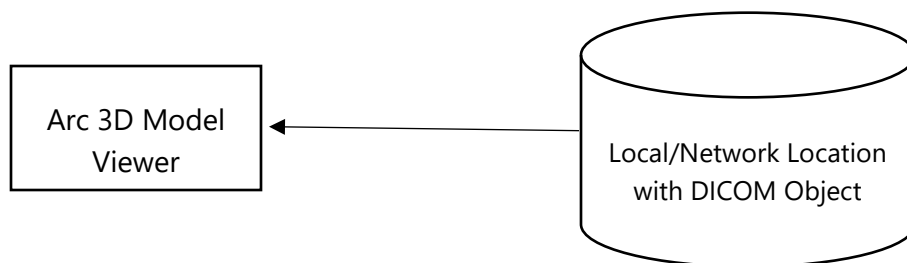


Figure A.4.1: Arc 3D Model Viewer Application Data Flow Diagram

# DICOM Configuration

## General Configuration Parameters

Arc 3D Model Viewer does not have any query/retrieve/Archive capabilities; the software can object select DICOM objects from a local or network location from a file browser. There are no associated DICOM parameters to adjust; see "Settings" for information on non-DICOM parameters.

# Media Storage AE

## General Configuration Parameters

When reading in 3D datasets in DICOM format (i.e., encapsulated STL) from a file browser; the SOP class must be the following:



SOP Class Name	UID
<b>Encapsulated STL Storage</b>	1.2.840.10008.5.1.4.1.1.104.3

Future versions will support Encapsulated OBJ Storage and a Private SOP Class implementations of Encapsulated X3D Storage and Encapsulated glTF Storage.

## Information Object Definitions

Table A.85.1-1 specifies the Encapsulated STL IOD Modules.

**Table A.85.1-1. Encapsulated STL IOD Modules**

IE	Module	Reference	Usage
Patient	Patient	<a href="#">C.7.1.1</a>	M
	Clinical Trial Subject	<a href="#">C.7.1.3</a>	U
Study	General Study	<a href="#">C.7.2.1</a>	M
	Patient Study	<a href="#">C.7.2.2</a>	U
	Clinical Trial Study	<a href="#">C.7.2.3</a>	U
Series	Encapsulated Document Series	<a href="#">C.24.1</a>	M
	Clinical Trial Series	<a href="#">C.7.3.2</a>	U
Frame of Reference	Frame of Reference	<a href="#">C.7.4.1</a>	M
Equipment	General Equipment	<a href="#">C.7.5.1</a>	M
	Enhanced General Equipment	<a href="#">C.7.5.2</a>	M
Encapsulated Document	Encapsulated Document	<a href="#">C.24.2</a>	M
	Manufacturing 3D Model	<a href="#">C.35.1</a>	M
	ICC Profile	<a href="#">C.11.15</a>	U
	SOP Common	<a href="#">C.12.1</a>	M
	Source Instance Sequence	<a href="#">C.12.2</a>	C - Required if other Instances are referenced