Laurel Bridge PowerTools User Manual

LAUREL BRIDGE

Orchestrating Medical Imaging Workflow

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Contents

1. PowerTools Introduction

1.1. Overview

Laurel Bridge PowerTools™ is a software only collection of stand-alone Windows® applications designed for the diagnosis, testing, and/or repair of DICOM® communications, for the viewing, repair, or creation of DICOM data sets and their contents, and for communications testing of basic HL7 messaging. It is suitable for use by PACS administrators, integration engineers, system testers, software developers, and others who have need of a broad range of DICOM related tools and utilities or need to test HL7 messaging.

The stand-alone PowerTools programs operate as easy-to-use DICOM server (SCP) or client (SCU) applications for communication purposes, or operate as other types of applications capable of viewing, changing, creating, converting, or fixing a DICOM data set, or sending and receiving of HL7 messages. Many are provided as both GUI-based and command line-based applications, so the PowerTools utilities may be used as independent applications or scripted into a variety of situations where their capabilities are needed.

These tools and utilities may be used to transmit, receive, or edit DICOM medical data or the send and receive HL7 messages. However, the PowerTools applications are not intended for diagnostic review of images or other medical data.

1.2. Included Utilities

The core utilities officially included in the PowerTools suite are:

1.2.1. Graphical User Interface (GUI) Applications

- PowerTools Launcher – provides access to all PowerTools GUI applications.
- DICOMDIR Creator – creates a DICOMDIR file from a directory of DICOM images on disk (i.e. DICOM media creator).
- DICOM File Editor – allows the viewing, printing, and modification of a DICOM file on disk, including modification of sequence elements. Pixel data can also be viewed.
- DICOM Filter – filters one or more DICOM images on disk.
- Dictionary Finder – displays data from the DICOM data dictionary.
- HL7 Receiver – receives HL7 messages from an HL7 client or sender.
- HL7 Sender – sends HL7 messages to an HL7 server or receiver.
- PDF to DICOM – create DICOM Encapsulated PDFs from existing PDF files and write them to files or store them to a PACS.
- Query Client – queries a query SCP (or PACS) for DICOM images and can move DICOM images from the server to another location.
- Store Client – stores DICOM images from disk to a store SCP.
- Store Server – receives C-Store DICOM images from a store SCU.

- **Structured Report Extractor** – parses structured reports and creates mapping files for use with Laurel Bridge Software **Compass™** and third-party systems.
- **Study Generator** – generates DICOM images and stores them to a store SCP.
- **Verification Client** – verification SCU to send C-Echo requests.
- **Verification Server** – verification SCP to receive C-Echo.

1.2.2. Command Line Applications

- **DICOMDIR Creator** – creates a DICOMDIR file from a directory of DICOM images on disk (i.e. DICOM media creator).
- **DICOM File Editor** – dumps the contents of a DICOM file and edits a single DICOM file.
- **DICOM Filter** – filters one or more DICOM images on disk.
- **DICOM to PDF** – extracts encapsulated PDFs from DICOM files.
- **Dictionary Finder** – displays data from the DICOM data dictionary.
- **Indexer** – iterates over images and indexes specified tags into a csv file.
- **MWL Client** – connects to a modality worklist SCP.
- **MWL Server** – provides a modality worklist SCP for a directory on disk.
- **Query Client** – queries a query SCP (or PACS) for DICOM images and can move DICOM images from the server to another location.
- **Query Server** – provides a query SCP for a directory on disk.
- **Store Client** – stores DICOM images from disk to a store SCP.
- **Store Server** – receives C-Store DICOM images from a store SCU.
- **Study Generator** – generates DICOM image studies and stores or writes them.
- **Verification Client** – verification SCU to send C-Echo requests.
- **Verification Server** – verification SCP to receive C-Echo.

1.2.3. Special Purpose Applications

- **Conductor** – an additional-cost application controller and performance measurement tool, used for performance testing proposed scenarios on a virtual network as a means of proof-of-concept or predictive analysis of a network configuration. See the **Conductor** section that begins below on page 74.

Note that occasionally some new tools which are not listed above may be included in intermediate release versions of PowerTools, providing an early look at upcoming additions to the suite.

1.3. Important Features

All of the applications in PowerTools have been written with easy to understand interfaces. In an effort to make PowerTools even easier to use each application has built in features designed to make understanding and using the application a more natural and less frustrating experience.

In all GUI applications most items on the screen have a tooltip which can be displayed by hovering the mouse pointer over the item. This tooltip displays information about the item which can be helpful for understanding the item’s purpose.

For console applications, running the applications with the **-h** flag will display the usage for the application, listing a description of all possible flags and arguments. Using the **-h** flag with GUI applications will display usage information in a pop-up window, while adding the **-nogui** flag to many of the GUI applications will display command-line usage for the console versions of the applications.

Many of the GUI and command line software applications in PowerTools incorporate innovations in user interface ease-of-use and the robustness of the underlying DICOM framework or HL7 library upon which most of the Laurel Bridge PowerTools applications are built.

An interesting innovation is built into the **Study Generator** command line tool is the inclusion of a first and last name database culled from recent U.S. Census Bureau statistics, enabling the random generation of realistic-looking patient names in roughly the same frequency with which the names occur in the general population.

2. Installation

To install PowerTools run the installer executable (Setup.exe) and follow the on screen directions.

2.1. Prerequisites

PowerTools uses several prerequisite components that must be installed before the application can function correctly. These prerequisites consist of:

- Microsoft .NET Framework 3.5
- Visual C++ Runtime Libraries (x86)
- Windows Installer 3.1

The main installer executable (Setup.exe) will determine whether these prerequisites are needed and install them accordingly.

If it is desired to install an older version of PowerTools than the currently installed version, or to reinstall the current version, it is necessary to first uninstall the current version.

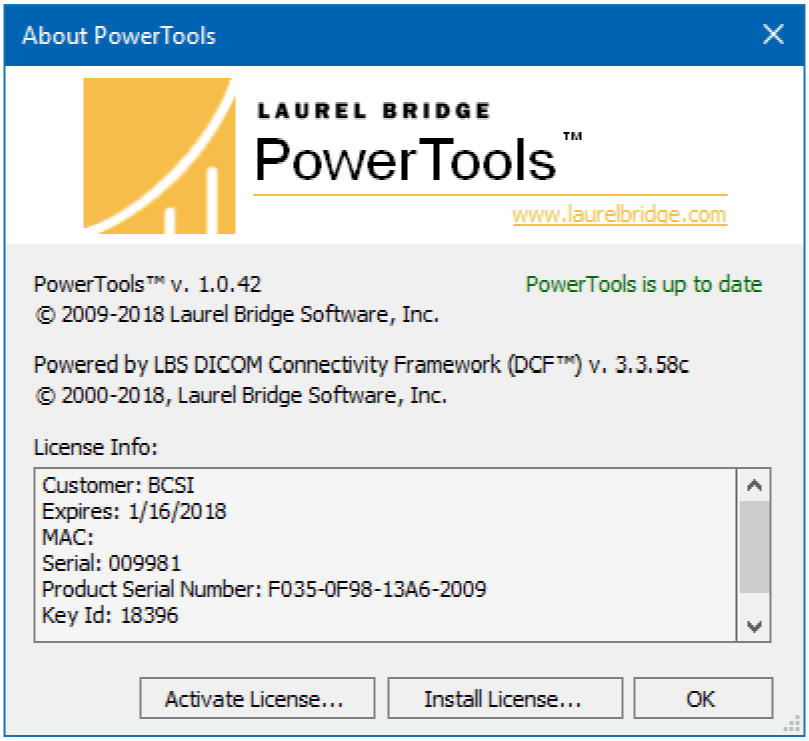
2.2. Installing PowerTools

After installing the prerequisites the PowerTools installer (PowerTools.msi) will run. For machines with an older version of PowerTools installed this installer will upgrade any previous installation while maintaining any current configuration settings.

3. Getting Started

3.1. Installing a License

The first step after launching PowerTools is to install a license. Running the PowerTools Launcher application from the start menu for the first time will bring up a dialog allowing a license to be installed. When the **About Laurel Bridge PowerTools** dialog appears, click the **Install License…** button, browse to the license file, and hit **OK**. Information on the status of the license, including when it expires, can be found on this dialog available at any time by clicking **Help > About…** in any PowerTools GUI application. The license works on a per user basis; each user will need to install a valid license to run any of the utilities.



PowerTools™ v. 1.0.42
© 2009-2018 Laurel Bridge Software, Inc.

PowerTools is up to date

Powered by LBS DICOM Connectivity Framework (DCF™) v. 3.3.58c
© 2000-2018, Laurel Bridge Software, Inc.

License Info:

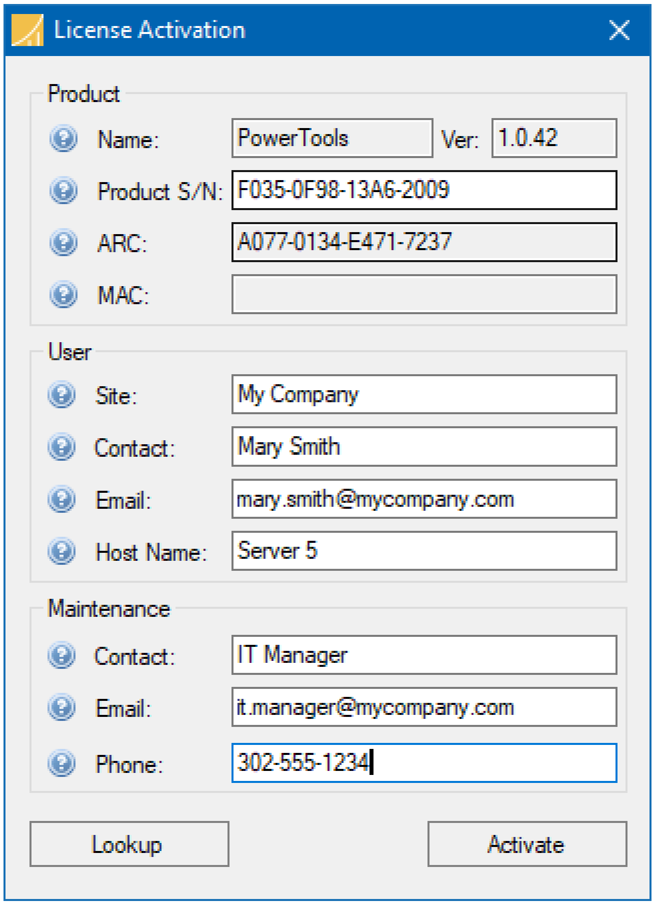
Customer: BCSI
Expires: 1/16/2018
MAC:
Serial: 009981
Product Serial Number: F035-0F98-13A6-2009
Key Id: 18396

3.2. Activating a License over the Internet

Clicking the **Activate License…** button will open the **License Activation** form. You will need to provide a 16-digit product serial number (**Product S/N**) to activate your license. All fields on the form should be filled out.

When the **License Activation** dialog first appears, it will attempt to contact the Laurel Bridge license server and pre-populate the form with as much information as it has available. If PowerTools cannot reach the license server you will be presented with an information message describing which fields need to be entered to activate your license on the Manual Product Activation interface on the Laurel Bridge Customer Access web page here:

https://www.laurelbridge.com/product_activation.php



Product

Name: PowerTools Ver: 1.0.42

Product S/N: F035-0F98-13A6-2009

ARC: A077-0134-E471-7237

MAC:

User

Site: My Company

Contact: Mary Smith

Email: mary.smith@mycompany.com

Host Name: Server 5

Maintenance

Contact: IT Manager

Email: it.manager@mycompany.com

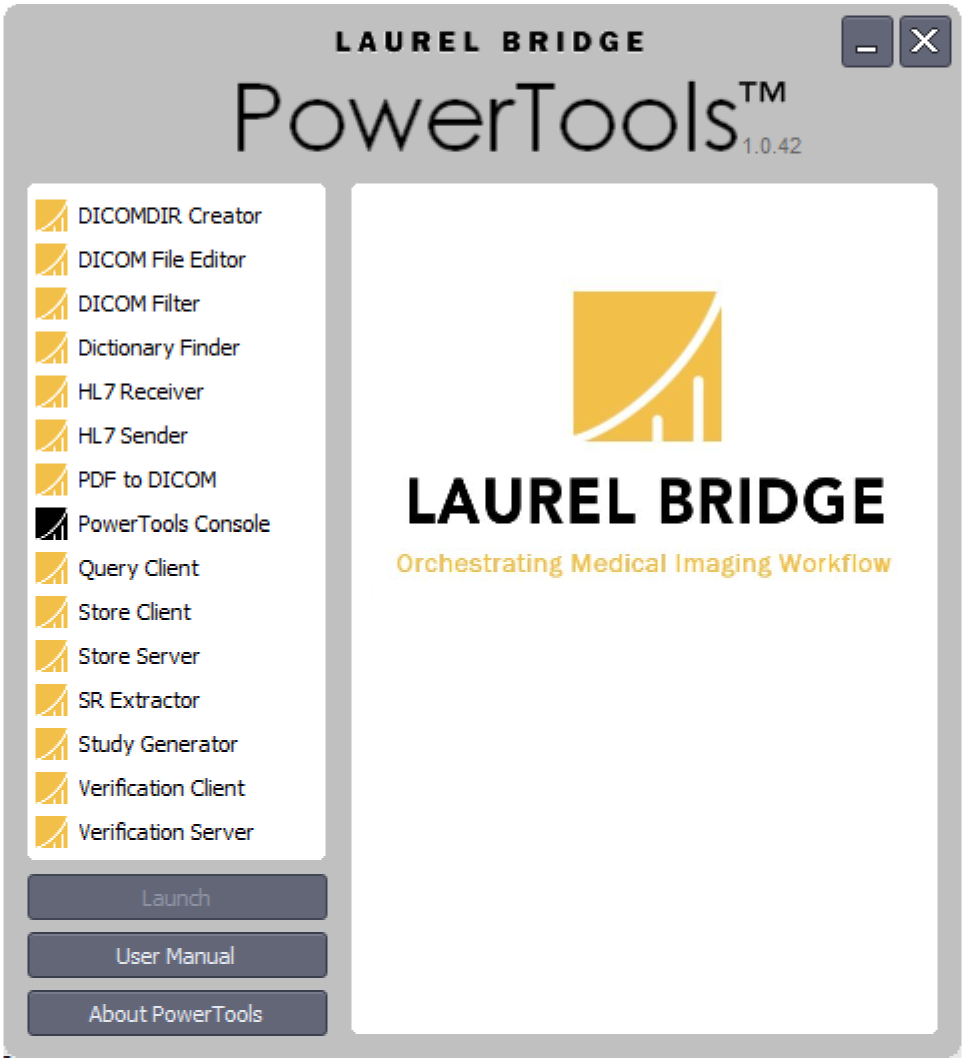
Phone: 302-555-1234

Note that if PowerTools does not have internet access you will need the **16-digit Activation Request Code (ARC)** from the Manual Product Activation (see above). On that form enter your 16-digit **Product Serial Number** and the 16-digit **Activation Request Code**. After completing the steps on the web activation form you can download a fully activated PowerTools license. Once downloaded, use the **Install License...** button on the **About** dialog to install your activated license.

If you only have a MAC address you will need a valid login to www.laurelbridge.com to proceed. For assistance with this process, please send email to: support@laurelbridge.com

3.3. PowerTools Launcher

The PowerTools Launcher can be found in the start menu and provides access to all of the PowerTools GUI applications. Each application has a brief description available by selecting the application in the list. Double-clicking an application or selecting it in the list and clicking **Launch** will begin execution of that application. All PowerTools applications (except for the Launcher) can have multiple copies running at once. Information about PowerTools and access to license information can be accessed by clicking the **About PowerTools** button. The user manual you are reading is available via the **User Manual** button.

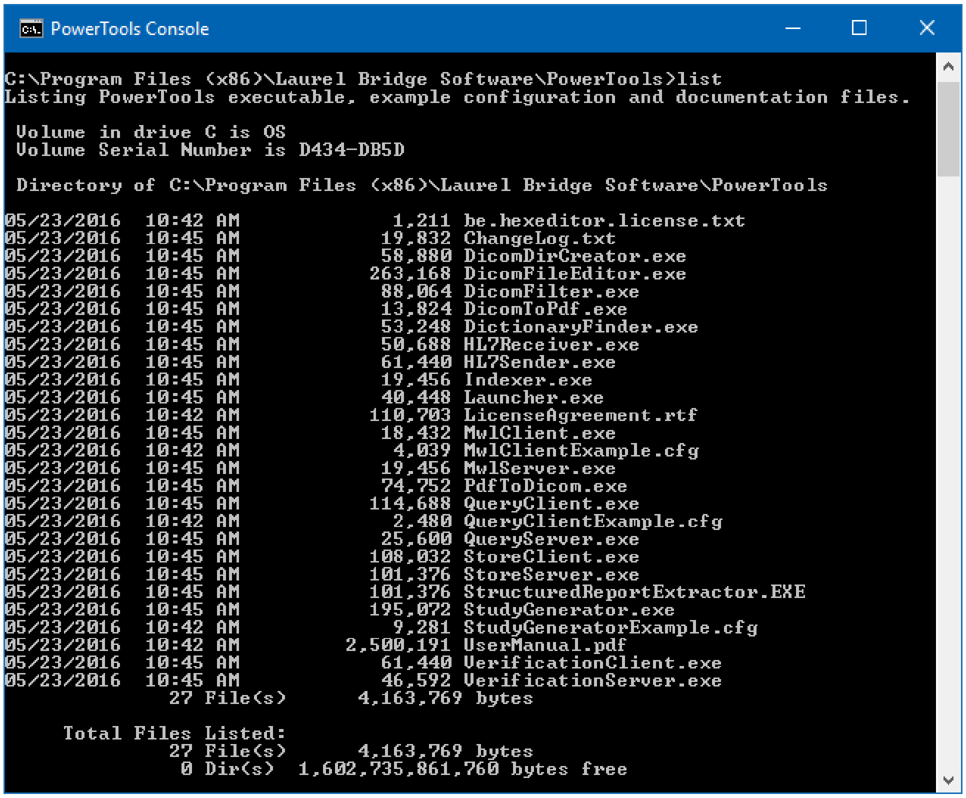


3.4. PowerTools Console

The **PowerTools Console** can be found in the start menu and provides access to all of the PowerTools command-line (console) applications. The console will launch and set the working directory to the installation folder for PowerTools. It will also add the PowerTools installation folder to the Path temporarily for the session.

Running the predefined PowerTools console command **list** will display all executables as well as any example configuration files and documentation files (see below). Running the command **dir *.exe** will display all of the executables in the directory. Running any of the applications with the **-h** flag will display the command-line usage statement for that application.

Many of the applications are combined GUI and console applications. For these combined applications, the **-h** flag will display usage information for the GUI version, while using the **-h** and **-nogui** flags together will display usage information for the console version. For GUI-only and console-only applications, the **-h** flag is all that is needed to display usage information.



```
C:\Program Files (x86)\Laurel Bridge Software\PowerTools>list
Listing PowerTools executable, example configuration and documentation files.

 Volume in drive C is OS
 Volume Serial Number is D434-DB5D

 Directory of C:\Program Files (x86)\Laurel Bridge Software\PowerTools

05/23/2016  10:42 AM             1,211 be.hexeditor.license.txt
05/23/2016  10:45 AM            19,832 ChangeLog.txt
05/23/2016  10:45 AM            58,880 DicomDirCreator.exe
05/23/2016  10:45 AM           263,168 DicomFileEditor.exe
05/23/2016  10:45 AM            88,064 DicomFilter.exe
05/23/2016  10:45 AM            13,824 DicomToPdf.exe
05/23/2016  10:45 AM            53,248 DictionaryFinder.exe
05/23/2016  10:45 AM            50,688 HL7Receiver.exe
05/23/2016  10:45 AM            61,440 HL7Sender.exe
05/23/2016  10:45 AM            19,456 Indexer.exe
05/23/2016  10:45 AM            40,448 Launcher.exe
05/23/2016  10:42 AM           110,703 LicenseAgreement.rtf
05/23/2016  10:45 AM            18,432 MwlClient.exe
05/23/2016  10:42 AM             4,039 MwlClientExample.cfg
05/23/2016  10:45 AM            19,456 MwlServer.exe
05/23/2016  10:45 AM            74,752 PdfToDicom.exe
05/23/2016  10:45 AM           114,688 QueryClient.exe
05/23/2016  10:42 AM             2,480 QueryClientExample.cfg
05/23/2016  10:45 AM            25,600 QueryServer.exe
05/23/2016  10:45 AM           108,032 StoreClient.exe
05/23/2016  10:45 AM           101,376 StoreServer.exe
05/23/2016  10:45 AM           101,376 StructuredReportExtractor.EXE
05/23/2016  10:45 AM           195,072 StudyGenerator.exe
05/23/2016  10:42 AM             9,281 StudyGeneratorExample.cfg
05/23/2016  10:42 AM         2,500,191 UserManual.pdf
05/23/2016  10:45 AM            61,440 VerificationClient.exe
05/23/2016  10:45 AM            46,592 VerificationServer.exe
              27 File(s)      4,163,769 bytes

     Total Files Listed:
              27 File(s)      4,163,769 bytes
               0 Dir(s)  1,602,735,861,760 bytes free
```

*Example output produced by running the PowerTools console command **list**.*

3.5. Security

Some systems are configured using the Federal Information Processing Standard (FIPS) for executable application security. As installed, PowerTools applications may be prevented from running on these systems. A simplified work-around is provided to enable FIPS enforcement to be disabled on an application-by-application basis.

3.5.1. Steps to disable FIPS enforcement

- Navigate to the PowerTools installation directory, typically which is:
  C:\Program Files (x86)\Laurel Bridge Software\PowerTools
- Identify the PowerTools application or applications you would like to execute, noting their filenames. For example:
  DicomFileEditor.exe
  StoreServer.exe
- For each of those applications, identify their corresponding **exe.config** files:
  DicomFileEditor.exe.config
  StoreServer.exe.config
- Using a text editor, edit each of the identified **exe.config** files, uncommenting the FIPS enforcement policy, as follows. Before editing, the config file looks like this:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
        <runtime>
                <!-- Uncomment the following line to disable FIPS enforcement -->
                <!--
                <enforceFIPSPolicy enabled="0"/>
                -->
        </runtime>
</configuration>
```

  After editing, the config file should look like this:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
        <runtime>
                <!-- Uncomment the following line to disable FIPS enforcement -->

                <enforceFIPSPolicy enabled="0"/>

        </runtime>
</configuration>
```

  You may find it helpful to leave the explanatory comment in place in case you decide later to reenable the FIPS policy. Otherwise, it is okay to delete that comment and also the two blank lines, if desired.
- Once the **exe.config** files have been edited, you should be able to successfully run the corresponding applications on an otherwise FIPS enabled system.

4. GUI Applications

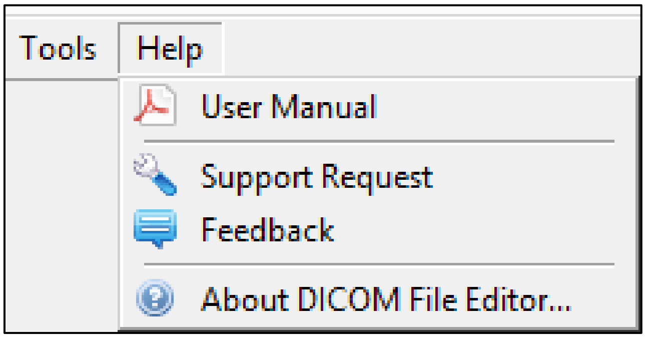
4.1. Common Components

There are several components that are common to many or all of the PowerTools GUI applications. Learning to use these components will make interacting with the PowerTools GUI interface much easier.

4.1.1. Menu Bar

The Menu Bar may vary slightly between GUI applications; however the following commands are present in almost every PowerTools application.

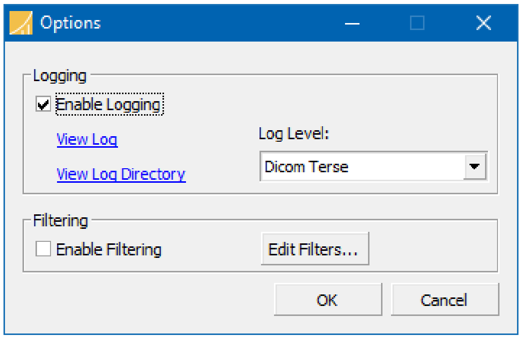
- **File > Exit** – Exits the application.
- **Tools > Options** – Displays options for the application. Many applications have settings to specify:
    - Logging
    - Filtering
- **Tools > Revert To Factory Settings** – Reverts all configuration settings for the application back to their original defaults.
- **Help > User Manu** – Opens the PDF user manual document for viewing.
- **Help > Support Request** – Opens the **Send Support Request** dialog so a user can send a request for support directly from the running application.
- **Help > Feedback** – Opens the **Send Feedback** dialog so a user can send feedback to Laurel Bridge Software directly from the running application.
- **Help > About** – Shows the **About** dialog for PowerTools information and for license management, including support for license installation and activation.



Help menu options

4.1.2. Options Dialog

The Options Dialog provides two common features shared by most of the GUI applications: logging and filtering.



Logging

☑ Enable Logging

Log Level: Dicom Terse

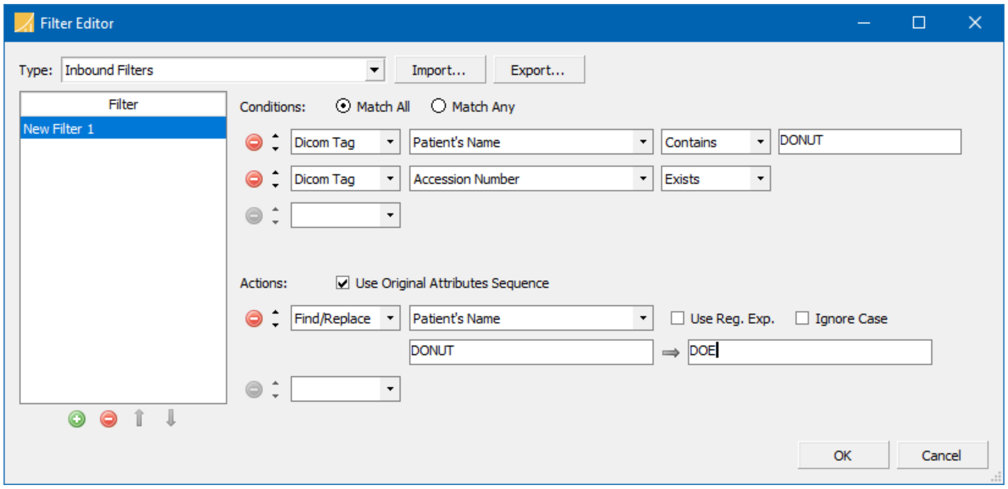
Filtering

□ Enable Filtering

- Logging
  - **Enable Logging** – enables/disables logging for the application.
  - **Log Level** – selects the amount/intensity of the logging (useful for debugging).
  - **View Log** – click to open the current log for the application.
  - **View Log Directory** – click to open the directory where the logs are stored.
- Filtering (only present in the Options Dialog for client and server applications)
  - **Enable Filtering** – enables/disables filtering for the application's input/output DICOM messages.
  - **Edit Filters…** – opens the Filter Editor Dialog to edit the filters for the application.
- **OK** – exits the Options Dialog and saves any changes.
- **Cancel** – exits the Options Dialog without saving.

4.1.3. Filter Editor Dialog

The Filter Editor Dialog provides the ability to create filters which will modify DICOM communication or DICOM files on disk. Each filter is chained together to the next one and all are executed in order on a DICOM data set—a collection of DICOM elements. These elements comprise the header of each DICOM image filtered (currently pixel data cannot be filtered).



Type: Inbound Filters

New Filter 1

Conditions: ● Match All ○ Match Any

Dicom Tag | Patient's Name | Contains | DONUT

Dicom Tag | Accession Number | Exists

Actions: ☑ Use Original Attributes Sequence

Find/Replace | Patient's Name | □ Use Reg. Exp. □ Ignore Case

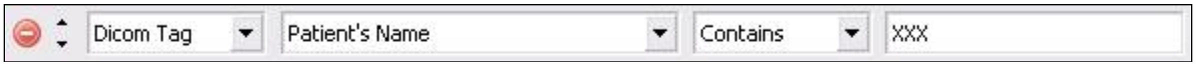
DONUT ⇒ DOE

Key components in the Filter Editor Dialog include:

- **Type** – changes the filters that are being edited (for example, "Inbound Filters" in the image above represents all incoming DICOM communication to the application).
- **Import…** – imports a filter configuration from disk (allows configurations to be shared between PowerTools utilities).
- **Export…** – exports a filter configuration to disk (allows configurations to be shared between PowerTools utilities).
- **Filter** – the list of filters in order of execution (filters are chained together) to be applied to the DICOM communication. The buttons at the bottom of the filter list allow filters to be added, removed, moved up in execution order, and moved down in execution order.
- **Conditions** – a list of conditions to check against to decide whether or not to apply actions. Conditions are checked in order as listed—to change the order click the up or down buttons for the condition.
- **Actions** – a list of actions to perform on the DICOM data if the conditions were true. Actions are applied in order as listed—to change the order click the up or down buttons for the action.
- **Match All / Match Any** – selects whether all conditions in the current filter must match before applying actions or whether only one condition is required to match.
- **OK** – exits the Filter Editor Dialog and saves any changes.
- **Cancel** – exits the Filter Editor Dialog without saving.

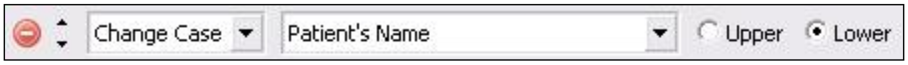
Filter Conditions

- **DICOM Tag** – condition which checks a DICOM element for certain requirements. **DICOM Tag** allows specification of a DICOM tag and an operator to check against the tag's value. In this example, if [Patient's Name] [Contains] [XXX] then the condition is true.


Dicom Tag
Patient's Name
Contains
XXX

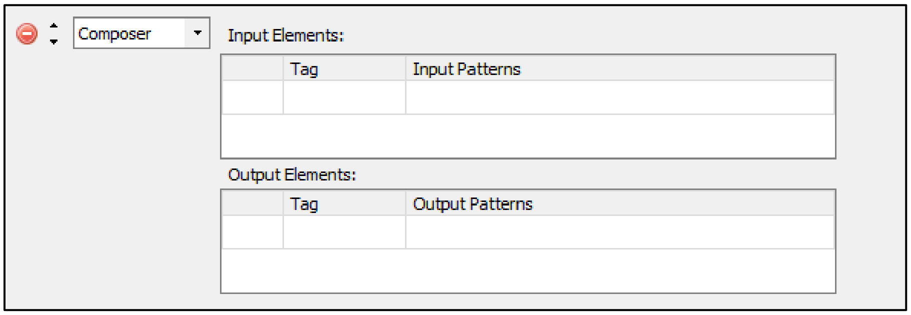
Filter Actions

- **Change Case** – changes the alphabetical case of a DICOM element's value to either all uppercase or all lowercase. In this example [Patient's Name] is changed to all [Lower]case.


Change Case
Patient's Name
○ Upper ● Lower

- **De-Identify** – provides a sophisticated mechanism to remove and replace certain attributes within a DICOM dataset that may lead to patient identification. For details on use of the De-Identify filter action, see section 5.2, De-Identify Filter Action, below.

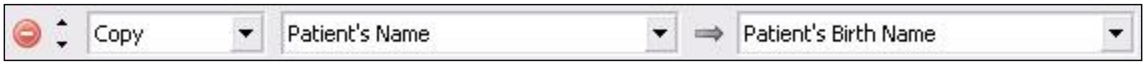
- **Composer** – supports the merging and splitting of elements. It can also be used to manipulate DICOM sequence elements with ease. It uses regular expressions to parse values from DICOM tags and combine the values into other DICOM tags. For example, it can take parts from two different tags and combine them to make a new value in a third tag. Regular expressions are specified to parse each input tag and substitution patterns determine how the output tags are constructed. For details on advanced use of the Composer filter action, see section 5.1, Composer Filter Action, below.


Composer

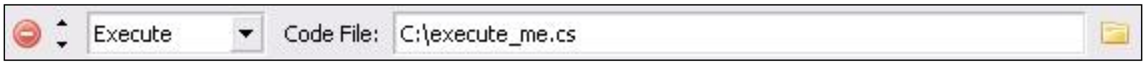
In the **Input Elements** table, specify the tags and how the regular expressions should parse each value into groups – the regular expressions go into the **Input Patterns** column. The groups that are produced are specified in the **Output Patterns** column of the **Output Elements** table. The first match in the first input element is referred to as “${1.1}”, the second match in the first input element is “${1.2}”, and the third match in the second input element would be “${2.3}”, and so on.

The **Output Elements** specify what parts of the input elements to combine and how to combine them; note that the parts can be used multiple times and may also be combined them with plain text.

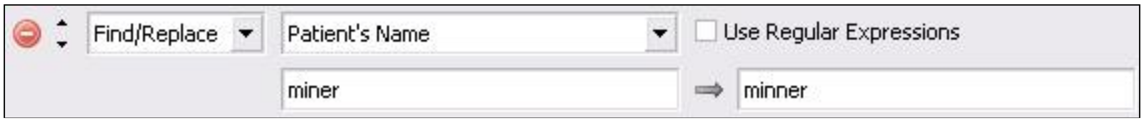
- **Copy** – copies one DICOM element’s value to another DICOM element. In this example the value in [Patient’s Name] is copied over the value for [Patient’s Birth Name].


Copy | Patient's Name ⇒ Patient's Birth Name

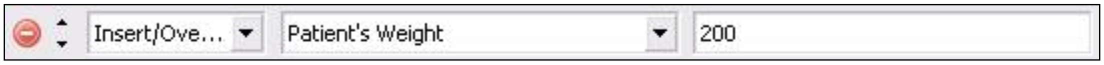
- **Execute** – executes the C# code contained in the code file provided. This option is provided for special cases where no other actions can perform the needed filtering. If this action is required please contact Laurel Bridge support.


Execute | Code File: C:\execute_me.cs

- **Find/Replace** – checks the value of the DICOM element specified for the given text (or regular expression) and replaces it with the substitute text (or regular expression substitution string). In this example the value in [Patient’s Name] is checked for instances of the text [miner] and any such instances are replaced with the text [minner].


Find/Replace | Patient's Name | □ Use Regular Expressions
miner ⇒ minner

- **Insert/Overwrite** – inserts a new DICOM element or overwrites it if it already exists in the DICOM data set. In this example the [Patient’s Weight] element is inserted into the DICOM data set and given a value of [200]. Any previous value if it existed is overwritten.



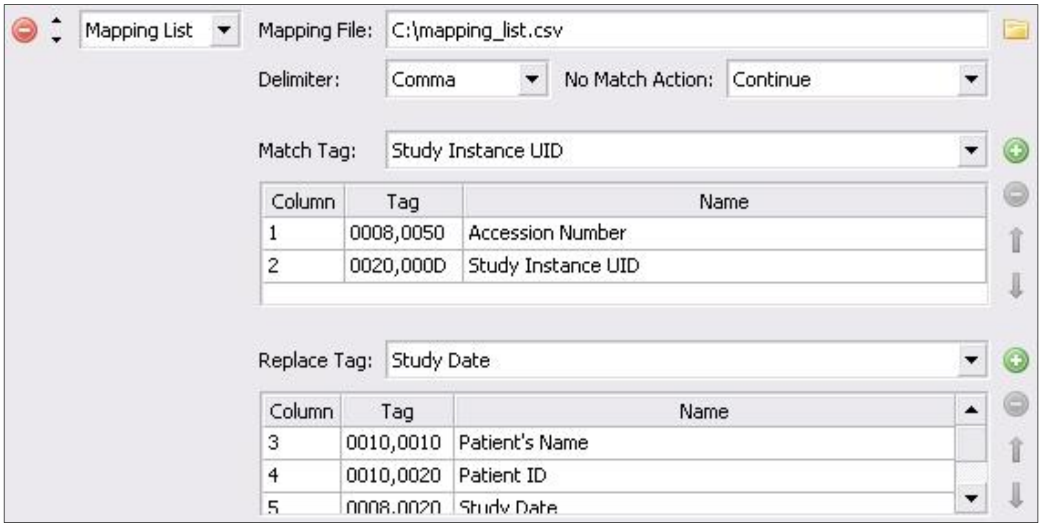
- **Mapping List** – performs a mapping based upon the arguments given. This is very useful if a large number of DICOM data sets need to be changed depending upon a large list of values for particular DICOM elements in those data sets. Arguments for this action are as follows:

  - **Mapping File** – a list of values separated by **Delimiter**. Each row of values should contain as many columns as is specified by the largest Column listed.
  - **Delimiter** – the character used to separate values in the **Mapping File**.
  - **No Match Action** – the action to perform if unable to find a match for the current DICOM data set using the **Match Tag List** selected.
  - **Match Tag List** – a list of tags to match against the current DICOM data set being filtered. These represent the first columns of values in the **Mapping File**.
  - **Replace Tag List** – a list of tags to replace with the values given in the **Mapping File** should a match occur.

  In this example the mapping file [C:\mapping_list.csv] should contain five columns of values each separated by a [Comma]. If there is no match the action will [Continue]. The first column of values corresponds to [Accession Number] and the second column of values corresponds to [Study Instance UID]. The third column of values corresponds to [Patient’s Name], the fourth to [Patient ID], and the fifth to [Study Date]. When a new DICOM data set arrives to be filtered the values for the two DICOM elements in the data set described by the first two columns will be compared against every row in the **Mapping File** for a match. If a match is found then the replace values in columns 3-5 will be inserted/overwritten for the **Replace Tags List**. These DICOM elements will only be overwritten in this example if a match is found.

  Here is an example row for this case: [1.2.3.4,3.3.1.2.4,JOHN,7.6.5.4.3.2.1,20091215]

  For this row to apply, the DICOM data set passed in must have its Accession Number set to “1.2.3.4” and its Study Instance UID set to “3.3.1.2.4”. If this matches, then the Patient’s Name will be changed to “JOHN”, the Patient ID will be changed to “7.6.5.4.3.2.1”, and the Study Date will be changed to “20091215”.



Mapping List — Mapping File: C:\mapping_list.csv

Delimiter: Comma — No Match Action: Continue

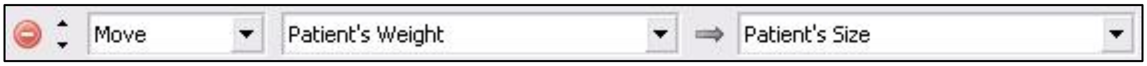
Match Tag: Study Instance UID

Column	Tag	Name
1	0008,0050	Accession Number
2	0020,000D	Study Instance UID

Replace Tag: Study Date

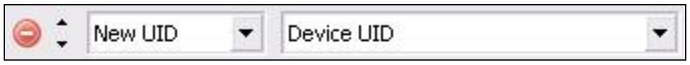
Column	Tag	Name
3	0010,0010	Patient's Name
4	0010,0020	Patient ID
5	0008,0020	Study Date

- **Move** – moves one DICOM element's value to another DICOM element. In this example the value in [Patient's Weight] is moved to the value for [Patient's Size] even if there is currently a value for [Patient's Size]. [Patient's Weight] will no longer exist in the DICOM data set.



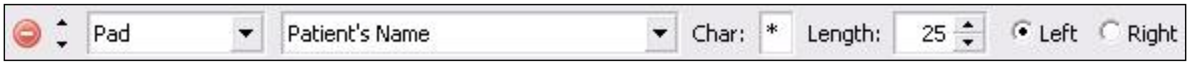
Move — Patient's Weight ⇒ Patient's Size

- **New UID** – replaces the UID for the DICOM element listed with a new generated one. In this example the value of [Device UID] will become a newly generated UID. If the DICOM element did not exist previously it will be created.



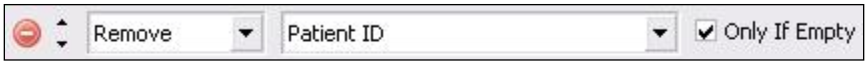
New UID — Device UID

- **Pad** – pads a DICOM element's value to the desired length with the given character. In this example [Patient's Name] will be changed to be [25] characters long by inserting the [*] character on the [Left] side of the current value for [Patient's Name] as many times as necessary to pad to [25] characters long. If the current length of the DICOM element selected is already long enough then nothing is changed (the value is not cropped).



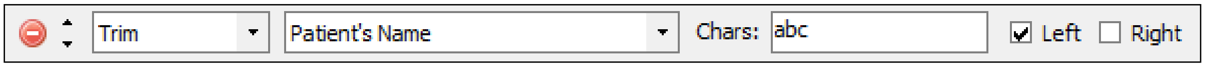
Pad — Patient's Name — Char: * — Length: 25 — ● Left ○ Right

- **Remove** – removes the given DICOM element from the DICOM data set. If the **Only If Empty** check box is selected then the element will only be removed if its value is empty or zero characters in length. In this example [Patient ID] is removed from the DICOM data set but [Only If Empty].



Remove — Patient ID — ☑ Only If Empty

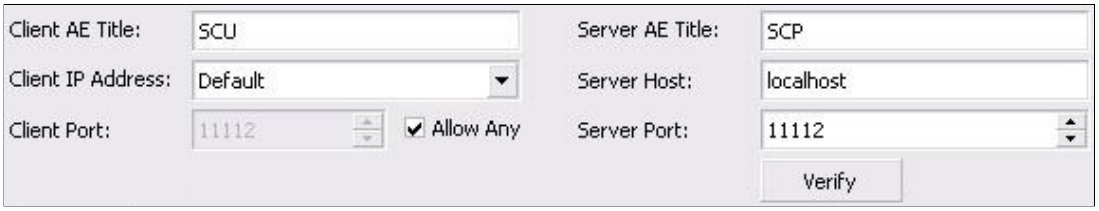
- **Trim** – removes the specified character sequence from the beginning and/or end of a DICOM element's value, if present. In this example the character sequence "abc" is removed from the beginning of the [Patient's Name] value. Note that multiple instances of the character sequence could be removed. For example, if the [Patient's Name] DICOM element contains the value "abcabcSteve", the resulting value will be "Steve".



Trim | Patient's Name | Chars: abc | ☑ Left ☐ Right

4.1.4. Client Routing Information

All client GUI applications have the same interface for specifying routing information.



Client AE Title: SCU

Client IP Address: Default

Client Port: 11112 ☑ Allow Any

Server AE Title: SCP

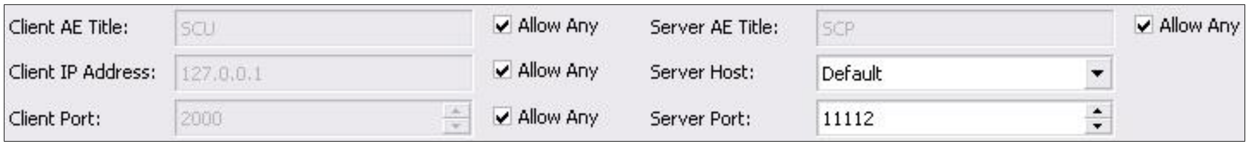
Server Host: localhost

Server Port: 11112

- **Client AE Title** – the Application Entity title for the running application (client).
- **Client IP Address** – the IP address to use on the local machine when sending data.
- **Client Port** – the port to use on the local machine when sending data (select **Allow Any** to choose the next available port).
- **Server AE Title** – the Application Entity title of the server machine to which to connect.
- **Server Host** – the host name or IP address of the machine to which to connect.
- **Server Port** – the port number on the server machine to which to connect.
- **Verify** – click this button to send both an ICMP Ping and a DICOM C-Echo test to the server. If logging is enabled then a log of the C-Echo will be recorded. A check means that the verification was successful; an X means that it was not.

4.1.5. Server Routing Information

All server GUI applications have the same interface for specifying routing information and for restricting which clients can connect.



Client AE Title: SCU ☑ Allow Any

Client IP Address: 127.0.0.1 ☑ Allow Any

Client Port: 2000 ☑ Allow Any

Server AE Title: SCP ☑ Allow Any

Server Host: Default

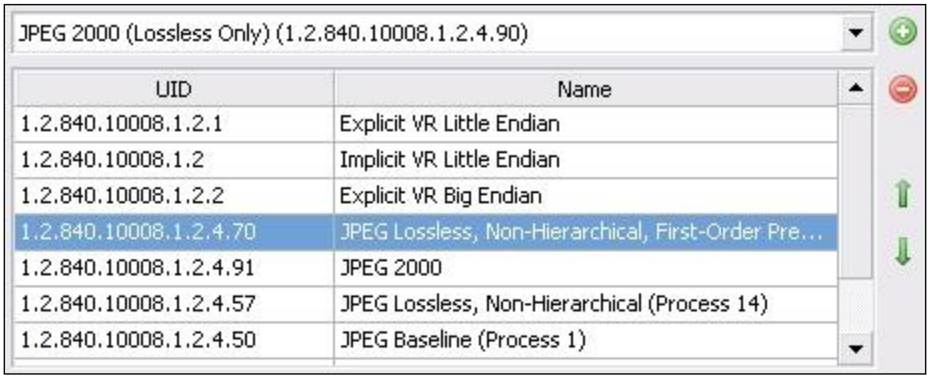
Server Port: 11112

- **Client AE Title** – reject any connecting clients that do not have the specified Application Entity title (select **Allow Any** to accept a client using any AE title).
- **Client IP Address** – reject any connecting clients that are not connecting from the specified IP address (select **Allow Any** to accept a client connecting from any IP address).
- **Client Port** – reject any connecting clients that are not connecting using the specified port number (select **Allow Any** to accept a client connecting using any port number).

- **Server AE Title** – reject any connecting clients that are not attempting to connect to the server with the specified server Application Entity title (select **Allow Any** to accept a client regardless of the AE title it is using for the server).
- **Server Host** – the IP address on the local machine on which to establish the server.
- **Server Port** – the port number on the local machine on which to establish the server.

4.1.6. Transfer Syntaxes for Presentation Context Negotiation

Some client and server applications provide the ability to select what transfer syntaxes should be included in presentation context negotiation. This ability allows a client application to force DICOM communication to a server to use a specific transfer syntax or to give preference to certain transfer syntaxes. It also allows a server to accept only certain transfer syntaxes from a client or to give preference to certain transfer syntaxes.



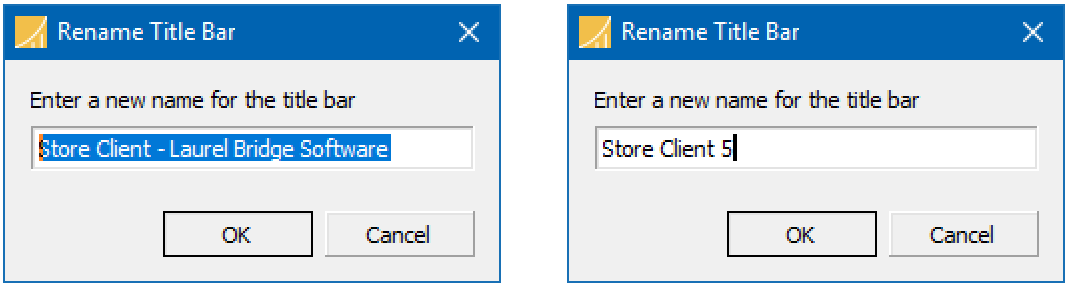
JPEG 2000 (Lossless Only) (1.2.840.10008.1.2.4.90)

UID	Name
1.2.840.10008.1.2.1	Explicit VR Little Endian
1.2.840.10008.1.2	Implicit VR Little Endian
1.2.840.10008.1.2.2	Explicit VR Big Endian
1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Pre...
1.2.840.10008.1.2.4.91	JPEG 2000
1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)
1.2.840.10008.1.2.4.50	JPEG Baseline (Process 1)

All supported transfer syntaxes are initially included in the drop down box. If the add button is clicked then the transfer syntax selected in the drop down box will be moved to the list below. Transfer syntaxes in the list can be removed and moved up or down in priority. The transfer syntaxes at the top of the list will be given greater priority when negotiating presentation contexts and the transfer syntaxes at the bottom of the list will be given lower priority.

4.1.7. Application Window Renaming

All of the client and server GUI applications have the ability to rename the application window title bar, which can be helpful when running multiple instances of the same application.

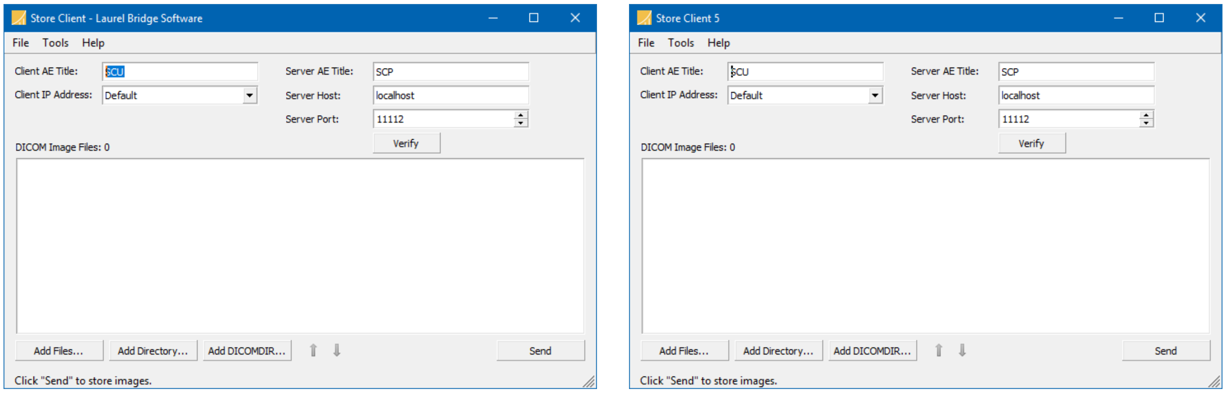


Enter a new name for the title bar: Store Client - Laurel Bridge Software

Enter a new name for the title bar: Store Client 5

Entering a new name in the **Store Client** application renaming dialog

The renaming dialog is activated by hitting the **F2** key (the default Windows file and dialog renaming key shortcut) when the application is open and has focus.



Store Client - Laurel Bridge Software

Client AE Title: SCU
Client IP Address: Default
Server AE Title: SCP
Server Host: localhost
Server Port: 11112
DICOM Image Files: 0
Click "Send" to store images.

Store Client 5

Client AE Title: SCU
Client IP Address: Default
Server AE Title: SCP
Server Host: localhost
Server Port: 11112
DICOM Image Files: 0
Click "Send" to store images.

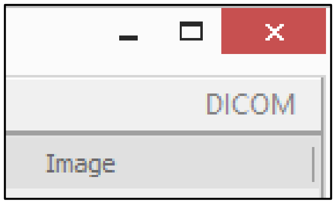
Store Client application before and after window renaming. Note the text in the title bar has changed from "Store Client - Laurel Bridge Software" to "Store Client 5"

Note that the new name in the title bar only persists until that application instance exits. The next time the application is run it will have the original, standard title in the title bar.

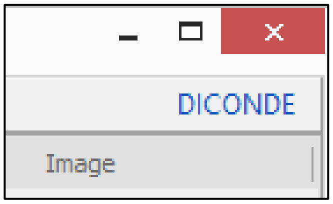
This renaming feature is also available when starting any of the GUI applications that support renaming at the command line, and is particularly helpful when scripting the startup of a number of collaborating applications. This is done using the **-name** command line switch. An example of starting up one renamed **Store Server** and three renamed **Study Generator** instances is provided in the demo batch script **example_gui_renaming.bat** in the PowerTools installation directory.

4.1.8. External Data Dictionary Management

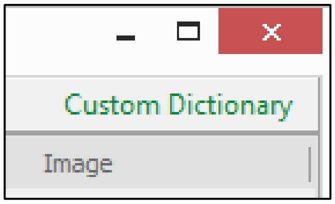
The **Dicom File Editor** and **Dictionary Finder** applications provide access to functionality that selects and manages an external data dictionary. When activated via an options setting, a status indicator appears in the upper right of the main application window.



Indicates that no external data dictionary is loaded



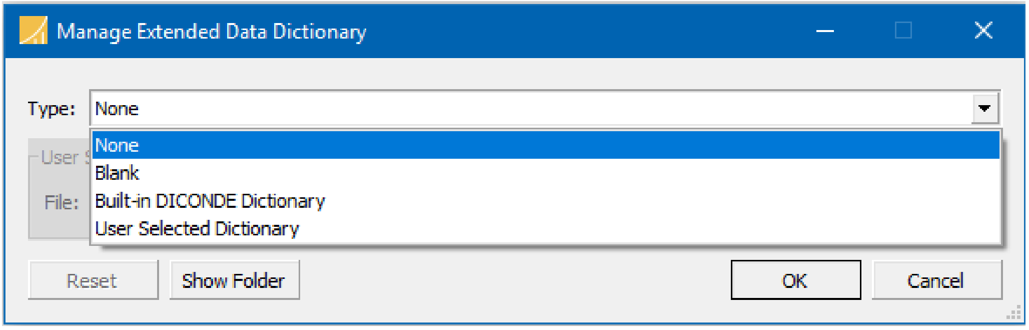
A DICONDE external data dictionary is loaded



A user-customized external data dictionary is loaded

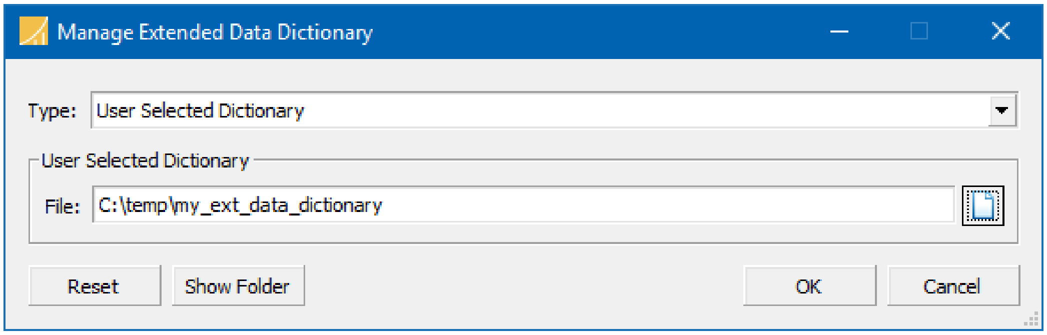
When the indicator is visible, clicking on it opens the external data dictionary manager, where the user is presented with a four choices of the **Type** of dictionary to load:

- **None** – do not load any external data dictionary.
- **Blank** – create an empty text file and load it as the external data dictionary.
- **Built-in DICONDE Dictionary** – load a standard DICONDE data dictionary.
- **User-selected Dictionary** – enable the selection of a data dictionary file.



Type: None

When the User-selected Dictionary option is selected, the file browser is activated so the user can select a data dictionary **File**.



Type: User Selected Dictionary

File: C:\temp\my_ext_data_dictionary

Buttons on the **Manage External Data Dictionary** dialog do the following when clicked:

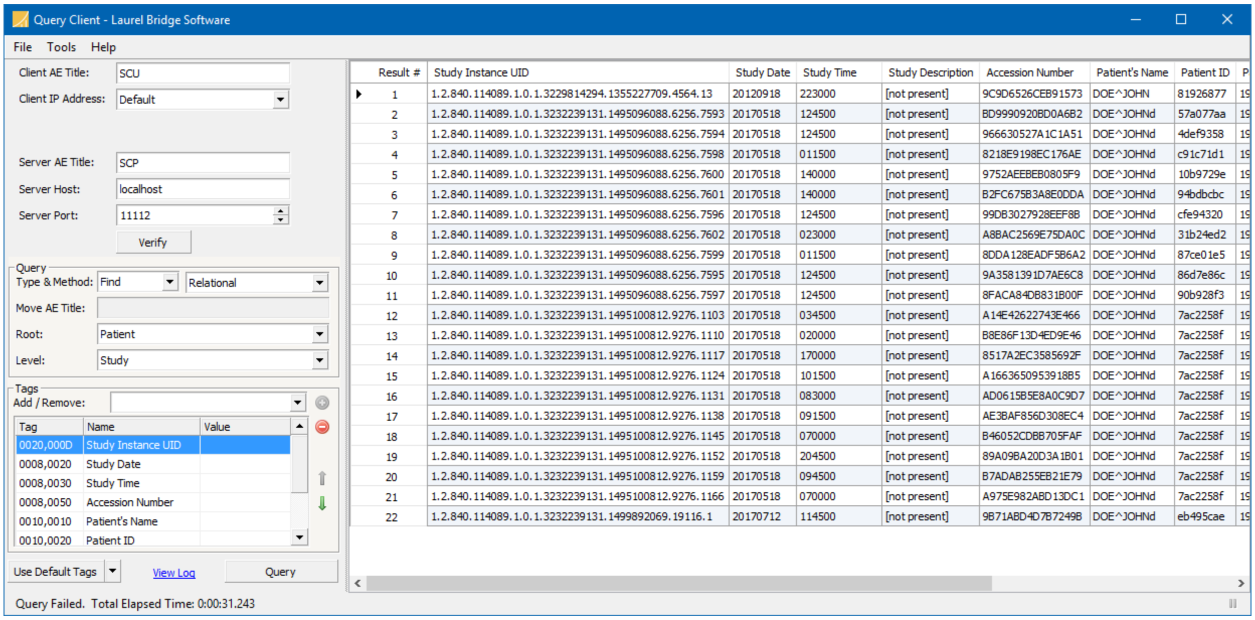
- **Reset** – sets the selected **Type** to **None** and clears the **File** entry field.
- **Show Folder** – opens the default application folder containing the current and any backup external data dictionaries.
- **OK** – saves the current options for external data dictionary. If the data dictionary in use was changed, a backup copy of the previous data dictionary is created in the same directory.
- **Cancel** – cancels any changes made to the selected options.

4.2. DICOM Client Applications

PowerTools provides several DICOM client applications which connect to a DICOM server on a remote machine and transmit DICOM communication. The advanced functionality of these applications is discussed below.

4.2.1.Query Client

Query Client can query a query SCP containing a database of DICOM images and request information about certain images. It has both console and GUI versions.



Client AE Title: SCU
Client IP Address: Default

Server AE Title: SCP
Server Host: localhost
Server Port: 11112

Query
Type & Method: Find | Relational
Move AE Title:
Root: Patient
Level: Study

Tags
Add / Remove:

Tag	Name	Value
0020,000D	Study Instance UID	
0008,0020	Study Date	
0008,0030	Study Time	
0008,0050	Accession Number	
0010,0010	Patient's Name	
0010,0020	Patient ID	

Result #	Study Instance UID	Study Date	Study Time	Study Description	Accession Number	Patient's Name	Patient ID	P
1	1.2.840.114089.1.0.1.3229814294.1355227709.4564.13	20120918	223000	[not present]	9C9D6526CEB91573	DOE^JOHN	81926877	19
2	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7593	20170518	124500	[not present]	BD9990920BD0A6B2	DOE^JOHNd	57a077aa	19
3	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7594	20170518	124500	[not present]	966630527A1C1A51	DOE^JOHNd	4def9358	19
4	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7598	20170518	011500	[not present]	8218E9198EC176AE	DOE^JOHNd	c91c71d1	19
5	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7600	20170518	140000	[not present]	9752AEEBEB0805F9	DOE^JOHNd	10b9729e	19
6	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7601	20170518	140000	[not present]	B2FC675B3A8E0DDA	DOE^JOHNd	94bdbcbc	19
7	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7596	20170518	124500	[not present]	99DB3027928EEF8B	DOE^JOHNd	cfe94320	19
8	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7602	20170518	023000	[not present]	A8BAC2569E75DA0C	DOE^JOHNd	31b24ed2	19
9	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7599	20170518	011500	[not present]	8DDA128EADF5B6A2	DOE^JOHNd	87ce01e5	19
10	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7595	20170518	124500	[not present]	9A3581391D7AE6C8	DOE^JOHNd	86d7e86c	19
11	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7597	20170518	124500	[not present]	8FACA84DB831B00F	DOE^JOHNd	90b928f3	19
12	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1103	20170518	034500	[not present]	A14E42622743E466	DOE^JOHNd	7ac2258f	19
13	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1110	20170518	020000	[not present]	B8E86F13D4ED9E46	DOE^JOHNd	7ac2258f	19
14	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1117	20170518	170000	[not present]	8517A2EC3585692F	DOE^JOHNd	7ac2258f	19
15	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1124	20170518	101500	[not present]	A166365095391 8B5	DOE^JOHNd	7ac2258f	19
16	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1131	20170518	083000	[not present]	AD0615B5E8A0C9D7	DOE^JOHNd	7ac2258f	19
17	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1138	20170518	091500	[not present]	AE3BAF856D308EC4	DOE^JOHNd	7ac2258f	19
18	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1145	20170518	070000	[not present]	B46052CDBB705FAF	DOE^JOHNd	7ac2258f	19
19	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1152	20170518	204500	[not present]	89A09BA20D3A1B01	DOE^JOHNd	7ac2258f	19
20	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1159	20170518	094500	[not present]	B7ADAB255EB21E79	DOE^JOHNd	7ac2258f	19
21	1.2.840.114089.1.0.1.3232239131.1495100812.9276.1166	20170518	070000	[not present]	A975E982ABD13DC1	DOE^JOHNd	7ac2258f	19
22	1.2.840.114089.1.0.1.3232239131.1499892069.19116.1	20170712	114500	[not present]	9B71ABD4D7B7249B	DOE^JOHNd	eb495cae	19

Query Failed. Total Elapsed Time: 0:00:31.243

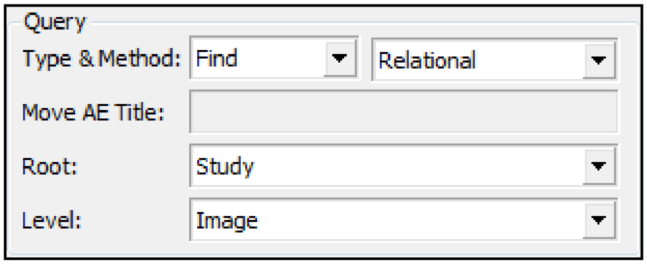
The main screen of the **Query Client** application

Using the command-line interface, query parameters can be specified either directly using the **−q** flag, or via a configuration file. For example, a command line query for all patients that have a Patient ID of “112233”, and returning those values plus Accession Number and Referring Physician, looks like this:

```
QueryClient [other params] -q 0008,0050=  -q 0008,0090=  -q 0010,0020=112233
```

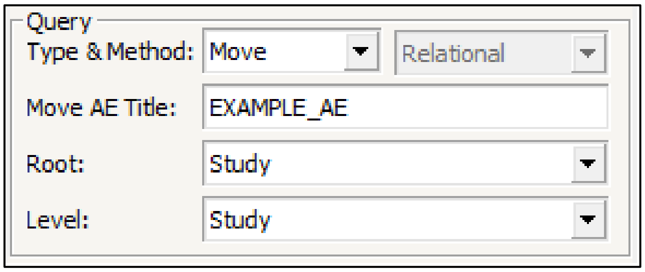
Instructions for using a configuration file to perform queries are contained in the example configuration file (**QueryClientExample.cfg**) found in the PowerTools installation directory.

Query Client includes three query modes, Find, Move, and MWL described by **Query Type**, and two search methods, Relational and Hierarchical, described by **Query Method**. Find mode queries a query SCP for DICOM data sets which contain DICOM elements which match the tags selected in the GUI. Tags with an empty value will be populated upon response from the server.



Query
Type & Method: Find | Relational
Move AE Title:
Root: Study
Level: Image

Move mode queries a query SCP in the same way, but instead of returning the found DICOM elements the entire DICOM data sets which match are sent to the Move destination, described by the **Move AE Title** (the query server should have a mapping for this AE title so that it knows where to send the DICOM images). Relational and Hierarchical search methods support queries to PACS of the corresponding query architecture.



Query

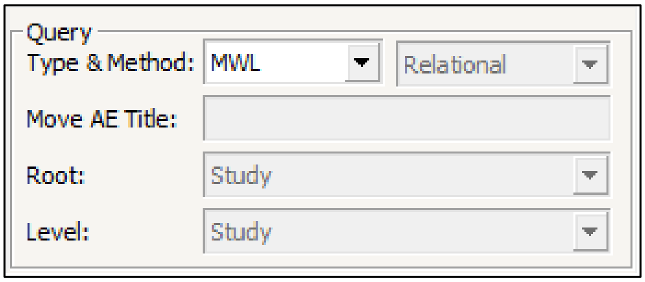
Type & Method: Move | Relational

Move AE Title: EXAMPLE_AE

Root: Study

Level: Study

MWL mode enables a mechanism for performing **Modality Worklist** queries using the Query Client user interface. When the application is in MWL mode, **Modality Worklist** queries of arbitrary depth can be crafted in the **Query Tag List**.



Query

Type & Method: MWL | Relational

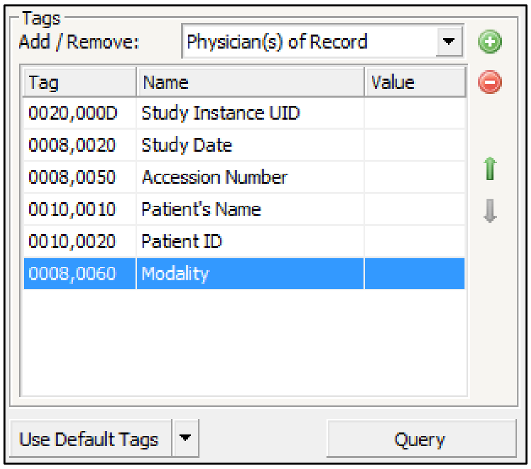
Move AE Title:

Root: Study

Level: Study

Key components of the Query Client user interface include:

- **Info Model (Root)** – the information model of the query server (Study, Patient, or PatientStudy).
- **Query Level** – the level at which to query on the server (Patient, Study, Series, or Image).
- **Query Tag List** – a list of tags with which to query the query SCP. Values can be edited to request a match, and if left blank that value will be filled in upon return.

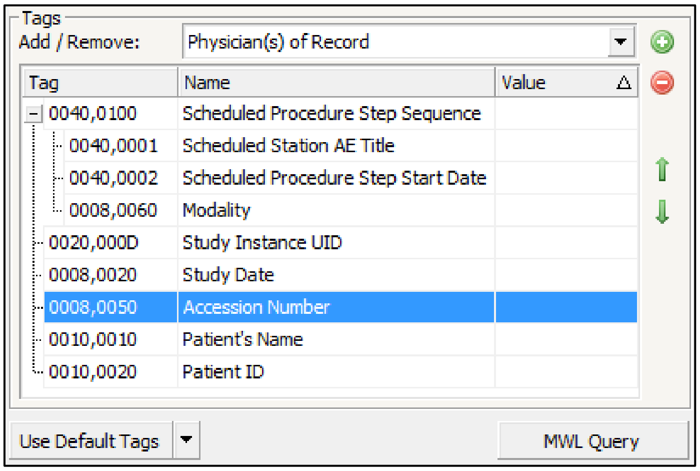


Tags

Add / Remove: Physician(s) of Record

Tag	Name	Value
0020,000D	Study Instance UID	
0008,0020	Study Date	
0008,0050	Accession Number	
0010,0010	Patient's Name	
0010,0020	Patient ID	
0008,0060	Modality	

Query Tag List in Find Mode



Tags

Add / Remove: Physician(s) of Record

Tag	Name	Value
0040,0100	Scheduled Procedure Step Sequence	
0040,0001	Scheduled Station AE Title	
0040,0002	Scheduled Procedure Step Start Date	
0008,0060	Modality	
0020,000D	Study Instance UID	
0008,0020	Study Date	
0008,0050	Accession Number	
0010,0010	Patient's Name	
0010,0020	Patient ID	

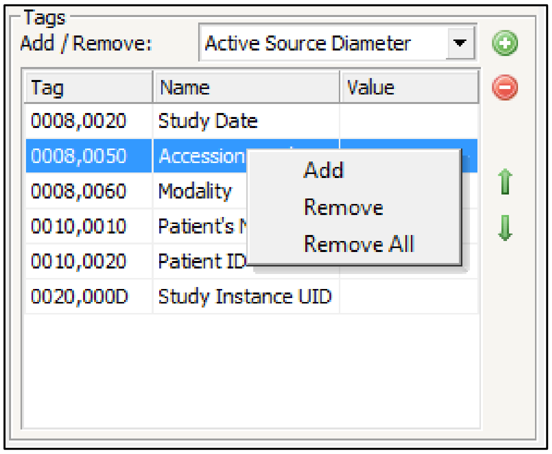
Query Tag List in MWL Mode

The green plus and red minus buttons are used to Add a tag to the list or to Remove the selected item, if any, from the list of items. The green up and down arrows move the selected item up or down in the list.

When in MWL mode where there **Query Tag List** can be in a tree layout, the Add button will add a tag as a child of the currently selected item in the list, or at the top level of the list if no item in the list is selected. In Find or Move mode, the Add button simply adds a tag to the list.

In all modes, the Remove button will immediately remove any item that has no child items. In MWL mode, the Remove button will cause a prompt for confirmation before removing a selected item and all of its child items if that item has one or more child items.

A context menu pops up when an item in the list is right-clicked. Depending on the current mode, an item can be added, added as a child of the selected item, removed along with any child items, or the entire list can be cleared.

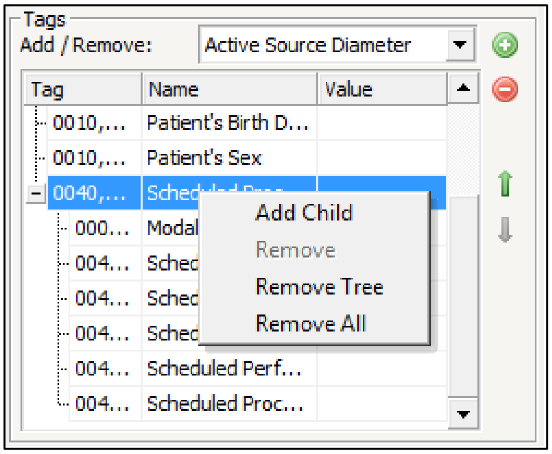


Tags

Add / Remove: Active Source Diameter

Tag	Name	Value
0008,0020	Study Date	
0008,0050	Accession	
0008,0060	Modality	
0010,0010	Patient's N	
0010,0020	Patient ID	
0020,000D	Study Instance UID	

Context menu in Find/Move mode



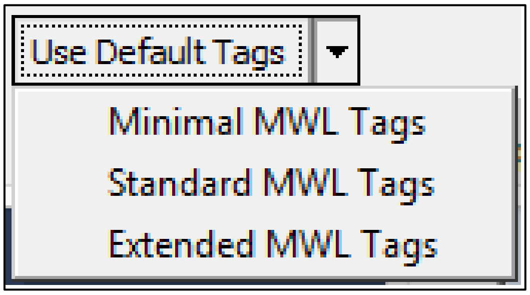
Tags

Add / Remove: Active Source Diameter

Tag	Name	Value
0010,…	Patient's Birth D…	
0010,…	Patient's Sex	
0040,…	Sched	
000…	Modal	
004…	Sched	
004…	Sched	
004…	Sched	
004…	Scheduled Perf…	
004…	Scheduled Proc…	

Context menu in MWL mode

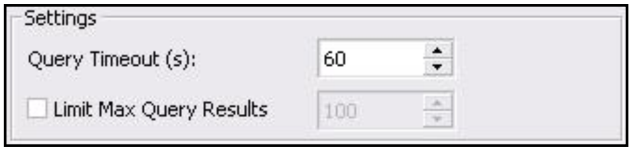
- **Use Default Tags** – populates the list with default query tags appropriate to the currently selected mode. Find/Move queries have a **Minimal** and **Standard** set of defaults, while MWL queries have **Minimal**, **Standard** and **Extended** default sets.



Predefined default tag sets are available.
(2 for Find/Move, 3 for MWL)

- **Find/Move/MWL Query** – clicking this button initiates a C-Find, C-Move or Modality Worklist query operation to the query SCP using the specified information.

- **Query Timeout** – the amount of time in seconds to wait before timing out the query (times out after no response has been received for the number of seconds specified).

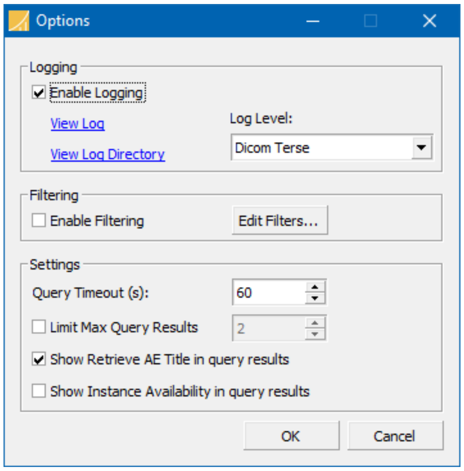


Settings

Query Timeout (s): 60

□ Limit Max Query Results 100

- **Limit Max Query Results** – if checked then the maximum number of queries returned is limited to the value specified.



Options

Logging

☑ Enable Logging

View Log

View Log Directory

Log Level: Dicom Terse

Filtering

□ Enable Filtering

Settings

Query Timeout (s): 60

□ Limit Max Query Results 2

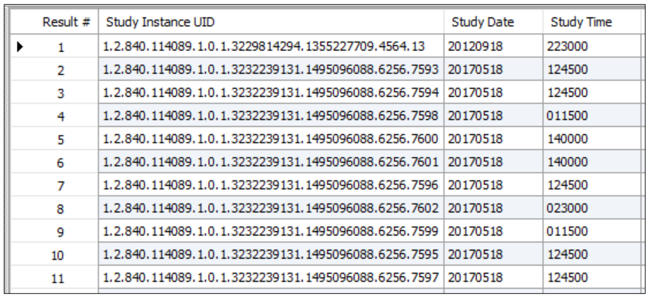
☑ Show Retrieve AE Title in query results

□ Show Instance Availability in query results

The **Options** dialog in the Query Client provides Logging and Filtering support, as well as a convenient interface to configure **Query Timeout** and to **Limit Max Query Results** returned. The **Show Retrieve AE Title** and **Show Instance Availability** options enable the display the respective information in the query results.

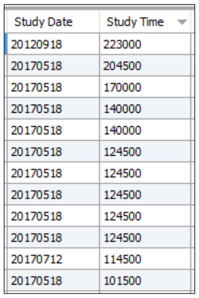
The query results table provides a variety of sorting and selecting capabilities.

- Sort values in a column - click on the column heading
- Reverse sorting direction in a column - click on the same column heading
- Select all values in a row - click on the **Result #** row heading for the row
- Select all values in a column - hold the Shift key and click on the column heading
- Select multiple columns or rows - hold the Shift key and click on multiple column headings or **Result #** row headings
- Select a rectange of result cells - click on a cell and drag to highlight a rectangular region of cells
- Select arbitrary result cells - hold the Ctrl key and click on multiple cells to select them
- Select all results - hold the Shift key and click on the **Result #** column heading
- Reset sorted order to original and deselect everything - click on the **Result #** column heading
- Copy selected values - right-click to bring up the context menu and select **Copy Selection to Clipboard**, or type Ctrl-C to copy selected values



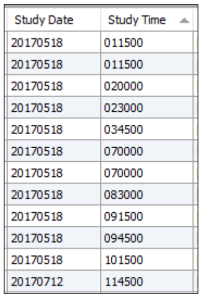
Result #	Study Instance UID	Study Date	Study Time
1	1.2.840.114089.1.0.1.3229814294.1355227709.4564.13	20120918	223000
2	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7593	20170518	124500
3	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7594	20170518	124500
4	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7598	20170518	011500
5	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7600	20170518	140000
6	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7601	20170518	140000
7	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7596	20170518	124500
8	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7602	20170518	023000
9	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7599	20170518	011500
10	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7595	20170518	124500
11	1.2.840.114089.1.0.1.3232239131.1495096088.6256.7597	20170518	124500

Initial results table



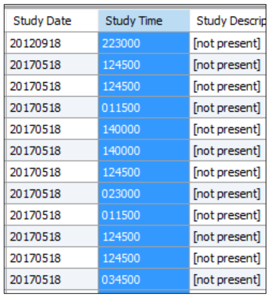
Study Date	Study Time
20120918	223000
20170518	204500
20170518	170000
20170518	140000
20170518	140000
20170518	124500
20170518	124500
20170518	124500
20170518	124500
20170518	124500
20170712	114500
20170518	101500

Sorted column



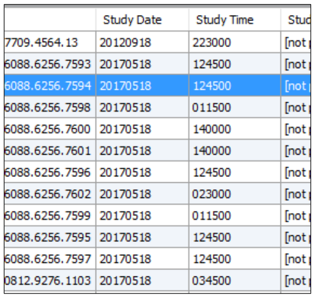
Study Date	Study Time
20170518	011500
20170518	011500
20170518	020000
20170518	023000
20170518	034500
20170518	070000
20170518	070000
20170518	083000
20170518	091500
20170518	094500
20170518	101500
20170712	114500

Reversed sort



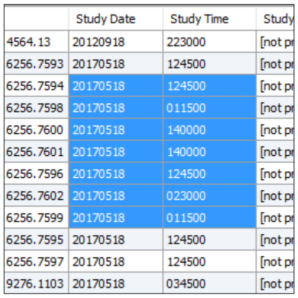
Study Date	Study Time	Study Descrip
20120918	223000	[not present]
20170518	124500	[not present]
20170518	124500	[not present]
20170518	011500	[not present]
20170518	140000	[not present]
20170518	140000	[not present]
20170518	124500	[not present]
20170518	023000	[not present]
20170518	011500	[not present]
20170518	124500	[not present]
20170518	124500	[not present]
20170518	034500	[not present]

Selected column



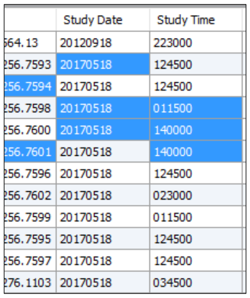
	Study Date	Study Time	Stuc
7709.4564.13	20120918	223000	[not
6088.6256.7593	20170518	124500	[not
6088.6256.7594	20170518	124500	[not
6088.6256.7598	20170518	011500	[not
6088.6256.7600	20170518	140000	[not
6088.6256.7601	20170518	140000	[not
6088.6256.7596	20170518	124500	[not
6088.6256.7602	20170518	023000	[not
6088.6256.7599	20170518	011500	[not
6088.6256.7595	20170518	124500	[not
6088.6256.7597	20170518	124500	[not
0812.9276.1103	20170518	034500	[not

Selected row



	Study Date	Study Time	Study
4564.13	20120918	223000	[not pr
6256.7593	20170518	124500	[not pr
6256.7594	20170518	124500	[not pr
6256.7598	20170518	011500	[not pr
6256.7600	20170518	140000	[not pr
6256.7601	20170518	140000	[not pr
6256.7596	20170518	124500	[not pr
6256.7602	20170518	023000	[not pr
6256.7599	20170518	011500	[not pr
6256.7595	20170518	124500	[not pr
6256.7597	20170518	124500	[not pr
9276.1103	20170518	034500	[not pr

Selected region

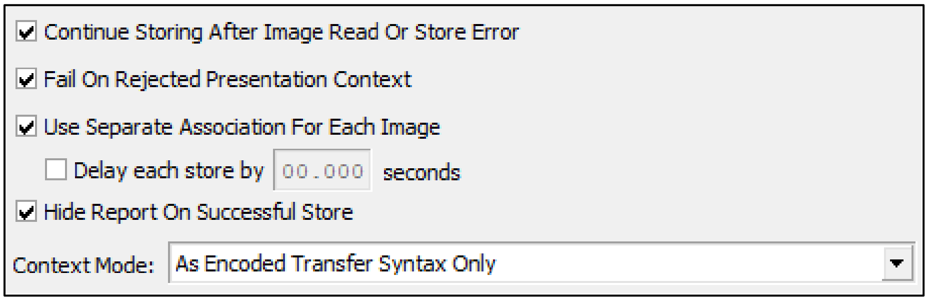


	Study Date	Study Time
564.13	20120918	223000
256.7593	20170518	124500
256.7594	20170518	124500
256.7598	20170518	011500
256.7600	20170518	140000
256.7601	20170518	140000
256.7596	20170518	124500
256.7602	20170518	023000
256.7599	20170518	011500
256.7595	20170518	124500
256.7597	20170518	124500
276.1103	20170518	034500

Arbitrary selections

4.2.2.Store Client

The Store Client is used to perform DICOM image store operations, and has both console and GUI versions. Once DICOM images have been selected and the **Send** button is clicked, images are sent to the selected DICOM store server. Sending can be canceled at any time by clicking the **Cancel** button. Upon completion, an optional status report of the completed store operation can be viewed. Advanced settings in Store Client are described below.



☑ Continue Storing After Image Read Or Store Error

☑ Fail On Rejected Presentation Context

☑ Use Separate Association For Each Image

☐ Delay each store by 00.000 seconds

☑ Hide Report On Successful Store

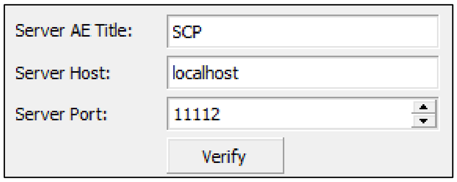
Context Mode: As Encoded Transfer Syntax Only

- **Continue Storeing After Image Read Or Store Error** – if checked and an error occurs during the transmission of a single DICOM image then the images that have not yet been sent will still be attempted.
- **Fail On Rejected Presentation Context** – if checked and presentation context negotiation is unsuccessful for an image then the store attempt will fail.
- **Use Separate Associations For Each Image** – if checked then each image will be sent using a separate association. By default all images are sent together in a single association. This option could be useful for load testing of a server.

- **Delay each store by** - optionally define a delay to be used between each image being sent, from 0 to 99.999 seconds.
- **Hide Report On Successful Send** – If all images are sent successful and this is checked then the status report shown at the conclusion of the send will not be displayed.
- **Context Mode** – the mode with which to negotiate presentation contexts using the **Desired Client Transfer Syntaxes For Presentation Context Negotiation List**.
    - **As Encoded Transfer Syntax Only** – sends all images in their current transfer syntax. If the SCP will not accept an image's transfer syntax then that image will not be sent.
    - **As Encoded Else SCP Preferred Transfer Syntax** – attempts **As Encoded Transfer Syntax Only**, and if that fails then the image will be sent in whatever transfer syntax the SCP prefers.
    - **As Encoded Else SCU Preferred Transfer Syntax** – attempts **As Encoded Transfer Syntax Only**, and if that fails then the image will be sent using the desired client transfer syntaxes for presentation context negotiation list if possible (the transfer syntaxes at the top of the list will be given a higher priority).
    - **SCP Preferred Transfer Syntax Only** – images will be sent in whatever transfer syntax the SCP prefers.
    - **SCU Preferred Transfer Syntax Only** – images will be sent using the desired client transfer syntaxes for presentation context negotiation list if possible (the transfer syntaxes at the top of the list will be given a higher priority).

4.2.3. Verification Client

Verification Client connects to a remote server and checks to see if it is currently running (both ICMP ping and DICOM C-Echo tests are performed). Its verification functionality is available in every client application, visible as a **Verify** button on the server configuration portion of the client GUI window.



Server AE Title: SCP
Server Host: localhost
Server Port: 11112

4.2.4. Modality Worklist Client

Modality Worklist Client provides a command-line interface to common functionality of a modality worklist client suitable for testing, troubleshooting and as a developer tool.

Using the command-line interface, query parameters can be specified either directly using the **–q** flag, or via a configuration file. For example, a command line query for all patients that have the word "Simpson" in their name and have a Patient ID of "112233", and returning those values plus Accession Number and Referring Physician, looks like this:

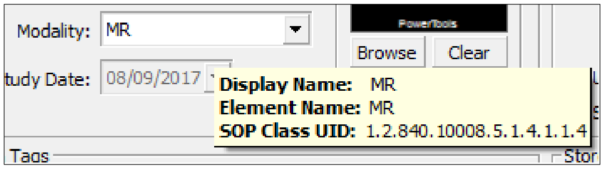
```
MwlClient [other params] -q 0008,0050=  -q 0008,0090=  -q 0010,0010=*Simpson*
```

Instructions for using a configuration file to perform queries are contained in the example configuration file (**MwlClientExample.cfg**) found in the PowerTools installation directory. Note that the GUI version of the Query Client supports top-level Modality Worklist queries, with future enhancements planned.

4.2.5.Study Generator

The Study Generator uses customizable Patient **Name**, **Date of Birth**, **Sex**, **Modality** and **Study Date** attributes to generate and store one or more DICOM images to a specified **Store Server** profile, comprised of **Host**, **Port**, **Called AE** and **Calling AE**. The application supports defining up to 32 of these Store Server profiles to simplify repeated testing on multiple destinations.

Hovering the mouse over the **Modality** produces a tooltip that displays the modality name, element name and SOP Class UID for the element.



Modality: MR

tudy Date: 08/09/2017

Display Name: MR
Element Name: MR
SOP Class UID: 1.2.840.10008.5.1.4.1.1.4

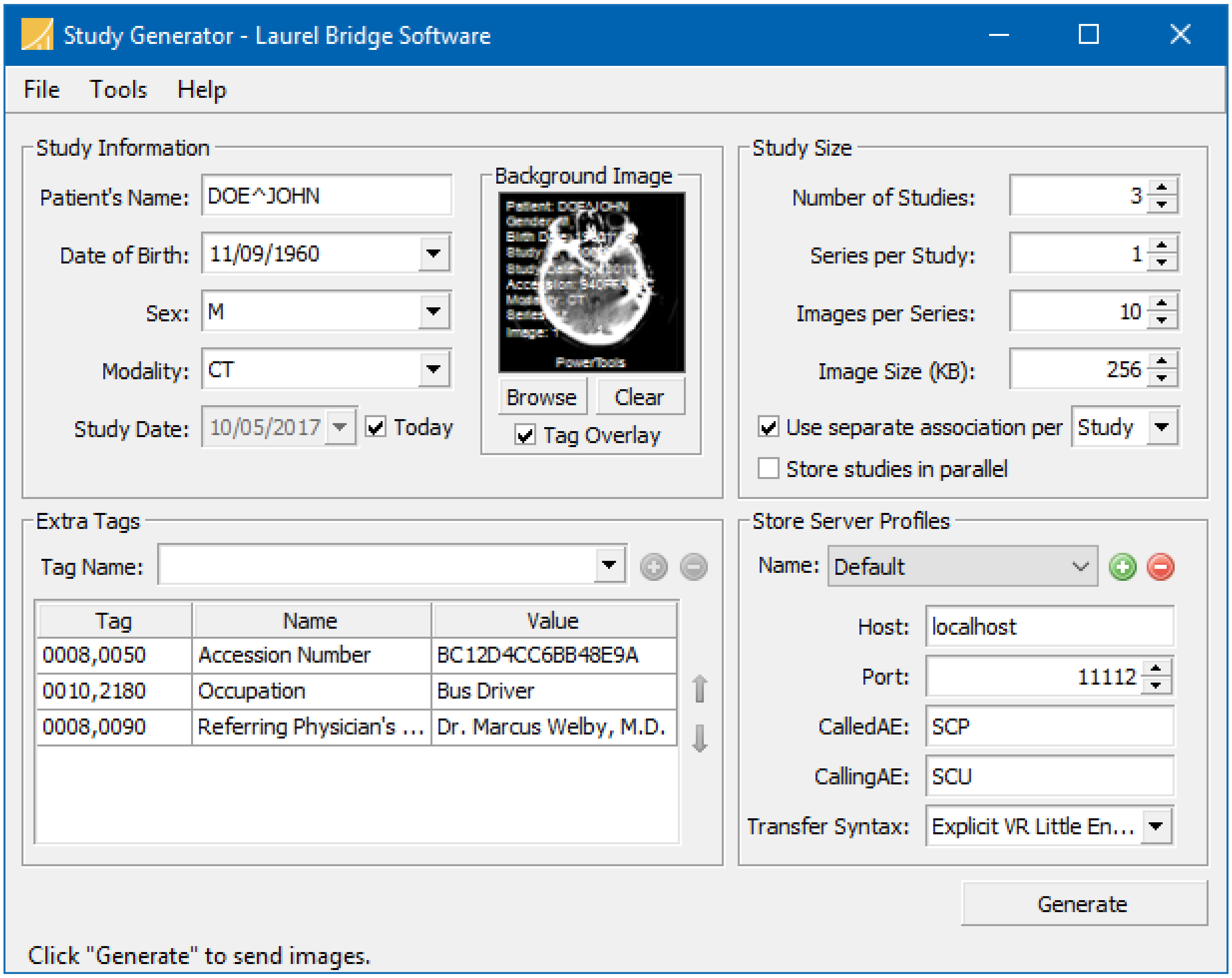
Any number of additional DICOM tags (**Extra Tags**) can be specified, and the user can specify the **Number of Studies**, **Series per Study**, **Images per Series**, **Image Size**, and whether or not to **Use Separate Association per** Study, Series or Image. Clicking on the **Generate** button starts the store job, which can be canceled at any time by clicking the **Cancel** button.

If the **Store Studies in Parallel** option is checked, the **Study Generator** will attempt to concurrently store each of the requested **Number of Studies**, up to a limit determined by the Windows operating system. There also may be an even lower limit for the maximum number of concurrent stores (i.e., associations) depending on the specific store server being targeted. The application attempts to warn the user when these limits are being exceeded, although some experimentation may be required.

An optional **Background Image** can be selected that will be used as the image content for all generated images. When present, the background image will contain a visible watermark indicating that the image is a “SAMPLE.” When not present, a solid black background will be used. An optional textual **Tag Overlay** of study information also can be displayed.

Any image in one of the more command image formats (JPEG, PNG, BMP, GIF and TIFF) can be used as a **Background Image**. A selection of example images for a variety of modalities is in the **backgrounds** subfolder in the PowerTools installation directory. Note that when a **Modality** is selected, a relevant image for that modality is automatically set as the **Background Image**.

If the **Extra Tags** for **Columns and Rows** are loaded after the **Background Image** is selected, their values will be auto-sized to the dimensions of the **Background Image**. See below for information on the **Load Extra Tags** options menu.



Patient's Name: DOE^JOHN

Date of Birth: 11/09/1960

Sex: M

Modality: CT

Study Date: 10/05/2017 ☑ Today

☑ Tag Overlay

Number of Studies: 3

Series per Study: 1

Images per Series: 10

Image Size (KB): 256

☑ Use separate association per Study

☐ Store studies in parallel

Tag Name:

Tag	Name	Value
0008,0050	Accession Number	BC12D4CC6BB48E9A
0010,2180	Occupation	Bus Driver
0008,0090	Referring Physician's …	Dr. Marcus Welby, M.D.

Name: Default

Host: localhost

Port: 11112

CalledAE: SCP

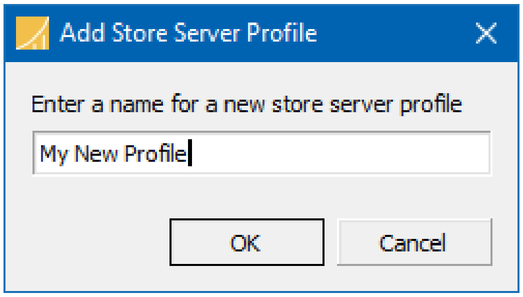
CallingAE: SCU

Transfer Syntax: Explicit VR Little En…

Click "Generate" to send images.

Study Generator main user interface

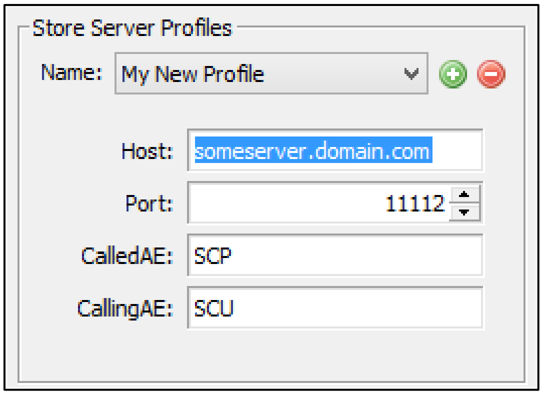
One or more **Store Server Profiles** can be defined, with the list of profiles each containing a Host, Port, CalledAE, CallingAE and Transfer Syntax persisting across uses of the Stdy Generator. To add a new store server profile, click the ⊕ button and enter a new profile name into the dialog:



Enter a name for a new store server profile

My New Profile

Once a profile has been added to the list of profiles, its values can be directly edited in the main GUI screen by first selecting the desired profile name from the list and then editing the four values underneath. Note that when adding a profile, the Host, Port, CalledAE and CallingAE values for the currently selected profile will be copied into the newly added profile.



Store Server Profiles

Name: My New Profile

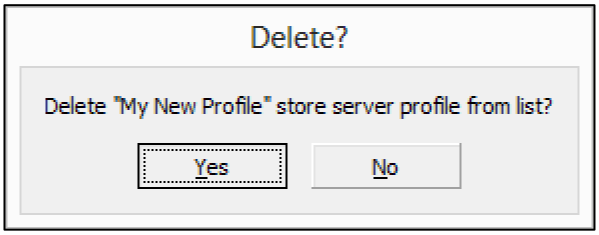
Host: someserver.domain.com

Port: 11112

CalledAE: SCP

CallingAE: SCU

To delete a store server profile, select the desired profile in the list and click the ⊖ button, and confirm deletion of the profile.

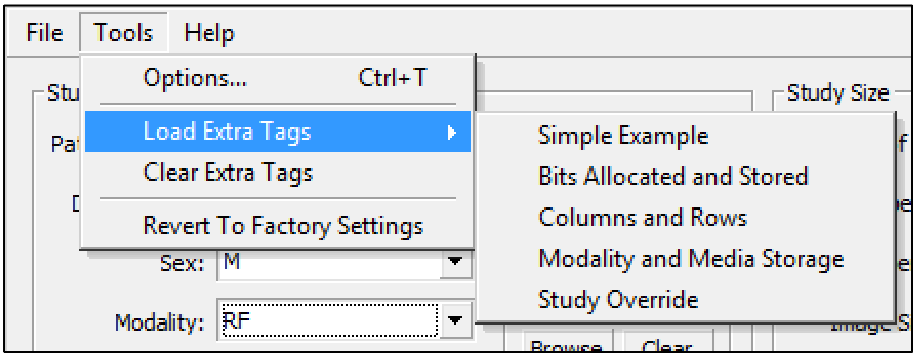


Delete?

Delete "My New Profile" store server profile from list?

There is no direct way to rename a store server profile. To effectively rename a profile, select the profile to be renamed (e.g., "Old Profile"), add a new profile (e.g., "New Profile") with the desired new name, and then delete the first profile (i.e., delete "Old Profile").

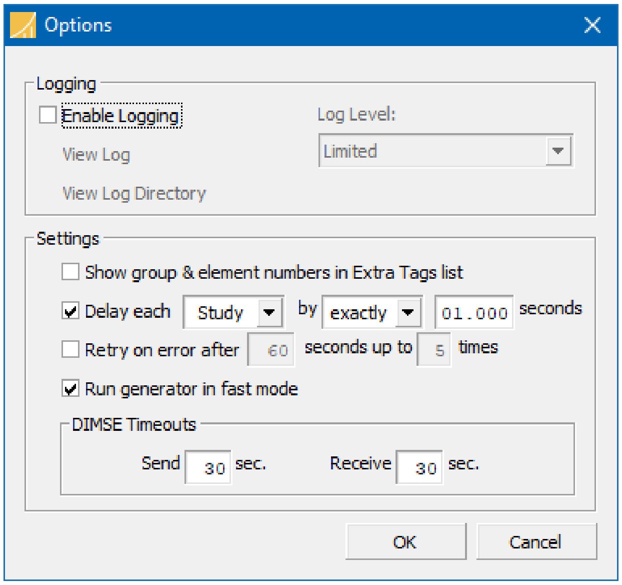
The **Tools** menu provides access to the **Options dialog** and to a variety of time-saving shortcuts.



- **Tools**
  - **Options** – launches the Options Dialog (see below).
  - **Load Extra Tags** – provides five convenient selections that will populate the **Extra Tags** list with the indicated tags. Note that a tooltip will pop up for each of these selections, providing information about the tags that will be added.
  - **Clear Extra Tags** – clears all tags from the **Extra Tags** list.
  - **Revert To Factory Settings** – resets the application to its initial settings.

When loading the **Bits Allocated and Stored** tags, the user can indicate generation of 8 or 16 bit images by setting the appropriate value in the **Bits Allocated** tag. If not indicated, 8 bit images are generated.

The **Options dialog** in the Study Generator provides support for **Logging**, as well as a number of additional settings.



Options

Logging

□ Enable Logging

Log Level: Limited

View Log

View Log Directory

Settings

□ Show group & element numbers in Extra Tags list

☑ Delay each Study by exactly 01.000 seconds

□ Retry on error after 60 seconds up to 5 times

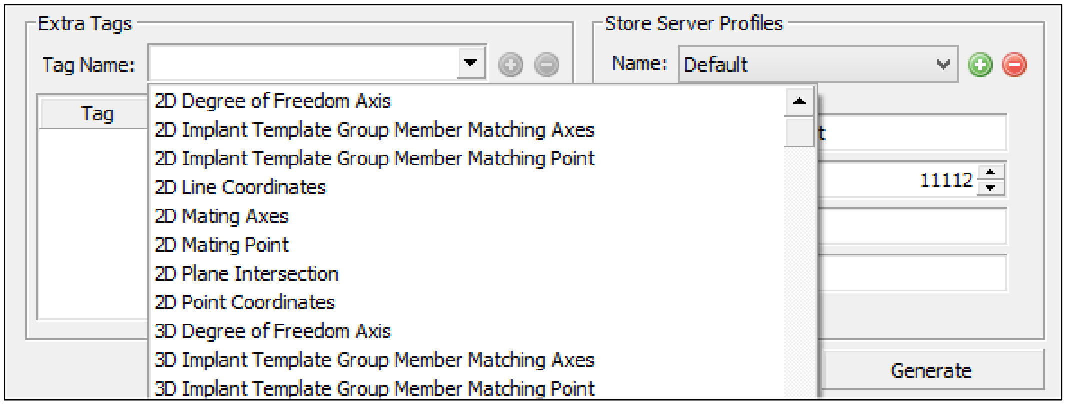
☑ Run generator in fast mode

DIMSE Timeouts

Send 30 sec. Receive 30 sec.

OK Cancel

By selecting **Show group & element numbers in Extra Tags list**, the group and element numbers are displayed in the drop down list of Extra Tags to support locating tags by group and element number in addition to tag name.



Extra Tags

Tag Name:

Tag

2D Degree of Freedom Axis
2D Implant Template Group Member Matching Axes
2D Implant Template Group Member Matching Point
2D Line Coordinates
2D Mating Axes
2D Mating Point
2D Plane Intersection
2D Point Coordinates
3D Degree of Freedom Axis
3D Implant Template Group Member Matching Axes
3D Implant Template Group Member Matching Point

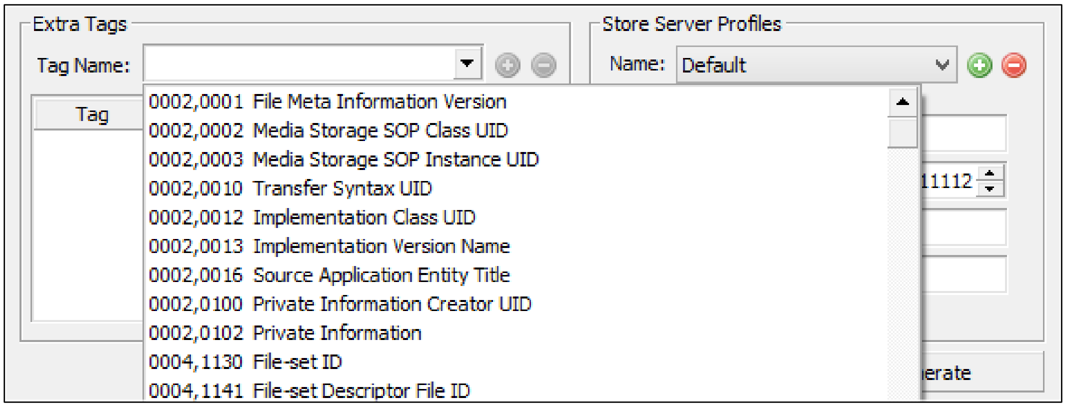
Store Server Profiles

Name: Default

11112

Generate

Extra Tags with no group and element numbers displayed


Extra Tags
Tag Name:
Tag
0002,0001 File Meta Information Version
0002,0002 Media Storage SOP Class UID
0002,0003 Media Storage SOP Instance UID
0002,0010 Transfer Syntax UID
0002,0012 Implementation Class UID
0002,0013 Implementation Version Name
0002,0016 Source Application Entity Title
0002,0100 Private Information Creator UID
0002,0102 Private Information
0004,1130 File-set ID
0004,1141 File-set Descriptor File ID
Store Server Profiles
11112
erate

Name: Default

Extra Tags with group and element numbers displayed

Selecting **Delay each** enables the store of each **Study**, **Series** or **Instance** to be delayed by a configurable number of seconds between each store operation. Each store can be delayed by **exactly** or **up to** a desired number of seconds, from 0.0 to 99.999 seconds.

Selecting **Retry on error after** enables a limited number of retries (maximum is 99 retries) with a delay of a configurable number of seconds (maximum is 999 seconds) between each attempted retry.

Selecting **Run generator in fast mode** enables a "fast" mode of generation to improve performance for situations where the fasted generation possible is needed. In the fast mode, a single generic image is generated and used over and over, and only the specific DICOM tags that change with each image are updated. Load tests using fast mode have shown an approximate speedup of 300% (3 times faster) as compared with standard mode generation.

DIMSE Timeouts for **Send** and **Receive** can be configured in the range 0 to 999 seconds.

When started at the command line, the GUI version of the Study Generator has a **-run** switch that causes the generator to immediately begin running upon application start up.

The console version of the Study Generator makes use of a configuration file that controls generation of a variety of Patient, Study, Series and Image tags. A number of built-in functions support generation of random values for UID, date, time, name and gender. Detailed instructions are contained in the example configuration file (**StudyGeneratorExample.cfg**) found in the PowerTools installation directory, along with a small, example DICOM file (**mr-knee.dcm**) that can be used as a template for generating studies.

4.3. DICOM Server Applications

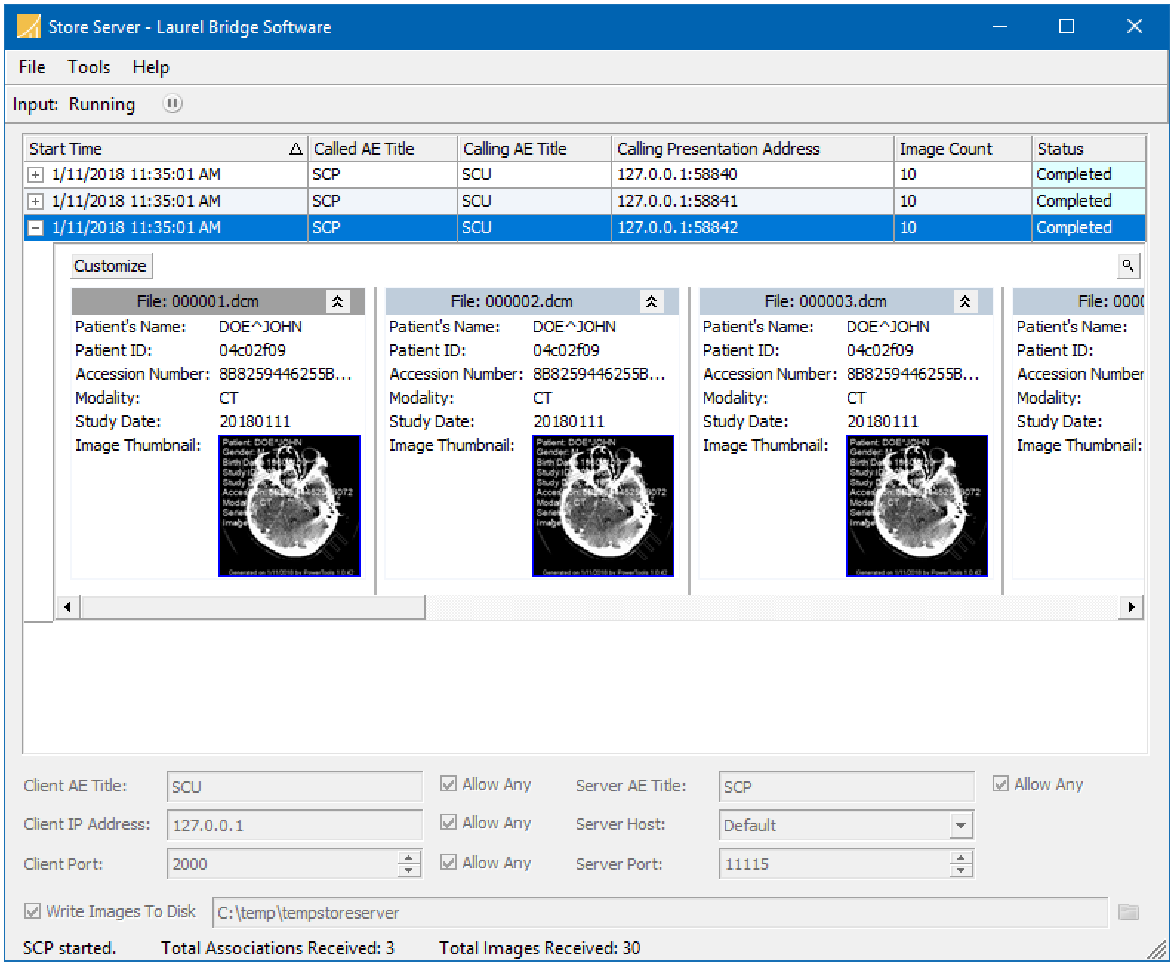
PowerTools provides several DICOM server applications which receive connections from a DICOM client on a remote machine. The more advanced functionality of these applications is discussed below.

4.3.1.Store Server

The Store Server provides DICOM SCP functionality. Received images are displayed in a grid display, with each row in the grid representing all images received within the same association. Rows can be expanded to show a sequence of cards displayed, each with a summary of DICOM header tags and a thumbnail view of the image, if any.

The Store Server is started and stopped (or paused) using the run button ▶ and the stop (or pause) button ⏸.

Within each card, if an image contains multiple frames, the **Number of Frames** is displayed. When the thumbnail image is clicked, it will be opened in the **Dicom File Editor** for viewing and editing.



Input: Running ⏸

Start Time	Called AE Title	Calling AE Title	Calling Presentation Address	Image Count	Status
⊞ 1/11/2018 11:35:01 AM	SCP	SCU	127.0.0.1:58840	10	Completed
⊞ 1/11/2018 11:35:01 AM	SCP	SCU	127.0.0.1:58841	10	Completed
⊟ 1/11/2018 11:35:01 AM	SCP	SCU	127.0.0.1:58842	10	Completed

File: 000001.dcm
Patient's Name: DOE^JOHN
Patient ID: 04c02f09
Accession Number: 8B8259446255B...
Modality: CT
Study Date: 20180111
Image Thumbnail:

File: 000002.dcm
Patient's Name: DOE^JOHN
Patient ID: 04c02f09
Accession Number: 8B8259446255B...
Modality: CT
Study Date: 20180111
Image Thumbnail:

File: 000003.dcm
Patient's Name: DOE^JOHN
Patient ID: 04c02f09
Accession Number: 8B8259446255B...
Modality: CT
Study Date: 20180111
Image Thumbnail:

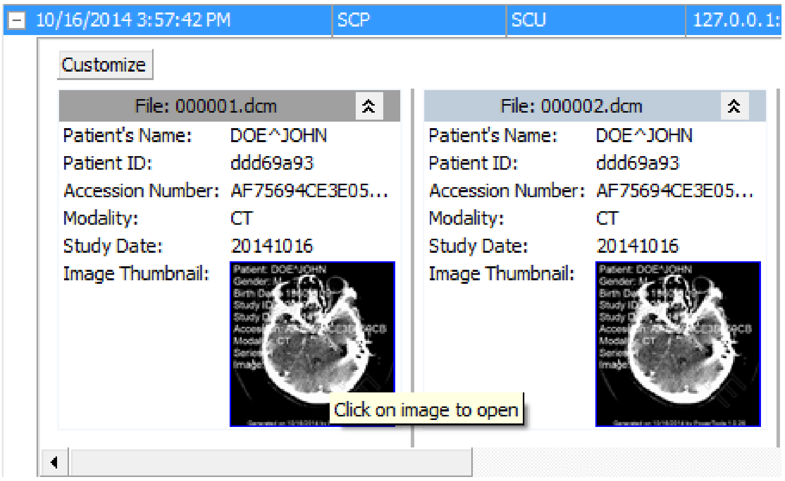
File: 000(
Patient's Name:
Patient ID:
Accession Number
Modality:
Study Date:
Image Thumbnail:

Client AE Title: SCU ☑ Allow Any
Client IP Address: 127.0.0.1 ☑ Allow Any
Client Port: 2000 ☑ Allow Any
Server AE Title: SCP ☑ Allow Any
Server Host: Default
Server Port: 11115

☑ Write Images To Disk C:\temp\tempstoreserver

SCP started. Total Associations Received: 3 Total Images Received: 30

Main user interface screen of the **Store Server**.



10/16/2014 3:57:42 PM | SCP | SCU | 127.0.0.1:

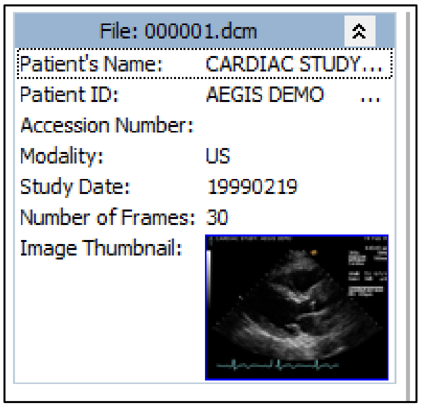
File: 000001.dcm

Patient's Name: DOE^JOHN
Patient ID: ddd69a93
Accession Number: AF75694CE3E05…
Modality: CT
Study Date: 20141016
Image Thumbnail:

File: 000002.dcm

Patient's Name: DOE^JOHN
Patient ID: ddd69a93
Accession Number: AF75694CE3E05…
Modality: CT
Study Date: 20141016
Image Thumbnail:

Clicking on a thumbnail image will open the underlying DICOM image file in the **Dicom File Editor**.

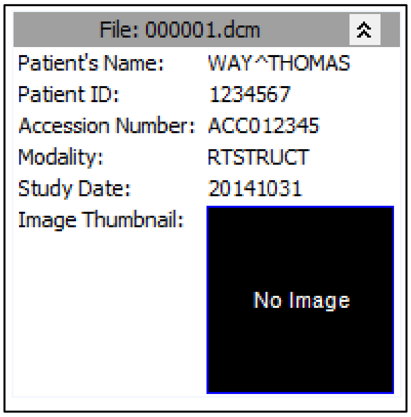


File: 000001.dcm

Patient's Name: CARDIAC STUDY…
Patient ID: AEGIS DEMO …
Accession Number:
Modality: US
Study Date: 19990219
Number of Frames: 30
Image Thumbnail:

The **Number of Frames** in a multi-frame image is shown.

For DICOM image files that do not contain viewable image data, a “No Image” indicator is displayed on the Image Thumbnail:



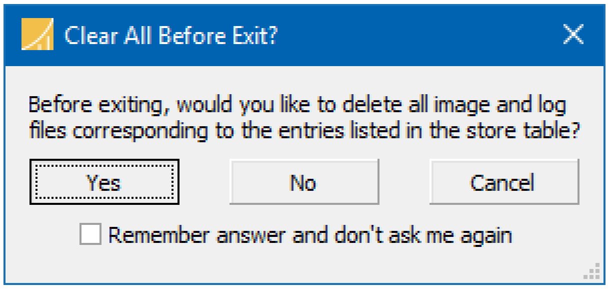
File: 000001.dcm

Patient's Name: WAY^THOMAS
Patient ID: 1234567
Accession Number: ACC012345
Modality: RTSTRUCT
Study Date: 20141031
Image Thumbnail:

The **No Image** indicator.

Large numbers of image and log files can be generated in the process of running the Store Server. To assist with file system cleanliness, when the application is exited the user is presented with a dialog offering the option of deleting these image and log files before exiting.

If the **Don't ask me again** checkbox is checked, this dialog will not appear again unless the feature is reset in the **Options** dialog.



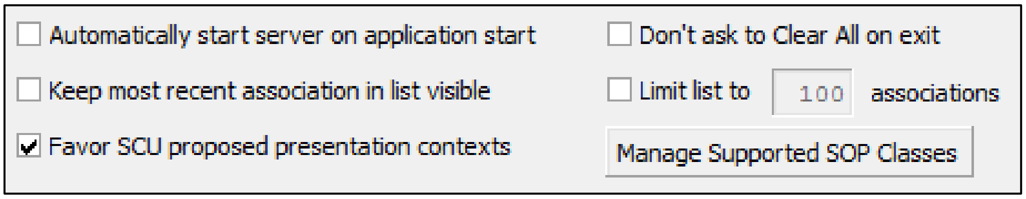
Clear All Before Exit?

Before exiting, would you like to delete all image and log files corresponding to the entries listed in the store table?

□ Remember answer and don't ask me again

The **Clear All Before Exit** dialog of the **Store Server**.

Advanced settings in **Store Server** are described below.



□ Automatically start server on application start

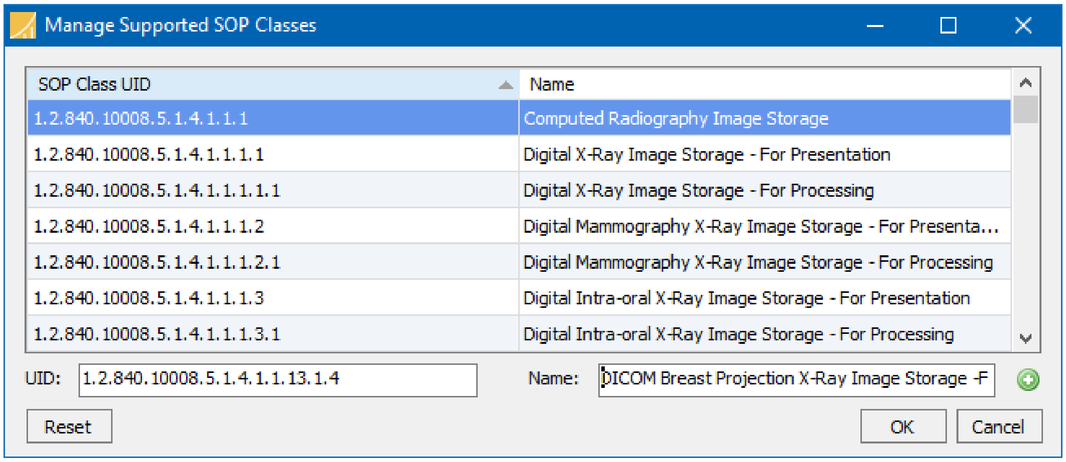
□ Don't ask to Clear All on exit

□ Keep most recent association in list visible

□ Limit list to 100 associations

☑ Favor SCU proposed presentation contexts

- **Automatically start server on application start** – if checked then the server will attempt to start immediately upon application startup.
- **Don't ask to Clear All on exit** - if checked then the "Clear All Before Exit" dialog will not appear on application exit.
- **Keep most recent association in list visible** - if checked then the association list automatically scrolls so the most recently received association is always visible.
- **Limit list** - maintains a maximum number of associations in the list to prevent the list from growing exceedingly large.
- **Favor SCU proposed presentation contexts** – if checked then the connecting SCU will be given preference when negotiation presentation contexts. If unchecked then Store Server will negotiate presentation contexts based upon its **Supported Server Transfer Syntaxes For Presentation Context Negotiation List**.
- **Manage Supported SOP Classes** – when clicked, the **Manage Supported SOP Classes** dialog opens, enabling the user to add, remove and modify the current list of supported SOP classes Store Server uses.



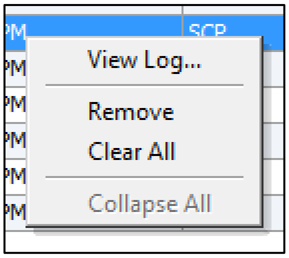
SOP Class UID	Name
1.2.840.10008.5.1.4.1.1.1	Computed Radiography Image Storage
1.2.840.10008.5.1.4.1.1.1.1	Digital X-Ray Image Storage - For Presentation
1.2.840.10008.5.1.4.1.1.1.1.1	Digital X-Ray Image Storage - For Processing
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage - For Presenta...
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage - For Processing
1.2.840.10008.5.1.4.1.1.1.3	Digital Intra-oral X-Ray Image Storage - For Presentation
1.2.840.10008.5.1.4.1.1.1.3.1	Digital Intra-oral X-Ray Image Storage - For Processing

UID: 1.2.840.10008.5.1.4.1.1.13.1.4 Name: DICOM Breast Projection X-Ray Image Storage -F

The **Manage Supported SOP Classes** dialog.

The **Manage Supported SOP Classes** dialog enables the user to selectively delete any, or all, of the UIDs in the list of supported SOP class UIDs and names. Additional SOP classes can be added by entering a new **UID** and **Name** and then pressing the green add button. Pressing the **Reset** button restores the default list of supported SOP classes.

In addition to the **Clear All Before Exit** functionality that can be configured via the Options dialog, the list of associations can be cleared via the **Clear All** item in right-click context menu, the **Clear All** item in the **File** menu or the menu item keyboard shortcut Ctrl-A. One or more selected items in the association list can be deleted by selecting the items you wish to remove and then either hitting the **Del** (delete) key or using the context menu **Remove** item.

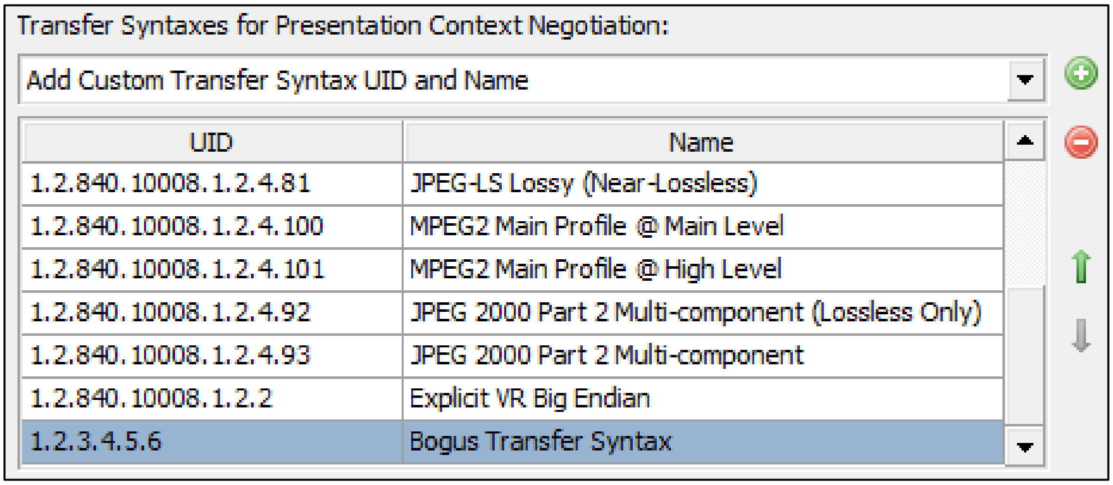


The right-click context menu of the **Store Server**.

When started at the command line, the GUI version of the Study Generator has a **-run** switch that causes the generator to immediately begin running upon application start up, which is the same optional functionality as that described above.

The **Transfer Syntaxes for Presentation Context Negotiation** setting (section 4.1.6) that is common in a number of client and server applications has been extended in the Store Server with the ability to add one or more custom transfer syntax entries to enable graceful handling of a wide variety of non-standard and incorrect transfer syntax values.

- **Add Custom Transfer Syntax UID and Name** – by selecting this option in the drop down list and clicking the add button, the user can enter any desired transfer syntax UID and Name. The list automatically prevents duplicate or blank UIDs from being entered.



Transfer Syntaxes for Presentation Context Negotiation:

Add Custom Transfer Syntax UID and Name

UID	Name
1.2.840.10008.1.2.4.81	JPEG-LS Lossy (Near-Lossless)
1.2.840.10008.1.2.4.100	MPEG2 Main Profile @ Main Level
1.2.840.10008.1.2.4.101	MPEG2 Main Profile @ High Level
1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component (Lossless Only)
1.2.840.10008.1.2.4.93	JPEG 2000 Part 2 Multi-component
1.2.840.10008.1.2.2	Explicit VR Big Endian
1.2.3.4.5.6	Bogus Transfer Syntax

Extended Transfer Syntax settings management in **Store Server**

4.3.2. Query Server

Query Server provides a command-line interface to a query SCP for a directory of DICOM files on disk. Command line options support return of **Retrieve AE Title** and **Instance Availability**.

4.3.3. Modality Worklist Server

Modality Worklist Server provides a command-line interface to common functionality of a modality worklist server that accesses its data from a directory on disk, and is suitable for testing, troubleshooting and as a developer tool.

4.3.4. Verification Server

Verification Server can be used to provide a very simple Verification SCP to test a verification SCU. Its functionality is present in every server application and will not be described further.

4.4. DICOM Data and File Manipulation Applications

PowerTools provides DICOM applications which modify one or more DICOM files on disk as well as applications used to manage DICOM data. The advanced functionality of these applications is discussed below.

4.4.1. DICOMDIR Creator

DICOMDIR Creator takes as arguments an **Image Directory** where DICOM images are located (may also be contained in subdirectories) and a **DICOMDIR File Name** (usually DICOMDIR). The application then creates a directory/image hierarchy from the images found in the image directory and creates a DICOMDIR file using the information gathered which is placed in the **Image Directory** upon completion. Results are shown in the **Results** list.

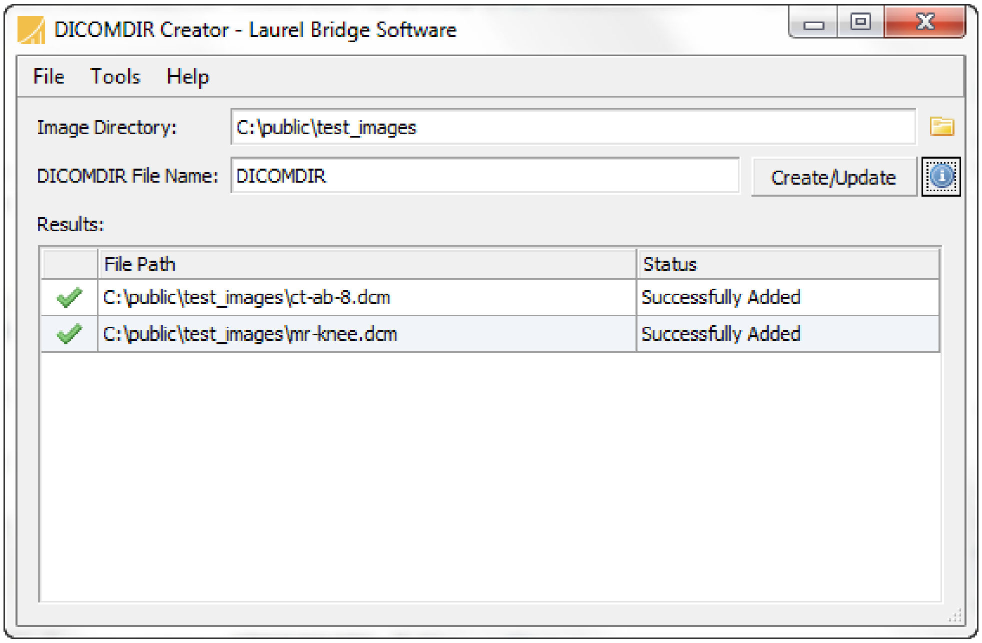


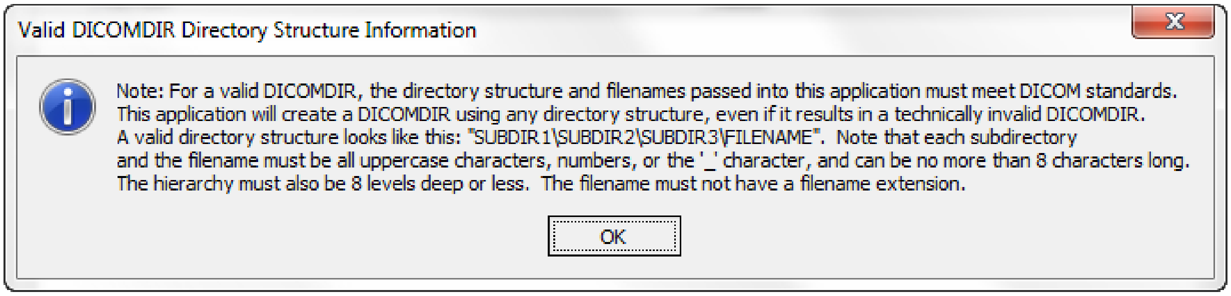
Image Directory: C:\public\test_images

DICOMDIR File Name: DICOMDIR

Results:

	File Path	Status
✓	C:\public\test_images\ct-ab-8.dcm	Successfully Added
✓	C:\public\test_images\mr-knee.dcm	Successfully Added

Also, please note the following when creating a DICOMDIR:

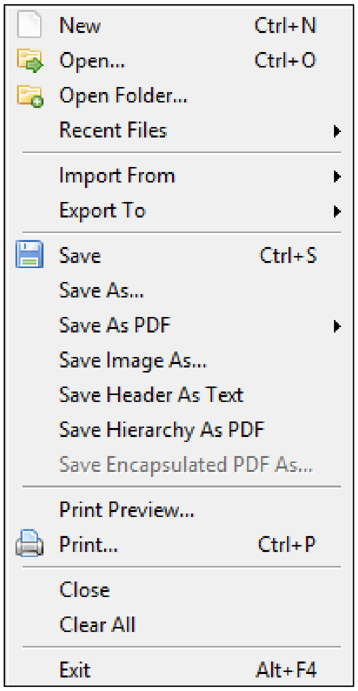


Note: For a valid DICOMDIR, the directory structure and filenames passed into this application must meet DICOM standards. This application will create a DICOMDIR using any directory structure, even if it results in a technically invalid DICOMDIR. A valid directory structure looks like this: "SUBDIR1\SUBDIR2\SUBDIR3\FILENAME". Note that each subdirectory and the filename must be all uppercase characters, numbers, or the '_' character, and can be no more than 8 characters long. The hierarchy must also be 8 levels deep or less. The filename must not have a filename extension.

4.4.2.DICOM File Editor

DICOM File Editor provides a three-tabbed view for inspecting DICOM files: a tabular view of the header contents, a hex viewer, and an image viewer for the pixel data. It is recommended to set the DICOM File Editor as the default viewer for .DCM files in Windows to enable faster viewing/editing of image files. Some advanced settings for this application are described below.

The DICOM File Editor menu bar has several options unique to the application.

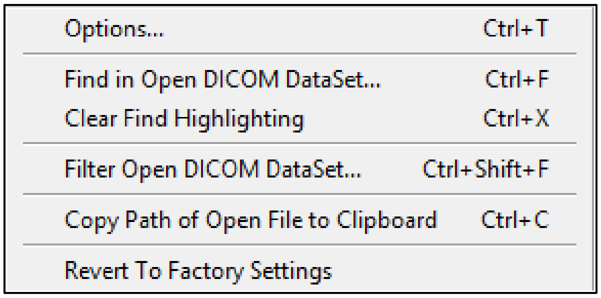


File Menu

- **File**
  - **New** – creates a new DICOM data set for editing.
  - **Open…** – opens a DICOM image or DICOMDIR file from disk. This functionality can also be performed by dragging a DICOM image or DICOMDIR file from Windows Explorer into the main view of the **DICOM File Editor**.
  - **Open Folder…** – opens a folder of DICOM files from disk. This functionality can also be performed by dragging a folder containing DICOM image or DICOMDIR files from Windows Explorer into the main view of the **DICOM File Editor**.
  - **Recent Files** – provides a convenient list of recently opened files.
  - **Import From** > **LBS CFGGroup**… – similar to **Open**, but uses a Laurel Bridge data file instead of a DICOM file.
  - **Export To** > **LBS CFGGroup**… – saves the currently open DICOM data set as a Laurel Bridge data file.
  - **Export To** > **Text Document…** – dumps the currently open DICOM data set to a text file in text format.
  - **Save** – saves the current DICOM data set to a file.
  - **Save As…** – saves the current DICOM data set to a file specifying the file name and transfer syntax in which to save the image.
  - **Save As PDF** – saves the current DICOM data set, including the first image frame if there is one, to a PDF document in one of two formats. Saving **With All Header Tags** includes the entire set of DICOM header tags in the PDF. Saving **With Demographic Header Tags** includes only a minimal set of DICOM header tags about the patient, study, series, instance.
  - **Save Image As** – saves the currently displayed image frame on the Image panel as a regular image (BMP, GIF, JPEG, PBM, PGM, PNG, PPM, TIFF). For multi-frame images, the current frame will be saved to one of these formats.

Additionally, for multi-frame images only, the complete multi-frame image can be saved as an Animated GIF at a 10 fps rate.

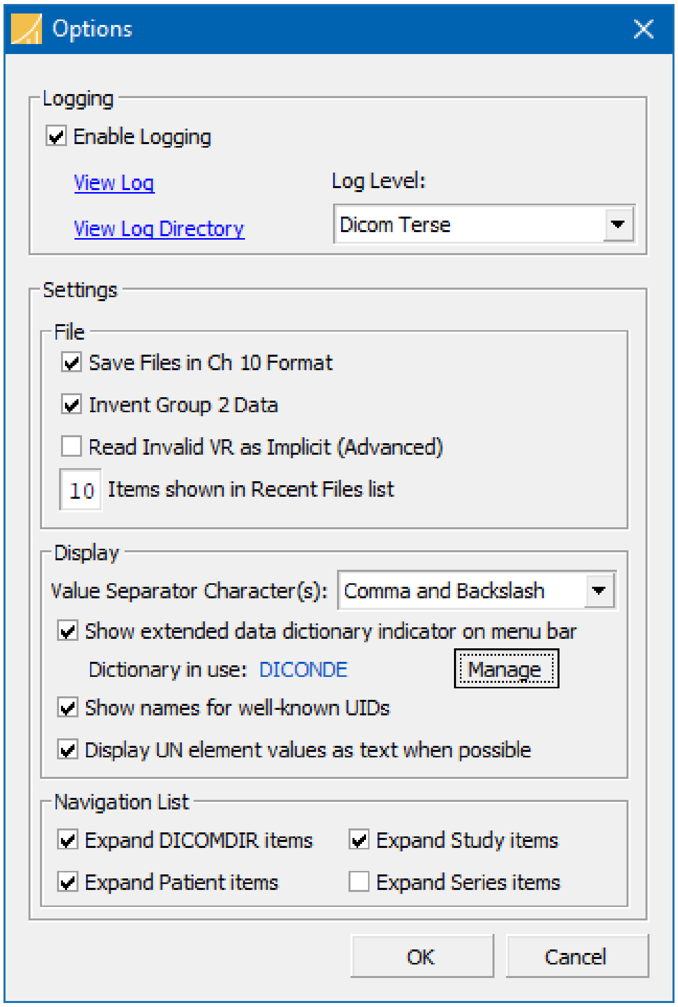
  - **Save Header As Text** – saves the header of the current DICOM data set as a plain text file, specifying the file name of the saved file.
  - **Save Hierarchy As PDF** – saves the current study hierarchy displayed in the left panel as a PDF.
  - **Save Encapsulated PDF As** – saves an Encapsulated PDF element to a file if one is present in the current DICOM data set.
  - **Print Preview…** – shows a preview of what will be printed if the current DICOM data set (without pixel data) is printed.
  - **Print…** – prints the current DICOM data set to a printer (without pixel data).
  - **Close** – closes the currently open data set, if any.
  - **Clear** – clears the list of DICOM data sets in the navigation view.
  - **Exit** – exits **DICOM File Editor**.


Options... Ctrl+T
Find in Open DICOM DataSet... Ctrl+F
Clear Find Highlighting Ctrl+X
Filter Open DICOM DataSet... Ctrl+Shift+F
Copy Path of Open File to Clipboard Ctrl+C
Revert To Factory Settings

Tools Menu

- **Tools**
  - **Options** – launches the Options Dialog (see below).
  - **Find in Open DICOM DataSet...** – launches the Find dialog that enables search operations in the open data set in both the header view and hex view panels.
  - **Clear Find Highlighting** – clears the highlighting that results from a Find All operation in the Find dialog after a search in the header view panel.
  - **Filter Open DICOM Data Set** – launches the Filter Editor Dialog and applies any filters to the currently open DICOM data set.
  - **Copy Path of Open File to Clipboard** – copies the complete path of the open DataSet file to the system Clipboard.
  - **Revert To Factory Settings** – in addition to the default reset behavior, selecting this will clear the **Recent Files** list and the list of recent search terms in the **Find** dialog.

The **Options Dialog** in **DICOM File Editor** allows the specification of several unique settings.



Options

Logging

☑ Enable Logging

View Log

View Log Directory

Log Level: Dicom Terse

Settings

File

☑ Save Files in Ch 10 Format

☑ Invent Group 2 Data

☐ Read Invalid VR as Implicit (Advanced)

10 Items shown in Recent Files list

Display

Value Separator Character(s): Comma and Backslash

☑ Show extended data dictionary indicator on menu bar

Dictionary in use: DICONDE

Manage

☑ Show names for well-known UIDs

☑ Display UN element values as text when possible

Navigation List

☑ Expand DICOMDIR items

☑ Expand Study items

☑ Expand Patient items

☐ Expand Series items

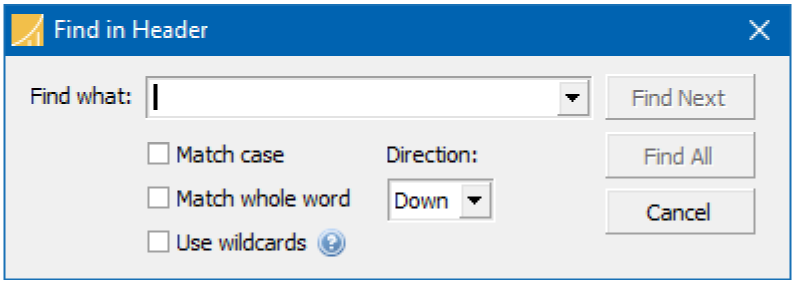
OK

Cancel

- **Enable Logging** – Checking this option will enable logging for **DICOM File Editor** use. For more description of logging, see the description of the Options Dialog in section 4.1.2.
- **Value Separator Characters(s)** – specifies the character(s) to use to separate multi-valued elements in the main value display.
  - **Comma and Backslash** – a multi-valued element will appear as [a/b] or [1,2]
  - **Newline** – a multi-valued element will place each new value on a new line.
- **Save Files in Ch 10 Format** – when checked, data sets will be saved in Chapter 10 format.
- **Invent Group 2 Data** – when checked, group 2 data will be invented if needed.
- **Read Invalid VR as Implicit** – an advanced and rarely needed option, it enables data sets containing a variety of errors to be opened and viewed.
- **Show external data dictionary indicator** – when checked, the external data dictionary indicator is displayed on the menu bar (section 4.1.8).
- **Manage** - when clicked, the **Select External Data Dictionary** (section 4.1.8) dialog pops up, enabling selection and management of external data dictionaries.

- **Show names for well-known UIDs** – causes the names of any well-known UIDs to be displayed in the header view tab rather than the UID strings themselves. The original UID will be displayed in a tooltip when the name is hovered over with the mouse.
- **Items shown in Recent Files List** - determines how many recently opened files will be listed in the Recent Files menu item.
- **Expand DICOMDIR items** - when checked, DICOMDIR items in the Navigation List will be expanded by default.
- **Expand Patient items** - when checked, Patient items in the Navigation List will be expanded by default.
- **Expand Study items** - when checked, Study items in the Navigation List will be expanded by default.
- **Expand Series items** - when checked, Series items in the Navigation List will be expanded by default.

The **Find in Header** Dialog for the header view panel of the **DICOM File Editor** provides searching within the DICOM header values of the open data set. The “Find what” field maintains a list of recently used search term. There also is a **Find in Hex** Dialog for the hex view panel (see below). When switching between the header, hex and image view panels, any open **Find** Dialog remembers whether or not it is open and if so it automatically closes and reopens as its panel is left and returned to.



Find in Header

Find what:

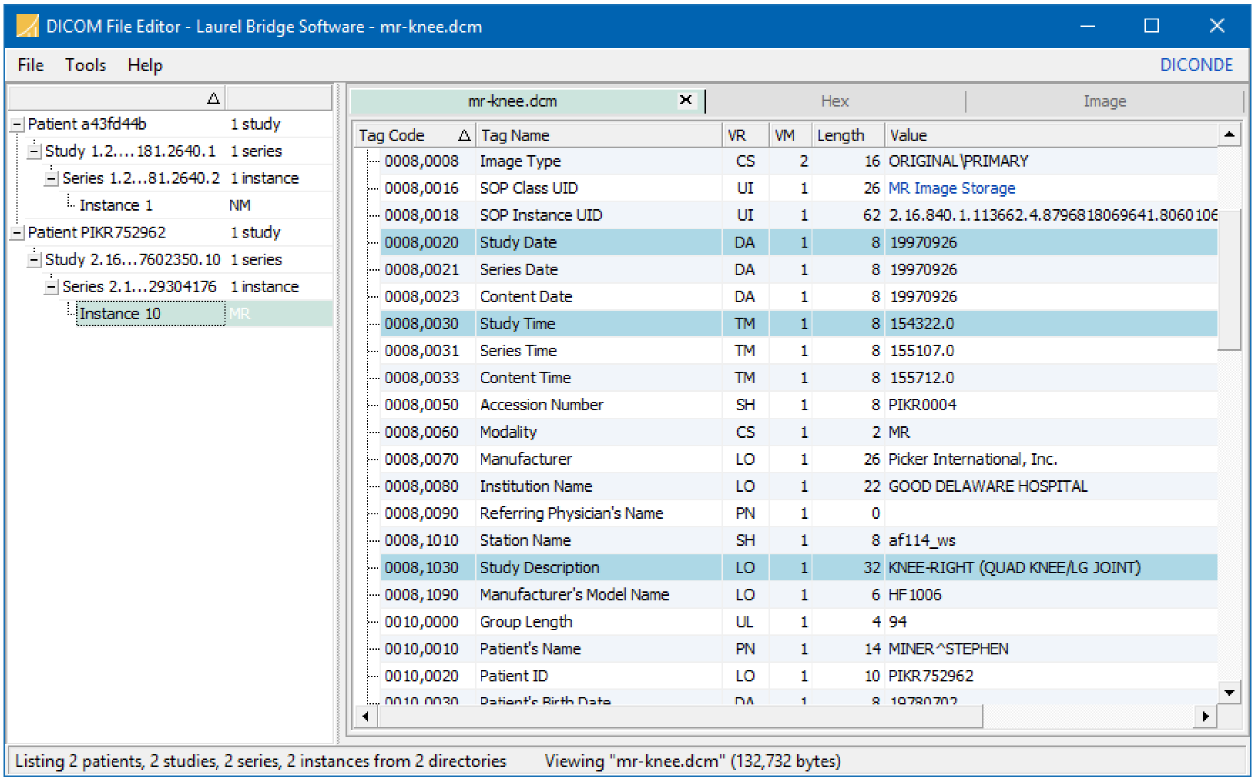
□ Match case

□ Match whole word

□ Use wildcards

Direction: Down

Clicking **Find Next** will search in the selected search **Direction** (Up or Down), while clicking **Find All** will highlight all matching elements in the data set. Selecting **Match whole word** will limit search results to matches that have whitespace or are at the start or end of a field rather than an arbitrary partial match. Selecting **Match case** will make the search case-sensitive.



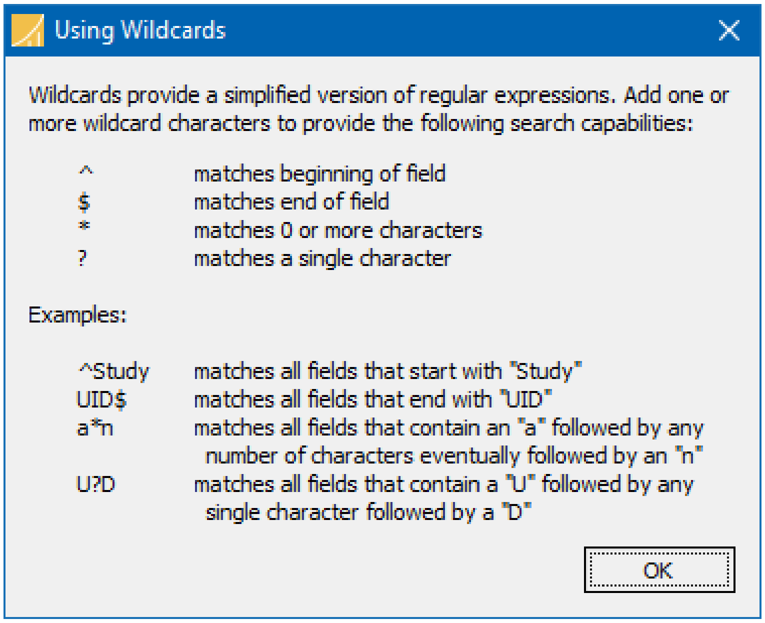
Patient a43fd44b	1 study
Study 1.2....181.2640.1	1 series
Series 1.2...81.2640.2	1 instance
Instance 1	NM
Patient PIKR752962	1 study
Study 2.16...7602350.10	1 series
Series 2.1...29304176	1 instance
Instance 10	MR

Tag Code	Tag Name	VR	VM	Length	Value
0008,0008	Image Type	CS	2	16	ORIGINAL\PRIMARY
0008,0016	SOP Class UID	UI	1	26	MR Image Storage
0008,0018	SOP Instance UID	UI	1	62	2.16.840.1.113662.4.8796818069641.8060106
0008,0020	Study Date	DA	1	8	19970926
0008,0021	Series Date	DA	1	8	19970926
0008,0023	Content Date	DA	1	8	19970926
0008,0030	Study Time	TM	1	8	154322.0
0008,0031	Series Time	TM	1	8	155107.0
0008,0033	Content Time	TM	1	8	155712.0
0008,0050	Accession Number	SH	1	8	PIKR0004
0008,0060	Modality	CS	1	2	MR
0008,0070	Manufacturer	LO	1	26	Picker International, Inc.
0008,0080	Institution Name	LO	1	22	GOOD DELAWARE HOSPITAL
0008,0090	Referring Physician's Name	PN	1	0	
0008,1010	Station Name	SH	1	8	af114_ws
0008,1030	Study Description	LO	1	32	KNEE-RIGHT (QUAD KNEE/LG JOINT)
0008,1090	Manufacturer's Model Name	LO	1	6	HF1006
0010,0000	Group Length	UL	1	4	94
0010,0010	Patient's Name	PN	1	14	MINER^STEPHEN
0010,0020	Patient ID	LO	1	10	PIKR752962
0010,0030	Patient's Birth Date	DA	1	8	19780702

Listing 2 patients, 2 studies, 2 series, 2 instances from 2 directories   Viewing "mr-knee.dcm" (132,732 bytes)

Highlighting after a **Find All** operation for the search term "study"

When **Use wildcards** is selected, a limited set of wildcard notation is available to enable more powerful and flexible searching. Selecting the help icon next to **Use wildcards** opens the **Using Wildcards** dialog that contains a summary of the wildcard syntax.



Wildcards provide a simplified version of regular expressions. Add one or more wildcard characters to provide the following search capabilities:

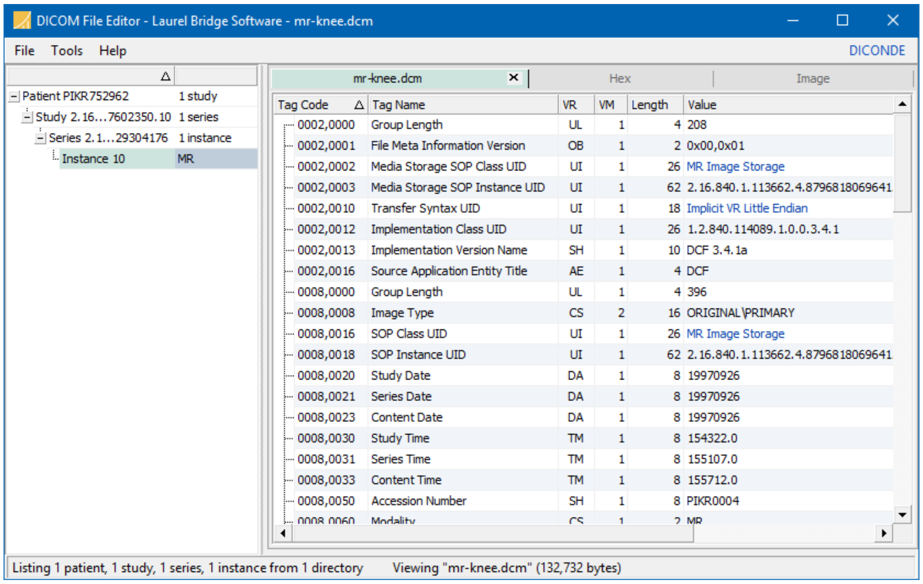
^	matches beginning of field
$	matches end of field
*	matches 0 or more characters
?	matches a single character

Examples:

^Study	matches all fields that start with "Study"
UID$	matches all fields that end with "UID"
a*n	matches all fields that contain an "a" followed by any number of characters eventually followed by an "n"
U?D	matches all fields that contain a "U" followed by any single character followed by a "D"

The navigation view on the left side of the UI displays the four levels of the imported instances: patient/study/series/instance. The displayed values for each level are: Patient ID, Study Instance

UID, Series Instance UID, and SOP Instance UID. All studies having the same Patient ID will be displayed underneath that entry. All series having the same Study Instance UID will be displayed underneath that entry. All instances having the same Series Instance UID will be displayed underneath that entry.

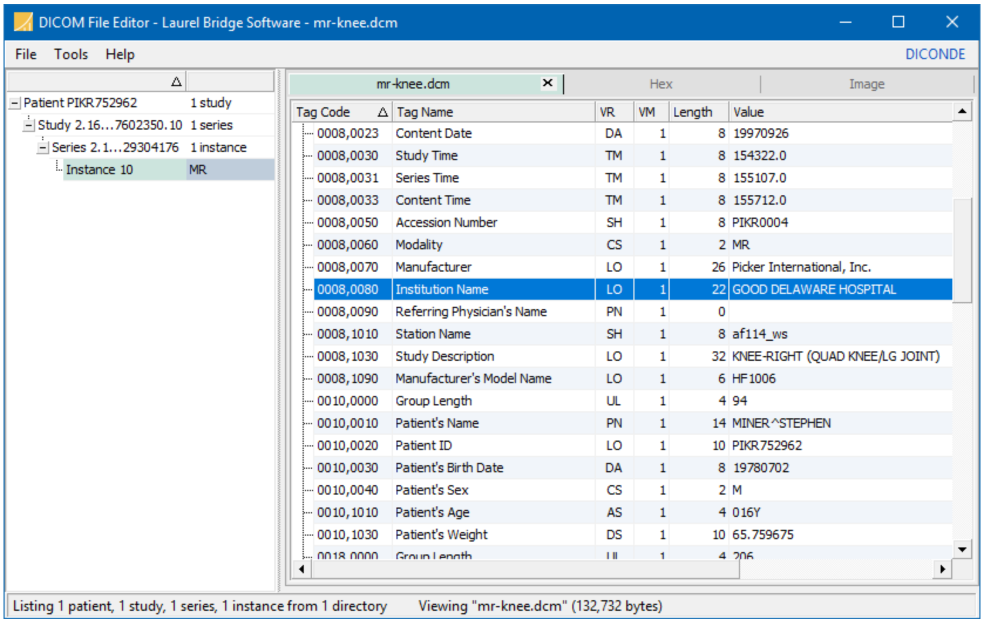


Patient PIKR752962	1 study
Study 2.16...7602350.10	1 series
Series 2.1...29304176	1 instance
Instance 10	MR

Tag Code	Tag Name	VR	VM	Length	Value
0002,0000	Group Length	UL	1	4	208
0002,0001	File Meta Information Version	OB	1	2	0x00,0x01
0002,0002	Media Storage SOP Class UID	UI	1	26	MR Image Storage
0002,0003	Media Storage SOP Instance UID	UI	1	62	2.16.840.1.113662.4.8796818069641
0002,0010	Transfer Syntax UID	UI	1	18	Implicit VR Little Endian
0002,0012	Implementation Class UID	UI	1	26	1.2.840.114089.1.0.0.3.4.1
0002,0013	Implementation Version Name	SH	1	10	DCF 3.4.1a
0002,0016	Source Application Entity Title	AE	1	4	DCF
0008,0000	Group Length	UL	1	4	396
0008,0008	Image Type	CS	2	16	ORIGINAL\PRIMARY
0008,0016	SOP Class UID	UI	1	26	MR Image Storage
0008,0018	SOP Instance UID	UI	1	62	2.16.840.1.113662.4.8796818069641
0008,0020	Study Date	DA	1	8	19970926
0008,0021	Series Date	DA	1	8	19970926
0008,0023	Content Date	DA	1	8	19970926
0008,0030	Study Time	TM	1	8	154322.0
0008,0031	Series Time	TM	1	8	155107.0
0008,0033	Content Time	TM	1	8	155712.0
0008,0050	Accession Number	SH	1	8	PIKR0004
0008,0060	Modality	CS	1	2	MR

Listing 1 patient, 1 study, 1 series, 1 instance from 1 directory   Viewing "mr-knee.dcm" (132,732 bytes)

The header view of the **DICOM File Editor** lists the DICOM elements loaded from the selected DICOM file in the navigation area. Each element can be edited by double clicking the element (except for sequence items). Also, right clicking any element in the display will provide a different context menu depending upon the type of element selected.



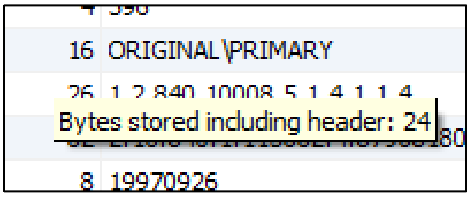
Patient PIKR752962	1 study
Study 2.16...7602350.10	1 series
Series 2.1...29304176	1 instance
Instance 10	MR

Tag Code	Tag Name	VR	VM	Length	Value
0008,0023	Content Date	DA	1	8	19970926
0008,0030	Study Time	TM	1	8	154322.0
0008,0031	Series Time	TM	1	8	155107.0
0008,0033	Content Time	TM	1	8	155712.0
0008,0050	Accession Number	SH	1	8	PIKR0004
0008,0060	Modality	CS	1	2	MR
0008,0070	Manufacturer	LO	1	26	Picker International, Inc.
0008,0080	Institution Name	LO	1	22	GOOD DELAWARE HOSPITAL
0008,0090	Referring Physician's Name	PN	1	0	
0008,1010	Station Name	SH	1	8	af114_ws
0008,1030	Study Description	LO	1	32	KNEE-RIGHT (QUAD KNEE/LG JOINT)
0008,1090	Manufacturer's Model Name	LO	1	6	HF1006
0010,0000	Group Length	UL	1	4	94
0010,0010	Patient's Name	PN	1	14	MINER^STEPHEN
0010,0020	Patient ID	LO	1	10	PIKR752962
0010,0030	Patient's Birth Date	DA	1	8	19780702
0010,0040	Patient's Sex	CS	1	2	M
0010,1010	Patient's Age	AS	1	4	016Y
0010,1030	Patient's Weight	DS	1	10	65.759675
0018,0000	Group Length	UL	1	4	206

Listing 1 patient, 1 study, 1 series, 1 instance from 1 directory   Viewing "mr-knee.dcm" (132,732 bytes)

Institution Name is highlighted in the header view panel

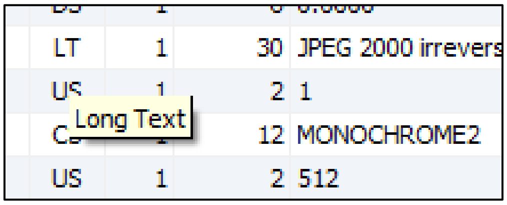
Hovering over the Length of any element in the header view panel will cause a descriptive tooltip to pop up, reporting on the total number of bytes stored in the file for that element, including the number of bytes in its header.



```
16  ORIGINAL\PRIMARY
26  1.2.840.10008.5.1.4.1.1.4
Bytes stored including header: 24
 8  19970926
```

A tooltip reports bytes stored
for each element

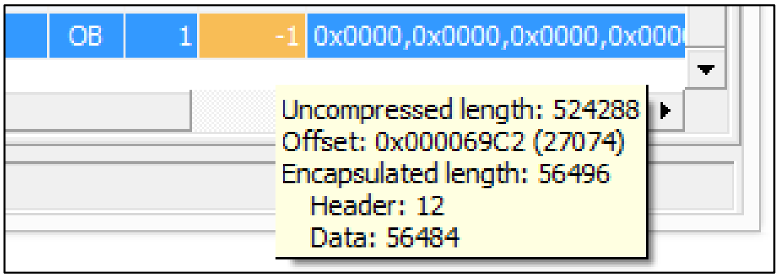
When hovering over the VR of an element, a tooltip describes the meaning of the VR.



```
LT   1   30  JPEG 2000 irrevers
US   1    2  1
C  Long Text
          12  MONOCHROME2
US   1    2  512
```

A tooltip describes each VR. In this
example, “LT” is “Long Text.”

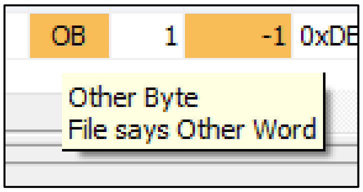
For Pixel Data elements that are stored in a compressed format, their **Length** is correctly reported as -1, and the **Length** field is highlighted. Pixel Data element data size information is reported in a tooltip.



```
OB   1   -1  0x0000,0x0000,0x0000,0x000
Uncompressed length: 524288
Offset: 0x000069C2 (27074)
Encapsulated length: 56496
   Header: 12
   Data: 56484
```

Highlighting of Length field for Pixel Data elements
is shown, indicating data size tooltip is available

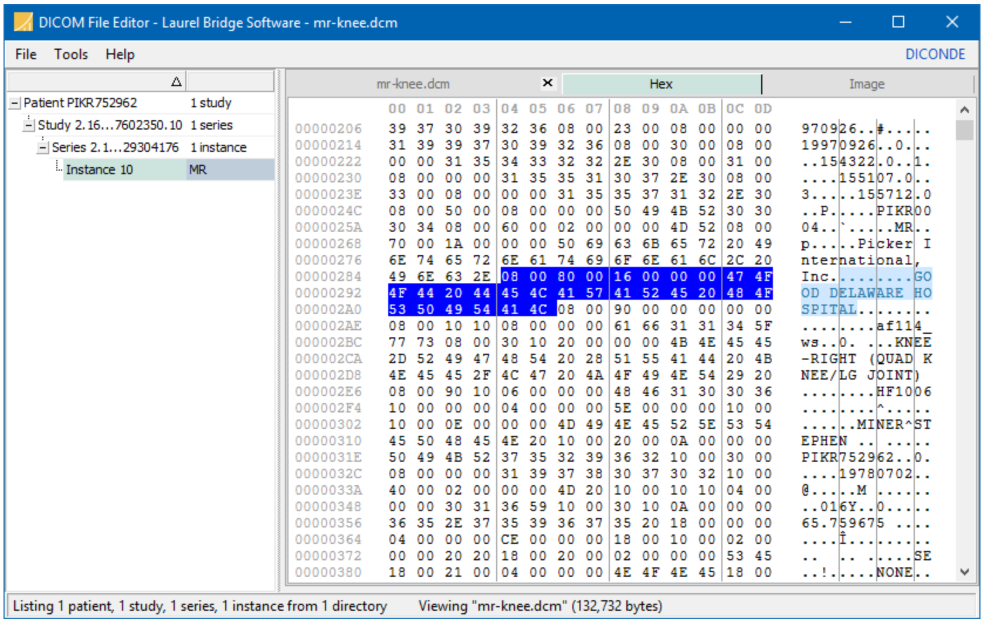
It is possible that a file containing compressed Pixel Data claims to store its data as OW, even when the data is OB. In this case, the **VR** field is highlighted and a tooltip explaining the discrepancy can be shown. This discrepancy can be confirmed using the hex view panel.



```
OB   1   -1  0xDE
Other Byte
File says Other Word
```

Stored encoding is reported
for OB data as OW in file

When an element is clicked on in the header view panel, the corresponding bytes for that element are highlighted in the hex view panel. Similarly, when some byte is clicked in the hex view panel, the element that contains that byte (and the bytes adjacent to it) is highlighted in the header view panel. When an element is highlighted in one image, and a different image is selected for viewing, the same element in the newly selected file will be highlight if present.

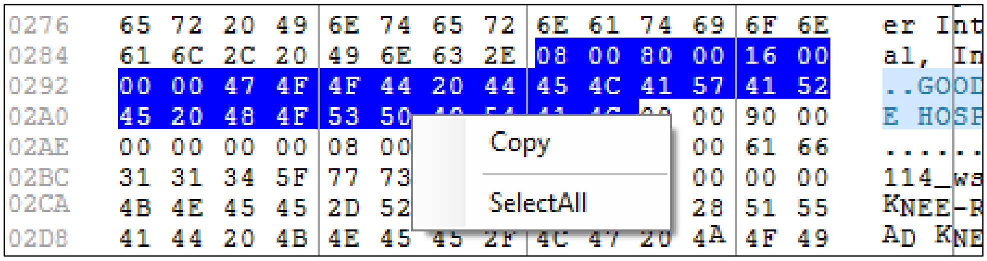


```
          00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D
00000206  39 37 30 39 32 36 08 00 23 00 08 00 00 00   970926..#.....
00000214  31 39 39 37 30 39 32 36 08 00 30 00 08 00   19970926..0...
00000222  00 00 31 35 34 33 32 32 2E 30 08 00 31 00   ..154322.0..1.
00000230  08 00 00 00 31 35 35 31 30 37 2E 30 08 00   ....155107.0..
0000023E  33 00 08 00 00 00 31 35 35 37 31 32 2E 30   3.....155712.0
0000024C  08 00 50 00 08 00 00 00 50 49 4B 52 30 30   ..P.....PIKR00
0000025A  30 34 08 00 60 00 02 00 00 00 4D 52 08 00   04..`.....MR..
00000268  70 00 1A 00 00 00 50 69 63 6B 65 72 20 49   p.....Picker I
00000276  6E 74 65 72 6E 61 74 69 6F 6E 61 6C 2C 20   nternational, 
00000284  49 6E 63 2E 08 00 80 00 16 00 00 00 47 4F   Inc.........GO
00000292  4F 44 20 44 45 4C 41 57 41 52 45 20 48 4F   OD DELAWARE HO
000002A0  53 50 49 54 41 4C 08 00 90 00 00 00 00 00   SPITAL........
000002AE  08 00 10 10 08 00 00 00 61 66 31 31 34 5F   ........af114_
000002BC  77 73 08 00 30 10 20 00 00 00 4B 4E 45 45   ws..0. ...KNEE
000002CA  2D 52 49 47 48 54 20 28 51 55 41 44 20 4B   -RIGHT (QUAD K
000002D8  4E 45 45 2F 4C 47 20 4A 4F 49 4E 54 29 20   NEE/LG JOINT) 
000002E6  08 00 90 10 06 00 00 00 48 46 31 30 30 36   ........HF1006
000002F4  10 00 00 00 04 00 00 00 5E 00 00 00 10 00   ........^.....
00000302  10 00 0E 00 00 00 4D 49 4E 45 52 5E 53 54   ......MINER^ST
00000310  45 50 48 45 4E 20 10 00 20 00 0A 00 00 00   EPHEN .. .....
0000031E  50 49 4B 52 37 35 32 39 36 32 10 00 30 00   PIKR752962..0.
0000032C  08 00 00 00 31 39 37 38 30 37 30 32 10 00   ....19780702..
0000033A  40 00 02 00 00 00 4D 20 10 00 10 10 04 00   @.....M ......
00000348  00 00 30 31 36 59 10 00 30 10 0A 00 00 00   ..016Y..0.....
00000356  36 35 2E 37 35 39 36 37 35 20 18 00 00 00   65.759675 ....
00000364  04 00 00 00 CE 00 00 00 18 00 10 00 02 00   ....Î.........
00000372  00 00 20 20 18 00 20 00 02 00 00 00 53 45   ..  .. .....SE
00000380  18 00 21 00 04 00 00 00 4E 4F 4E 45 18 00   ..!.....NONE..
```

Listing 1 patient, 1 study, 1 series, 1 instance from 1 directory   Viewing "mr-knee.dcm" (132,732 bytes)

Hexadecimal byte values corresponding to the **Institution Name** element are highlight in the hex view panel

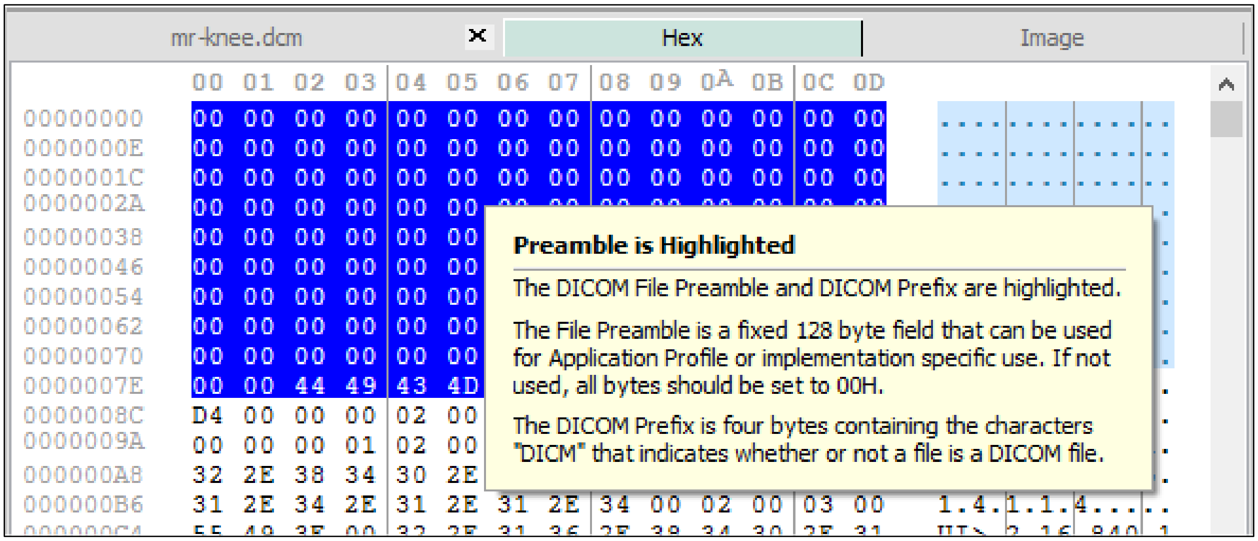
Right-clicking on highlighted bytes in the hex view panel enable those bytes to be copied to the Clipboard, both as binary values and text values, for pasting into applications that accept either binary or text.



```
0276  65 72 20 49 6E 74 65 72 6E 61 74 69 6F 6E   er Int
0284  61 6C 2C 20 49 6E 63 2E 08 00 80 00 16 00   al, In
0292  00 00 47 4F 4F 44 20 44 45 4C 41 57 41 52   ..GOOD
02A0  45 20 48 4F 53 50                00 90 00   E HOSP
02AE  00 00 00 00 08 00                00 61 66   ......
02BC  31 31 34 5F 77 73                00 00 00   114_ws
02CA  4B 4E 45 45 2D 52                28 51 55   KNEE-R
02D8  41 44 20 4B 4E 45                4A 4F 49   AD KNE
```

Highlighted bytes can be copied to the Clipboard.

When any byte in the DICOM preamble (for which there is no corresponding DICOM element) is selected, the entire preamble is selected in the hex viewer panel and a descriptive tooltip is displayed.



```
          00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D
00000000  00 00 00 00 00 00 00 00 00 00 00 00 00 00
0000000E  00 00 00 00 00 00 00 00 00 00 00 00 00 00
0000001C  00 00 00 00 00 00 00 00 00 00 00 00 00 00
0000002A  00 00 00 00 00 00
00000038  00 00 00 00 00 00
00000046  00 00 00 00 00 00
00000054  00 00 00 00 00 00
00000062  00 00 00 00 00 00
00000070  00 00 00 00 00 00
0000007E  00 00 44 49 43 4D
0000008C  D4 00 00 00 02 00
0000009A  00 00 00 01 02 00
000000A8  32 2E 38 34 30 2E
000000B6  31 2E 34 2E 31 2E 31 2E 34 00 02 00 03 00   1.4.1.1.4.....
```

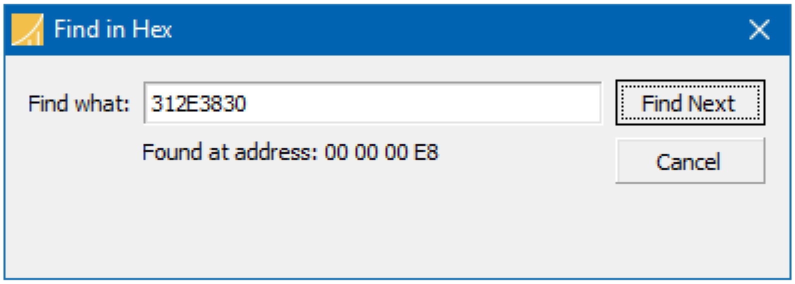
Preamble is Highlighted

The DICOM File Preamble and DICOM Prefix are highlighted.

The File Preamble is a fixed 128 byte field that can be used for Application Profile or implementation specific use. If not used, all bytes should be set to 00H.

The DICOM Prefix is four bytes containing the characters "DICM" that indicates whether or not a file is a DICOM file.

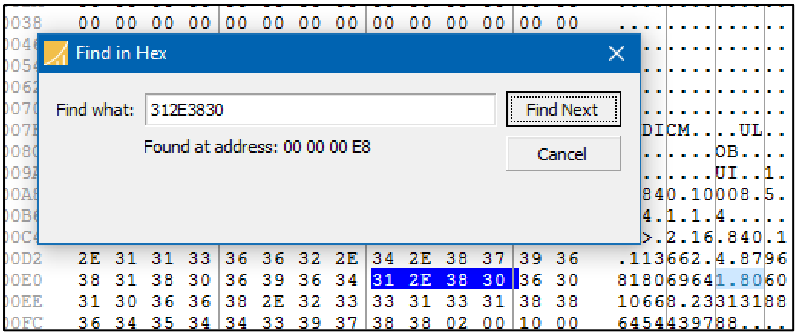
The **Find in Hex** Dialog for the hex view panel of the **DICOM File Editor** provides searching within the hex values of the open data set. The "Find what" field limits the search term to valid hexadecimal digits.



Find what: 312E3830

Found at address: 00 00 00 E8

Clicking **Find Next** will search forward from the current position in the hex view panel. If matching hex values are found, they are highlighted in the hex and string value areas and the starting address of the match is displayed on the dialog.

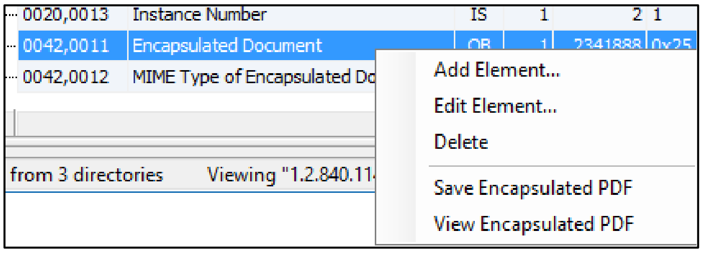


Find what: 312E3830

Found at address: 00 00 00 E8

```
0D2  2E 31 31 33 36 36 32 2E 34 2E 38 37 39 36  .113662.4.8796
0E0  38 31 38 30 36 39 36 34 31 2E 38 30 36 30  818069641.8060
0EE  31 30 36 36 38 2E 32 33 33 31 33 31 38 38  10668.23313188
0FC  36 34 35 34 34 33 39 37 38 38 02 00 10 00  6454439788....
```

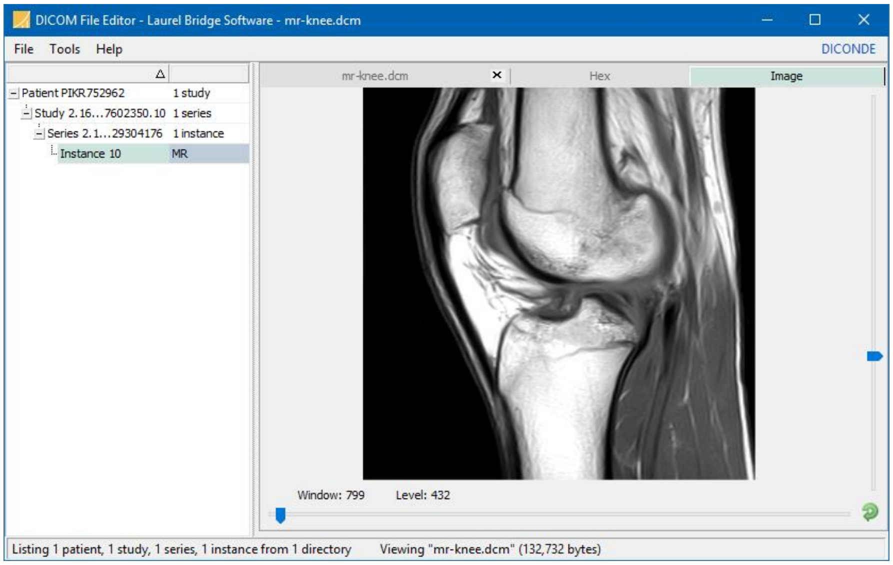
When an Encapsulated PDF document is present in the current data set, it can be saved to a file and viewed from either the File menu option or by right-clicking on the Encapsulated Document element in the header view panel and selecting **Save Encapsulated PDF** or **View Encapsulated PDF**.



0020,0013	Instance Number	IS	1	2 1
0042,0011	Encapsulated Document	OB	1	2341888 0x25
0042,0012	MIME Type of Encapsulated Do			

from 3 directories Viewing "1.2.840.11

When present, DICOM image data is displayed with the built-in basic window-level image viewer on the image panel.



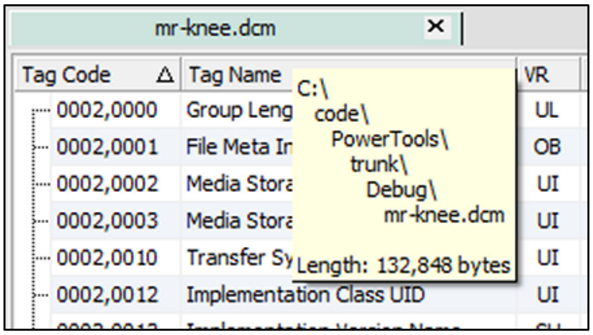
DICOM File Editor - Laurel Bridge Software - mr-knee.dcm

Patient PIKR752962	1 study
Study 2.16...7602350.10	1 series
Series 2.1...29304176	1 instance
Instance 10	MR

Window: 799 Level: 432

Listing 1 patient, 1 study, 1 series, 1 instance from 1 directory Viewing "mr-knee.dcm" (132,732 bytes)

Hovering the mouse over the header, hex or image panel tabs will cause the currently displayed DICOM file's complete path to be displayed in a tooltip.

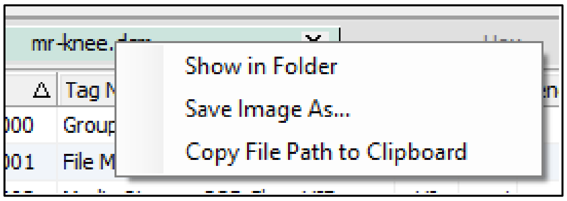


mr-knee.dcm

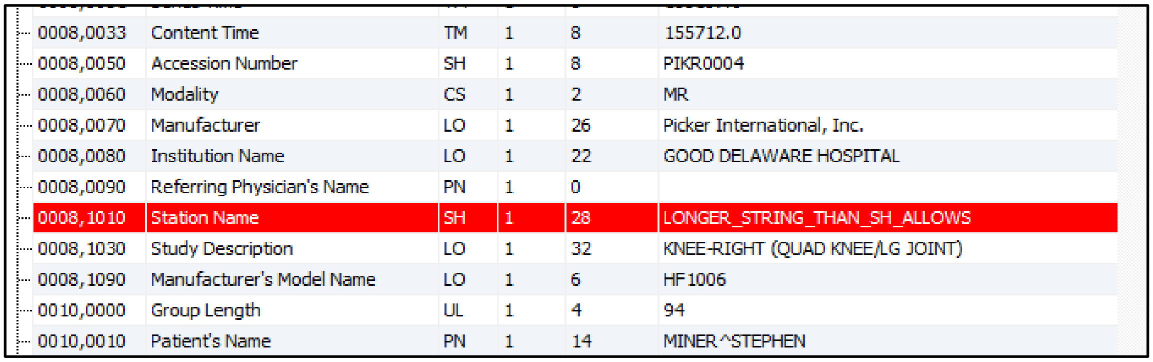
Tag Code	Tag Name	VR
0002,0000	Group Leng	UL
0002,0001	File Meta Ir	OB
0002,0002	Media Stora	UI
0002,0003	Media Stora	UI
0002,0010	Transfer Sy	UI
0002,0012	Implementation Class UID	UI

C:\
code\
PowerTools\
trunk\
Debug\
mr-knee.dcm
Length: 132,848 bytes

Right-clicking on any of the three tab headers, or anywhere on the Image panel, will cause a context menu to pop up, enabling the currently displayed DataSet file to be shown in its folder on the file system (**Show in Folder**), saved as a regular image (BMP, GIF, JPEG, PNG, TIFF) (**Save Image As**) or have the path of the DataSet file copied to the system Clipboard (**Copy File Path to Clipboard**).

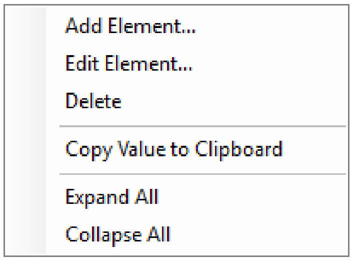


When an element has an invalid value, it is displayed with red highlighting (below). Specifically, this is an indication that the VR validator has failed and that the element value has an invalid length.

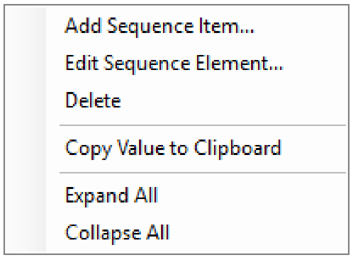


0008,0033	Content Time	TM	1	8	155712.0
0008,0050	Accession Number	SH	1	8	PIKR0004
0008,0060	Modality	CS	1	2	MR
0008,0070	Manufacturer	LO	1	26	Picker International, Inc.
0008,0080	Institution Name	LO	1	22	GOOD DELAWARE HOSPITAL
0008,0090	Referring Physician's Name	PN	1	0	
0008,1010	Station Name	SH	1	28	LONGER_STRING_THAN_SH_ALLOWS
0008,1030	Study Description	LO	1	32	KNEE-RIGHT (QUAD KNEE/LG JOINT)
0008,1090	Manufacturer's Model Name	LO	1	6	HF1006
0010,0000	Group Length	UL	1	4	94
0010,0010	Patient's Name	PN	1	14	MINER^STEPHEN

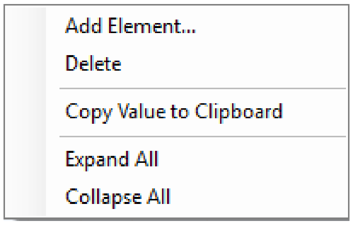
The context menu for each type of element is shown and described below.



DICOM Element



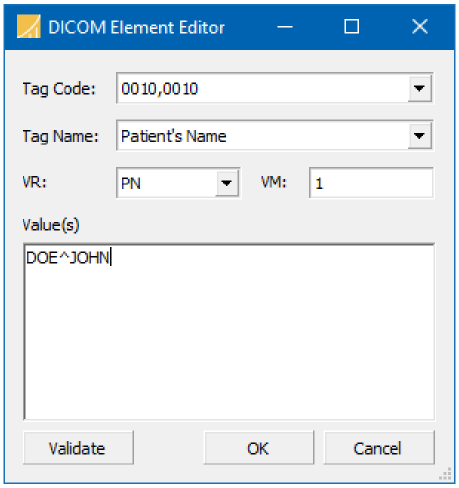
DICOM Sequence Element



Sequence Item

- **Add Element** – adds a new element to the DICOM data set (standard element or sequence element).
- **Edit Element** – edits the currently selected element (sequence items cannot be edited).
- **Delete** – deletes the currently selected element(s) or item(s).
- **Copy Value(s) to Clipboard** – copies one or more selected items to the system Clipboard.
- **Add Sequence Item** – adds an item to the selected sequence element.
- **Edit Sequence Element** – edits the selected sequence element.
- **Expand All** – expands all sequences for complete viewing.
- **Collapse All** – collapses all sequences for compact viewing.

The **DICOM Element Editor** provides an interface for editing an individual item in a DICOM data set. Its fields are described below.



DICOM Element Editor

Tag Code: 0010,0010

Tag Name: Patient's Name

VR: PN

VM: 1

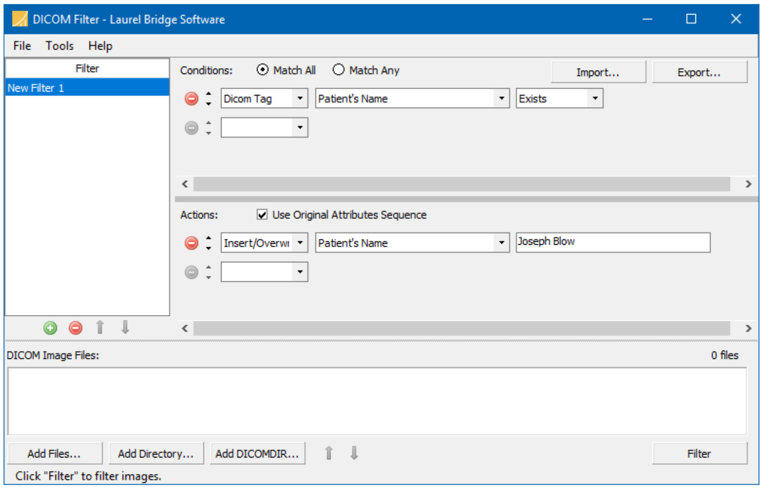
Value(s)

DOE^JOHN

- **Tag Code** – the group/element hexadecimal value describing the DICOM element (private tags may be specified by typing them in directly).
- **Tag Name** – the name of the DICOM element.
- **VR** – the value representation type of the DICOM element.
- **VM** – read only field describing the value multiplicity (usually “1”, but will be greater for multi-valued elements).
- **Value(s)** – the values for the DICOM element with each value on a new line.
- **Validate** – validates the DICOM element to make sure all fields are DICOM valid.
- **OK** – saves the element and exits the dialog.
- **Cancel** – exits the dialog without saving.

4.4.3. DICOM Filter

DICOM Filter allows for the filtering of multiple DICOM image files on the disk. For example, if a patient’s name was spelled incorrectly in an entire study of hundreds of images, simply select the directory containing the images and add a filter to correct the name. The functionality in this application is shared with other applications and will not be described further here.



DICOM Filter - Laurel Bridge Software

Filter: New Filter 1

Conditions: ● Match All ○ Match Any

Dicom Tag | Patient's Name | Exists

Actions: ☑ Use Original Attributes Sequence

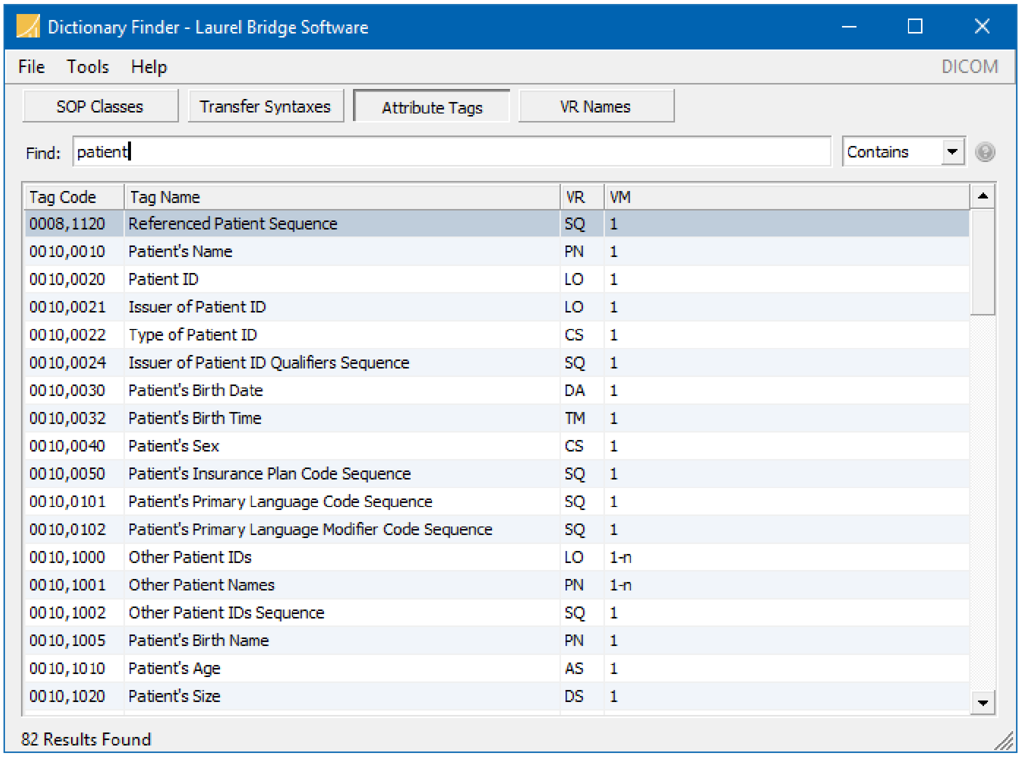
Insert/Overwı | Patient's Name | Joseph Blow

DICOM Image Files: 0 files

Click "Filter" to filter images.

4.4.4. Dictionary Finder

Dictionary Finder provides the ability to search the DICOM data dictionary for a particular UID (unique identifier) or for a specific DICOM element. Settings for this application are described below.



Find: patient

Contains

Tag Code	Tag Name	VR	VM
0008,1120	Referenced Patient Sequence	SQ	1
0010,0010	Patient's Name	PN	1
0010,0020	Patient ID	LO	1
0010,0021	Issuer of Patient ID	LO	1
0010,0022	Type of Patient ID	CS	1
0010,0024	Issuer of Patient ID Qualifiers Sequence	SQ	1
0010,0030	Patient's Birth Date	DA	1
0010,0032	Patient's Birth Time	TM	1
0010,0040	Patient's Sex	CS	1
0010,0050	Patient's Insurance Plan Code Sequence	SQ	1
0010,0101	Patient's Primary Language Code Sequence	SQ	1
0010,0102	Patient's Primary Language Modifier Code Sequence	SQ	1
0010,1000	Other Patient IDs	LO	1-n
0010,1001	Other Patient Names	PN	1-n
0010,1002	Other Patient IDs Sequence	SQ	1
0010,1005	Patient's Birth Name	PN	1
0010,1010	Patient's Age	AS	1
0010,1020	Patient's Size	DS	1

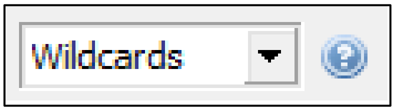
82 Results Found

There are four different dictionaries available for searching: **SOP Classes**, **Transfer Syntaxes**, **Attribute Tags**, and **VR Names**. Once one of these dictionaries has been selected by clicking on one of the four tabs, relevant columns are displayed and are searchable by typing into the **Filter** text box.

Search results consist of only the rows in the table of values that match the text typed into the **Find** text box, subject to one of four matching criteria:

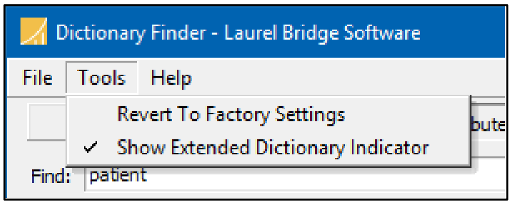
- **Contains** – the find text is contained anywhere in a field.
- **Starts With** – the find text is found at the beginning of a field.
- **Ends With** – the find text is found at the end of a field.
- **Wildcards** – the find text can contain wildcards that enable a simplified regular expression style matching.

When Wildcards mode is selected, a help icon is enabled.



When the help icon is clicked, a **Using Wildcards** instruction dialog pops up. A description and screen capture of the **Using Wildcards** dialog is contained above in the **Dicom File Editor** description (section 4.4.2).

The **Dictionary Finder** provides access to loading and managing an external data dictionary (section 4.1.8). The external data dictionary indicator can be shown or hidden using the **Show External Dictionary Indicator** option in the **Tools** menu.


Dictionary Finder - Laurel Bridge Software
File
Tools
Help
Revert To Factory Settings
✓ Show Extended Dictionary Indicator
bute

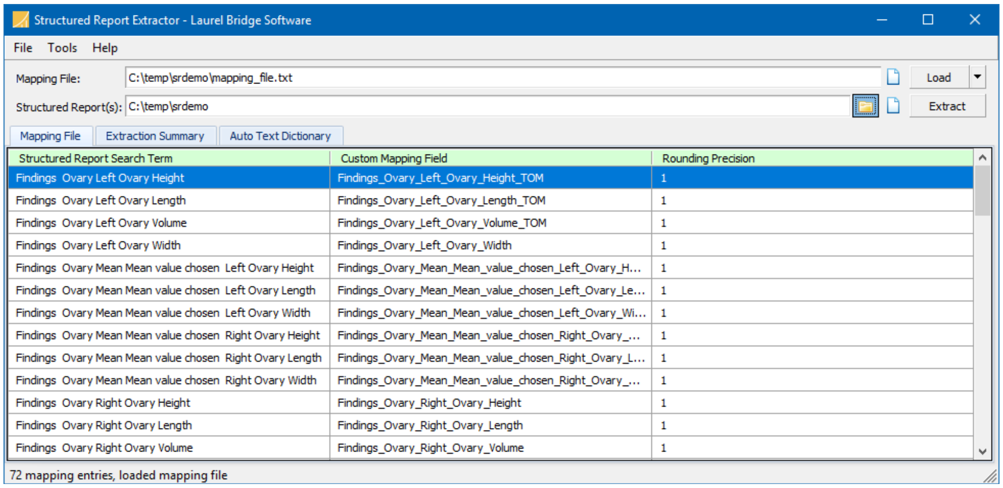
Find: patient

4.4.5. PDF to DICOM

The **PDF to DICOM** tool enables one or more existing PDF files to be converted to DICOM Encapsulated PDF files, which optionally can be written to files on the local disk or stored to a PACS. A sequence of screens guides the user step-by-step through the conversion process. The user first selects one or more PDF files to encapsulate. Next, a data entry step allow DICOM tag values to be customized. Finally, the user selects an output directory to which the DICOM Encapsulated PDFs will be written, or optionally the Hostname or IP address, Port number, Called AE and Calling AE of a PACS to store the files.

4.4.6. Structured Report Extractor

The **Structured Report Extractor** is a tool that parses one or more DICOM Structured Report files. It is designed specifically to generate a mapping file for use with the Laurel Bridge Software **Compass™** product and third-party integrated dictation and transcription systems, such as PowerScribe® 360 (PS360) and M*Modal Fluency™, though it can be used more generally to reveal the fields and values contained in one or more DICOM Structured Reports.



Mapping File: C:\temp\srdemo\mapping_file.txt

Structured Report(s): C:\temp\srdemo

Structured Report Search Term	Custom Mapping Field	Rounding Precision
Findings Ovary Left Ovary Height	Findings_Ovary_Left_Ovary_Height_TOM	1
Findings Ovary Left Ovary Length	Findings_Ovary_Left_Ovary_Length_TOM	1
Findings Ovary Left Ovary Volume	Findings_Ovary_Left_Ovary_Volume_TOM	1
Findings Ovary Left Ovary Width	Findings_Ovary_Left_Ovary_Width	1
Findings Ovary Mean Mean value chosen Left Ovary Height	Findings_Ovary_Mean_Mean_value_chosen_Left_Ovary_H...	1
Findings Ovary Mean Mean value chosen Left Ovary Length	Findings_Ovary_Mean_Mean_value_chosen_Left_Ovary_Le...	1
Findings Ovary Mean Mean value chosen Left Ovary Width	Findings_Ovary_Mean_Mean_value_chosen_Left_Ovary_Wi...	1
Findings Ovary Mean Mean value chosen Right Ovary Height	Findings_Ovary_Mean_Mean_value_chosen_Right_Ovary_...	1
Findings Ovary Mean Mean value chosen Right Ovary Length	Findings_Ovary_Mean_Mean_value_chosen_Right_Ovary_L...	1
Findings Ovary Mean Mean value chosen Right Ovary Width	Findings_Ovary_Mean_Mean_value_chosen_Right_Ovary_...	1
Findings Ovary Right Ovary Height	Findings_Ovary_Right_Ovary_Height	1
Findings Ovary Right Ovary Length	Findings_Ovary_Right_Ovary_Length	1
Findings Ovary Right Ovary Volume	Findings_Ovary_Right_Ovary_Volume	1

72 mapping entries, loaded mapping file

The **Mapping File** field is the path to a text file containing the **Structured Report Search Term** values and their corresponding mapped **Custom Mapping Field** values.

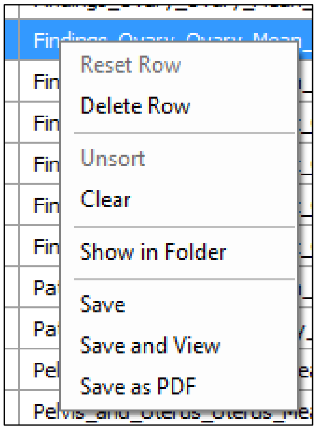
The **Structured Report(s)** field contains the path to a file or folder of structured report data to be parsed and then used to create a **Mapping File**. For convenience, a file or folder can be dragged and dropped on the **Structured Report(s)** field or a file or folder can be selected using the corresponding browse buttons.

Other features of the **Structure Report Extractor** are:

- **Mapping File** tab – displays a table of mapping values, which map the **Structured Report Search Term** (the complete branch name of an element) with a **Custom Mapping Field** (a simplified branch name with all spaces replaced by underscore characters).
- **Extraction Summary** tab – displays summary output from the structured report parser.
- **Auto Text Dictionary** tab – displays an example Auto Text Dictionary that can be used for reference or as a starting point for creating or troubleshooting application use of mapping names and their structured report data values.
- **Load** – when clicked, the currently selected **Mapping File** to be loaded into the **Mapping File** tab. Any mapping data loaded will be merged into any data already present on the **Mapping File** tab. The **Load** button also has a **Clear & Load** choice that first clears all data from the **Mapping File** tab before loading new data.
- **Extract** - when clicked, the currently selected **Structured Report(s)** are parsed and the resulting data is added to the **Mapping File** tab.

Columns in the **Mapping File** tab can be sorted in ascending and descending order by clicking on the column heading.

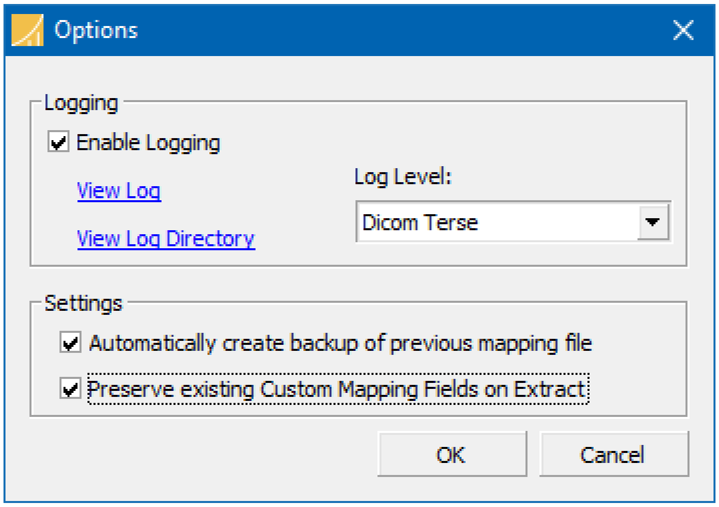
A context menu appears when any row in the **Mapping File** tab is right-clicked.



Choices in the context menu perform the following:

- **Reset Row** - restores the **Custom Mapping Field** value on the currently selected row to the default mapping value, which is a simple replacement of all spaces with underscore characters.
- **Delete Row** - deletes the currently selected row from the **Mapping File** tab.
- **Unsort** - removes any sorting of columns that was done, displaying the **Mapping File** tab values in their original order.
- **Clear** - deletes all rows in the **Mapping File** tab, although it does not affect the **Mapping File** stored as a file, which is only changed by saving a new **Mapping File** using the same file name.
- **Show in Folder** - opens the containing folder of the current file.
- **Save** - stores the currently viewed **Mapping File** data as a text file and creates a backup of the previous file if it has the same name. **Save** can also be performed from the File menu.
- **Save and View** - performs a **Save** of the **Mapping File** data and then opens the file for viewing in the default system text file viewing application (e.g., Notepad).
- **Save As PDF** - saves all structured reports contained in the file or directory indicated by the **Structured Report(s)** field as a single PDF file and then opens the file for viewing in the default system text file viewing application (e.g., Acrobat). **Save As PDF** can also be performed from the File menu.

The **Options Dialog** in the **Structured Report Extractor** allows configuration of settings related to mapping file backups and extraction behavior, in addition to common logging settings.



Logging

☑ Enable Logging

Log Level: Dicom Terse

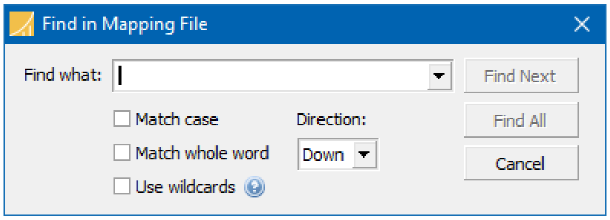
Settings

☑ Automatically create backup of previous mapping file

☑ Preserve existing Custom Mapping Fields on Extract

- **Automatically create backup of previous mapping file** – causes an automatic backup of the previous mapping file of the same name to be created, incorporating a current timestamp in the filename.
- **Preserve existing Custom Mapping Fields on Extract** – when the **Extract** button is clicked, this option perserves existing modifications to Custom Mapping Fields in the Mapping File list. When unchecked, modifications can be overwritten.

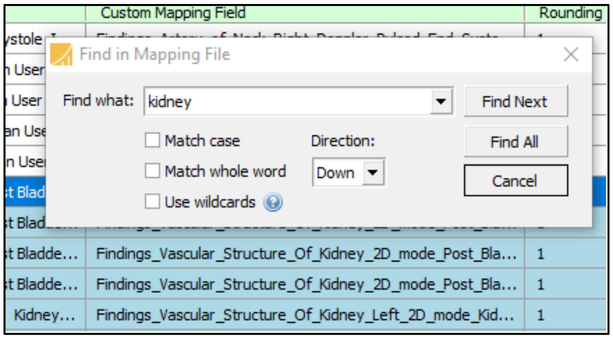
Search functionality is provided by a **Find Dialog** customized for each tab. The **Mapping File** tab Find Dialog has options for case and whole word matches, search direction and use of wildcards.



Find what:

Direction: Down

The **Find All** button will search and highlight all rows that match the current search term. A convenient menu choice in the **Tools** menu will **Clear Find Highlighting** when selected.

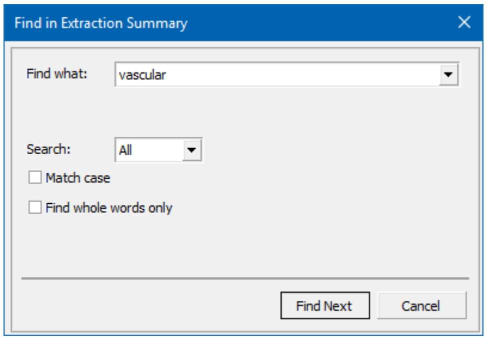


Find what: kidney

Direction: Down

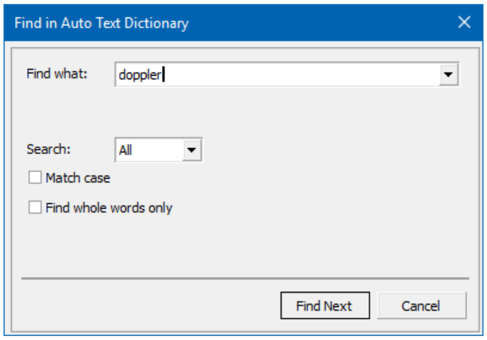
	Custom Mapping Field	Rounding
t Bladde…	Findings_Vascular_Structure_Of_Kidney_2D_mode_Post_Bla…	1
t Bladde…	Findings_Vascular_Structure_Of_Kidney_2D_mode_Post_Bla…	1
Kidney…	Findings_Vascular_Structure_Of_Kidney_Left_2D_mode_Kid…	1

The **Find** Dialogs on the **Extraction Summary** and **Auto Text Dictionary** tabs provide matching of the search term, with optional constraints of matching the case of the search term and matching whole words.



Find what: vascular

Search: All



Find what: doppler

Search: All

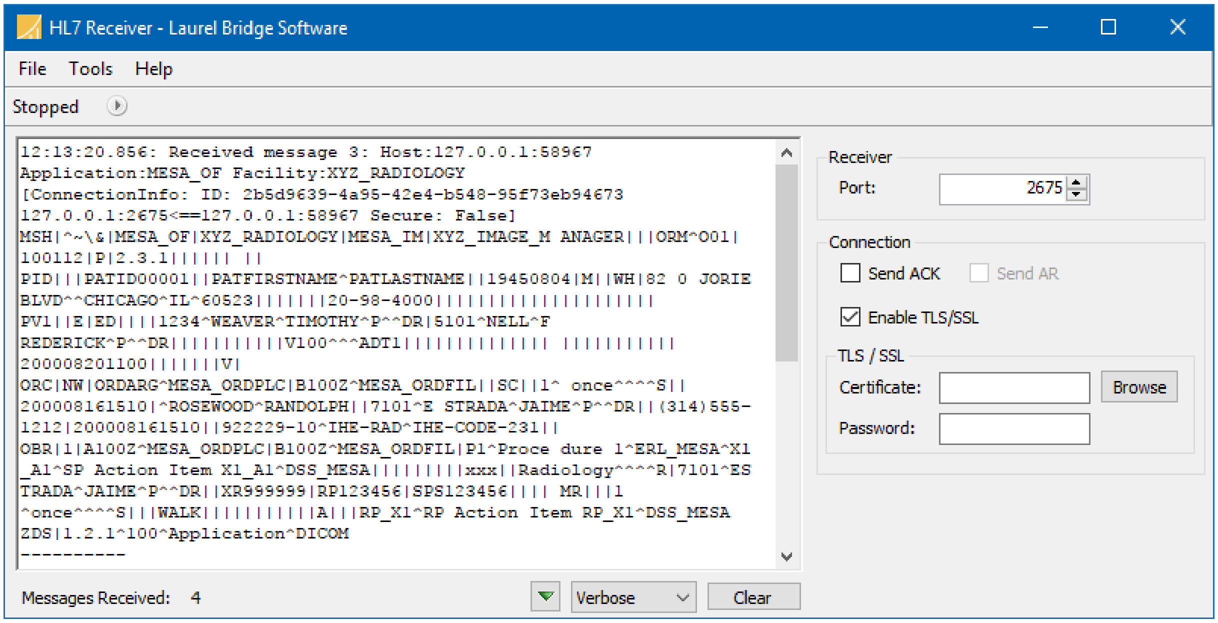
For easier viewing of the sometimes extensive contents of the **Extraction Summary** and **Auto Text Dictionary** tabs, the view can be zoomed in and out using the **+** and **-** keys on the keyboard. Pressing the **Enter** key while viewing either the contents of either of these two tabs resets the zoom level to normal.

4.5. HL7 Applications

PowerTools provides two Health Level 7 (HL7) applications for sending and receiving HL7 messages. The tools are under continuing development. An overview of each is provided below.

4.5.1. HL7 Receiver

The HL7 Receiver is a server that manages communication with an HL7 Sender client, receiving messages and optionally replying with ACK responses. The HL7 Receiver is started and stopped (or paused) using the run button ▶ and the stop (or pause) button ⏸.



```
12:13:20.856: Received message 3: Host:127.0.0.1:58967
Application:MESA_OF Facility:XYZ_RADIOLOGY
[ConnectionInfo: ID: 2b5d9639-4a95-42e4-b548-95f73eb94673
127.0.0.1:2675<==127.0.0.1:58967 Secure: False]
MSH|^~\&|MESA_OF|XYZ_RADIOLOGY|MESA_IM|XYZ_IMAGE_M ANAGER|||ORM^O01|
100112|P|2.3.1|||||| ||
PID|||PATID00001||PATFIRSTNAME^PATLASTNAME||19450804|M||WH|82 0 JORIE
BLVD^^CHICAGO^IL^60523|||||||20-98-4000||||||||||||||||||||
PV1||E|ED||||1234^WEAVER^TIMOTHY^P^^DR|5101^NELL^F
REDERICK^P^^DR|||||||||||V100^^^ADT1||||||||||||||| |||||||||||
200008201100|||||||V|
ORC|NW|ORDARG^MESA_ORDPLC|B100Z^MESA_ORDFIL||SC||1^ once^^^^S||
200008161510|^ROSEWOOD^RANDOLPH||7101^E STRADA^JAIME^P^^DR||(314)555-
1212|200008161510||922229-10^IHE-RAD^IHE-CODE-231||
OBR|1|A100Z^MESA_ORDPLC|B100Z^MESA_ORDFIL|P1^Proce dure 1^ERL_MESA^X1
_A1^SP Action Item X1_A1^DSS_MESA|||||||||xxx||Radiology^^^^R|7101^ES
TRADA^JAIME^P^^DR||XR999999|RP123456|SPS123456|||| MR|||1
^once^^^^S|||WALK|||||||||||A|||RP_X1^RP Action Item RP_X1^DSS_MESA
ZDS|1.2.1^100^Application^DICOM
----------
```

Port: 2675

□ Send ACK □ Send AR

☑ Enable TLS/SSL

Certificate:

Password:

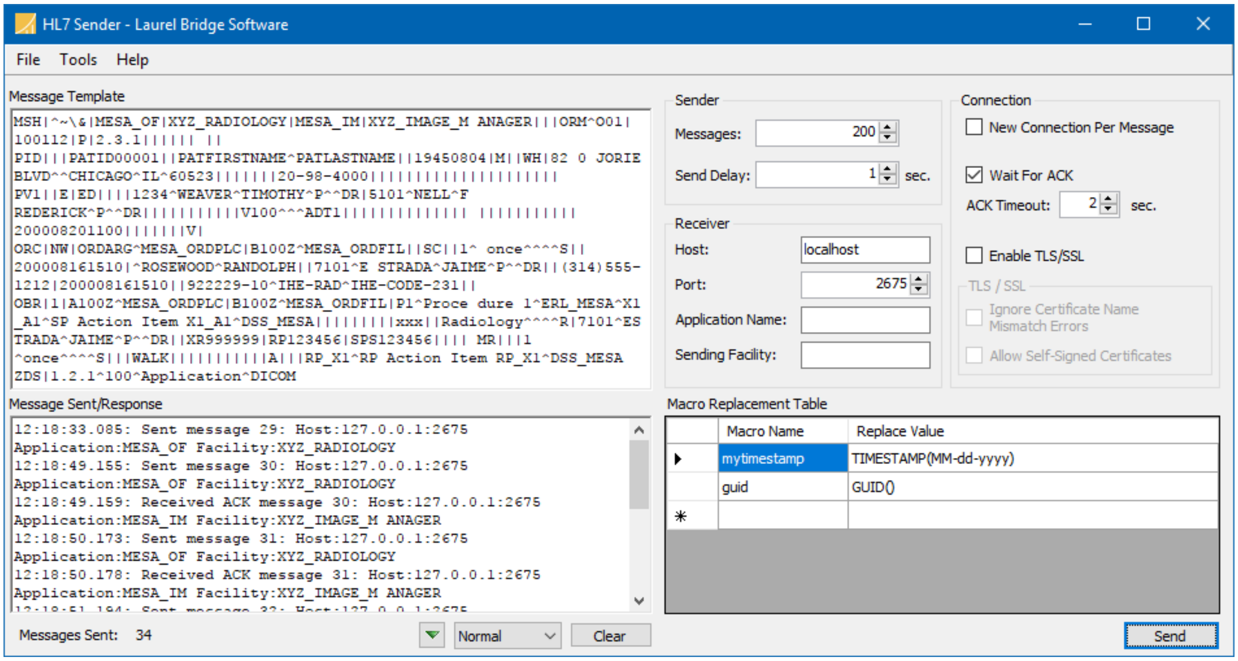
Messages Received: 4

The user interface provides the following configurable options and information display components:

- **Port** – the port on which the server will listen for incoming connections and HL7 messages.
- **Send ACK** – when checked, causes the application to send a general acknowledgement ACK message to the HL7 Sender when it has received a message.
- **Send AR** – when checked, causes the application to send an AR acknowledgement ACK message to the HL7 Sender when it has received a message.
- **Enable TLS/SSL** – when checked, enables a TLS/SSL connection with an HL7 Sender.
- **Certificate** – selects the file containing the TLS/SSL certificate.
- **Password** – the password associated with the TLS/SSL certificate.
- **Messages Received** - is a count of the number of messages that have been received.
- **Quiet/Normal/Verbose** - the quantity of message content logged to the message window can be selected. **Quiet** produces a message once every 5,000 messages, **Normal** produces a single line of information and **Verbose** also logs the entire text of each message.
- **Clear** - when clicked, clears the message window.

4.5.2.HL7 Sender

The HL7 Sender is a client that communicates with an HL7 Receiver server, sending messages and receiving optional ACK responses. The user interface provides the following configurable options and information display components:



Message Template

```
MSH|^~\&|MESA_OF|XYZ_RADIOLOGY|MESA_IM|XYZ_IMAGE_M ANAGER|||ORM^O01|
100112|P|2.3.1|||||| ||
PID|||PATID00001||PATFIRSTNAME^PATLASTNAME||19450804|M||WH|82 0 JORIE
BLVD^^CHICAGO^IL^60523|||||||20-98-4000||||||||||||||||||||
PV1||E|ED||||1234^WEAVER^TIMOTHY^P^^DR|5101^NELL^F
REDERICK^P^^DR|||||||||||V100^^^ADT1||||||||||||||| |||||||||||
200008201100|||||||V|
ORC|NW|ORDARG^MESA_ORDPLC|B100Z^MESA_ORDFIL||SC||1^ once^^^^S||
200008161510|^ROSEWOOD^RANDOLPH||7101^E STRADA^JAIME^P^^DR||(314)555-
1212|200008161510||922229-10^IHE-RAD^IHE-CODE-231||
OBR|1|A100Z^MESA_ORDPLC|B100Z^MESA_ORDFIL|P1^Proce dure 1^ERL_MESA^X1
_A1^SP Action Item X1_A1^DSS_MESA|||||||||xxx||Radiology^^^^R|7101^ES
TRADA^JAIME^P^^DR||XR999999|RP123456|SPS123456|||| MR|||1
^once^^^^S|||WALK|||||||||||A|||RP_X1^RP Action Item RP_X1^DSS_MESA
ZDS|1.2.1^100^Application^DICOM
```

Message Sent/Response

```
12:18:33.085: Sent message 29: Host:127.0.0.1:2675
Application:MESA_OF Facility:XYZ_RADIOLOGY
12:18:49.155: Sent message 30: Host:127.0.0.1:2675
Application:MESA_OF Facility:XYZ_RADIOLOGY
12:18:49.159: Received ACK message 30: Host:127.0.0.1:2675
Application:MESA_IM Facility:XYZ_IMAGE_M ANAGER
12:18:50.173: Sent message 31: Host:127.0.0.1:2675
Application:MESA_OF Facility:XYZ_RADIOLOGY
12:18:50.178: Received ACK message 31: Host:127.0.0.1:2675
Application:MESA_IM Facility:XYZ_IMAGE_M ANAGER
12:18:51.194: Sent message 32: Host:127.0.0.1:2675
```

Messages Sent: 34

Normal

Clear

Sender

Messages: 200

Send Delay: 1 sec.

Receiver

Host: localhost

Port: 2675

Application Name:

Sending Facility:

Connection

□ New Connection Per Message

☑ Wait For ACK

ACK Timeout: 2 sec.

□ Enable TLS/SSL

TLS / SSL

□ Ignore Certificate Name Mismatch Errors

□ Allow Self-Signed Certificates

Macro Replacement Table

	Macro Name	Replace Value
▶	mytimestamp	TIMESTAMP(MM-dd-yyyy)
	guid	GUID()
*		

Send

- **Message Template** – A user-editable area that contains the template to be used for sending an HL7 message. In the **Tools** menu, there is support for loading an example message template and for clearing the template window.
- **Message Sent/Response** – A logging window that displays messages sent and responses received.
- **Messages Sent** – a count of the number of messages that have been sent.
- **Quiet/Normal/Verbose** - the quantity of message content logged to the message window can be selected. **Quiet** produces a message once every 5,000 messages, **Normal** produces a single line of information and **Verbose** also logs the entire text of each message.
- **Clear** - when clicked, clears the message window.

Sender

- **Messages** – a count of the number of times the message template should be used to send a message. It is the total number of messages to be sent.
- **Send Delay** – a delay in seconds to be inserted between each successive message send.

Receiver

- **Host** – host name of the HL7 Receiver server.
- **Port** – port number that the HL7 Receiver server is listening on.
- **Application Name** – configurable name of an application that is sending the HL7 messages.
- **Sending Facility** - configurable name of the facility sending the HL7 messages.

Connection

- **New Connection Per Message** - when checked, sends each message on a new connection.
- **Wait for ACK** - when checked, causes the application to wait to receive an acknowledgement ACK message from the HL7 Receiver before sending the next message.
- **ACK Timeout** - how long to wait in seconds for an ACK to be received before timing out and continuing with the next message.
- **Enable TLS/SSL** - when checked, enables a TLS/SSL connection with an HL7 Receiver.

TLS/SSL

- **Ignore Certificate Name Mismatch Errors** - when checked, allows name mismatches in the TLS/SSL certificate to be ignored.
- **Allow Self-Signed Certificates** - when checked, allows TLS/SSL certificates to be self-signed.

Macro Replacement Table

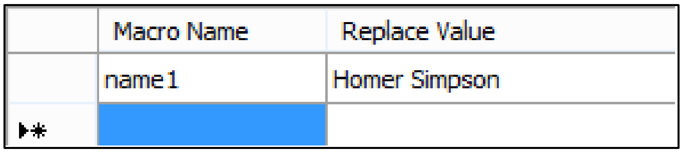
This is a table of **Macro Replacement** mapping rules to support dynamic, send-time HL7 message customization. Each occurrence of an item in the **Macro Name** column will be replaced in the message, before it is sent, with the corresponding **Replace Value**. For more details on using **Macro Replacement**, see below.

Using Macro Replacement

Simple Replacement

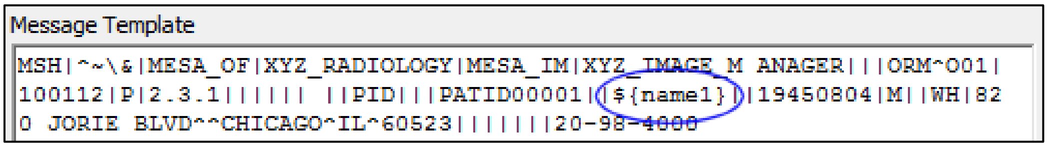
Macro Replacement provides a simple, convenient and powerful mechanism for automating HL7 message formatting. To use **Macro Replacement**, define a **Macro Name** that will be embedded in the message template and a **Replace Value** that determine the replacement behavior of the **Macro Name**. The **Replace Value** can be a simple string or one of the pre-defined macro functions.

For simple string value replacement, first define the desired **Macro Name** and **ReplaceValue**.



	Macro Name	Replace Value
	name1	Homer Simpson
▸✱		

Next, insert a macro name string in the message template in the form: **`${macro name}`**



Message Template

```
MSH|^~\&|MESA_OF|XYZ_RADIOLOGY|MESA_IM|XYZ_IMAGE_M ANAGER|||ORM^O01|
100112|P|2.3.1|||||| ||PID|||PATID00001||${name1}||19450804|M||WH|82
0 JORIE BLVD^^CHICAGO^IL^60523||||||20-98-4000
```

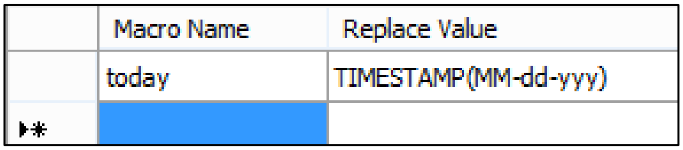
Using Macro Functions

Macro functions are used to insert generated values at a specific points in an HL7 message. To use macro functions, define a **Macro Name** as before. Insert a macro name string in the message template at the point you want the replacement to occur.

For the **Replace Value**, use one of the following functions:

TIMESTAMP()
TIMESTAMP(*format*)

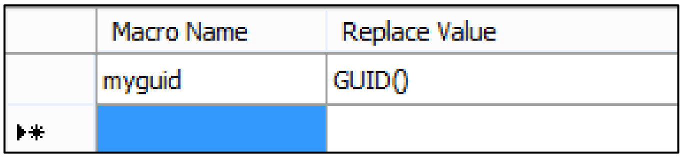
This macro function will generate a date and time stamp in a desired format. The *format* is defined using standard date string formatting. For reference, refer to the online MSDN Custom Date and Time Format Strings documentation. Leaving the format empty will generate a timestamp for the current date and time. For example, to insert the current month, day and year, define the **Replace Value** as:



	Macro Name	Replace Value
	today	TIMESTAMP(MM-dd-yyy)
▶✱		

GUID()

This macro function will generate a new GUID at the desired position. Define the **Replace Value** using only the function:



	Macro Name	Replace Value
	myguid	GUID()
▶✱		

To use these two specific examples of a TIMESTAMP and GUID, add the corresponding macro name references in the desired spots in the message template:

```
MSH|^~\&|RAD|CDIC|||${today}||ORM^O01|${myguid}|P|2.3
```

Embedded Macro Functions

For convenience, macro functions described above can be embedded directly inside the message template using the same format as was used above for the **ReplaceValue**: **`${macro function}`**

For example, embedding a TIMESTAMP and GUID in the first line of the message template looks like this:

```
MSH|^~\&|RAD|CDIC|||${TIMESTAMP(yyyyMMddHHmmss)}||ORM^O01|${GUID()}|P|2.3
```

Note that the syntax for the macro functions is the same as when they are used in the **ReplaceValue** field.

5. Advanced Filtering

5.1. Composer Filter Action

The Composer action uses .NET regular expressions to parse an element's value and combine the parts into new elements.

1) **Swap two tags** – Swap the Patient's Name and the Patient ID to be in each other's place you would specify the following inputs:

Tag	Input Pattern
0010,0010	(.*)
0010,0020	(.*)

The regexes shown here mean that the entire value should be one capturing group. Then the outputs would look like this:

Tag	Output Pattern
0010,0010	${2.1}
0010,0020	${1.1}

This results in the first pattern ${1.1} from the first input tag ${1.1} being put into the second output tag (0010,0020), and the first pattern ${2.1} from the second input tag ${2.1} being put into the first output tag (0010,0010). (In this case, the first pattern is also the entire value.) So if you started with "John Doe" and "1.2.3.4.5" in Name and ID respectively, your result would be a Patient ID of "John Doe" and a Patient's Name of "1.2.3.4.5".

2) **Split one tag into two tags** – Take the Accession Number (0008,0050) and keep only the first 10 characters in it and put the rest of it into the Requested Procedure ID (0040,1001). In this case, the regex for the input pattern has to specify how to split the Accession Number.

Tag	Input Pattern
0008,0050	(^.{10})(.*)

This regex means the first 10 characters will be the first capturing group and everything else will be the second capturing group.
Then the outputs would look like this:

Tag	Output Pattern
0080,0050	${1.1}
0040,1001	${1.2}

This means that the first capturing group – the first 10 characters – will go into the Accession Number; everything else from the Accession Number will go into the Requested Procedure ID. If the initial Accession Number was "ABCDEF1234567890", then you would have "ABCDEF1234" as the Accession Number and "567890" as the Requested Procedure ID. (Note that the output tag does not necessarily have to be parsed as an input.)

3) **Combine two tags** – Take parts of the Accession Number and parts of the Requested Procedure ID and "mix and match" them.

Tag	Input Pattern
0008,0050	(^.{10})(.*)
0040,1001	(^.{6})(.{4})

These regular expressions mean to split the first tag into two capturing groups – the first one having 10 characters and the second one having whatever is left – and to split the second tag into two capturing groups, the first one having 6 characters and the second one having the following 4 characters.
Then the outputs might look like this:

Tag	Output Pattern
0080,0050	${1.1}---{$2.2}---${2.1}
0040,1001	${2.1}${1.2}

If the initial Accession Number was "ABCDEF1234567890" and the initial Requested Procedure ID was "1.2.3.4.5.6.7.8.9.0", then the resulting Accession Number would be "ABCDEF1234---4.5.---1.2.3."; the resulting Requested Procedure ID would be "1.2.3.567890". Note that the patterns can be used multiple times and also combined with plain text.

Working with DICOM sequences

A sequence may be entered as a tag by appending it to a numeric tag (the traditional group-element pair) with a period ("."). You may also indicate an item in the sequence with "#" and the sequence item ID, followed by the tag indicating the sequence. There may be multiple sequences and sequence IDs as part of one "tag". Examples are shown below:

- Simple tag - 0010,0010
- Tag within sequence - 0080,0100.0008,0060
- Tag within specific sequence item - 0080,0100.#0.0008,0060
- Tag within nested sequence with sequence items
  0080,0100.#1.0080,0100.#0.0008,0060

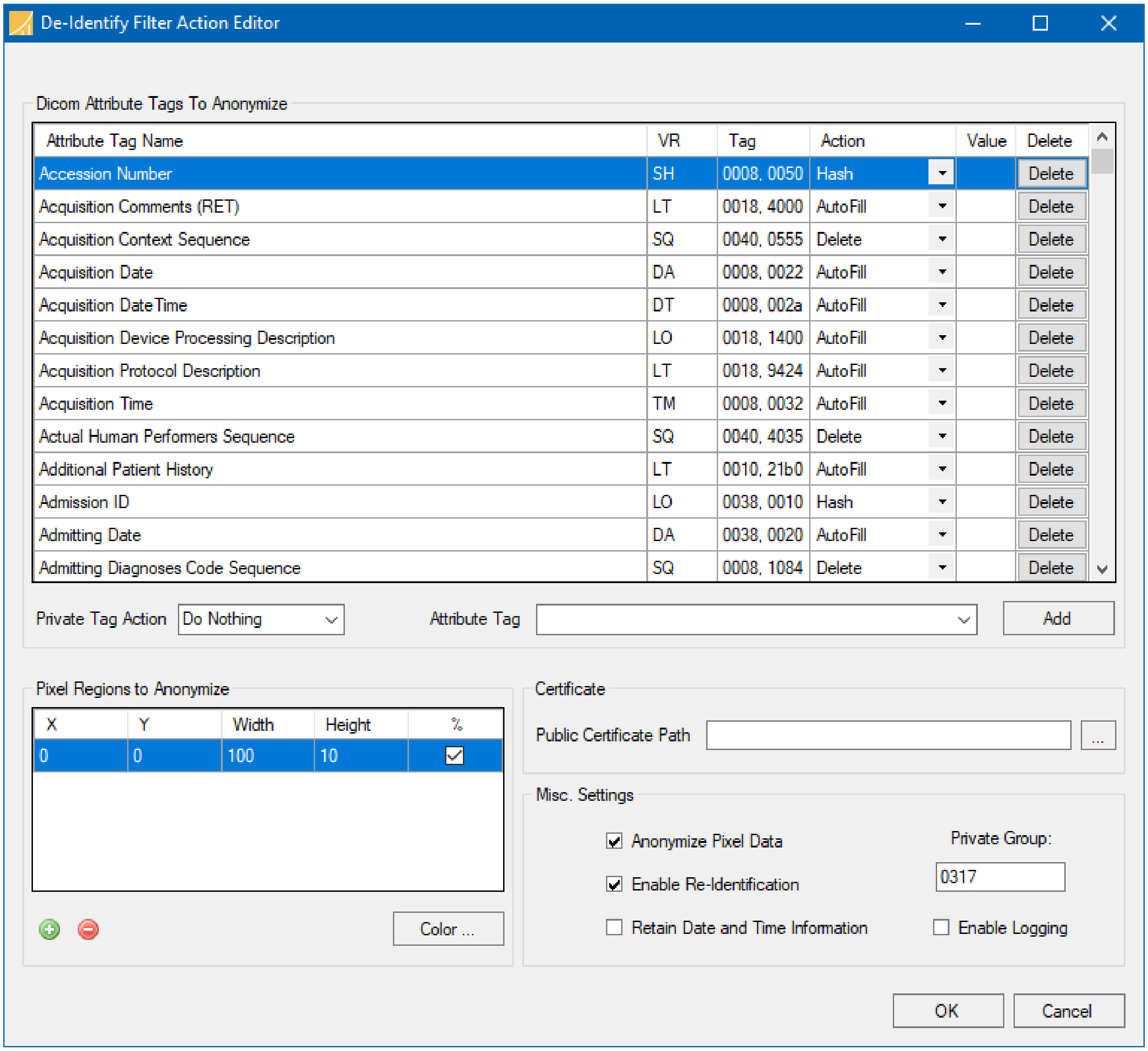
If no item number is specified, the first item (#0) is assumed. Specify the last element in a sequence by "#L" (upper-case is important!) if the number of sequence items is unknown.

Specify the next item in the sequence via “#N” (again, case is important) to append to the sequence. For example: 0080,0100.#L.0010,0010.#N.0008,0060

Please notice that:

- The sequence IDs (e.g., #1) and the tag-value pairs for the sequences are all separated by periods (“.”).
- The tags for the sequences are simple group-element pairs themselves.

5.2. De-Identify Filter Action



Dicom Attribute Tags To Anonymize

Attribute Tag Name	VR	Tag	Action	Value	Delete
Accession Number	SH	0008, 0050	Hash		Delete
Acquisition Comments (RET)	LT	0018, 4000	AutoFill		Delete
Acquisition Context Sequence	SQ	0040, 0555	Delete		Delete
Acquisition Date	DA	0008, 0022	AutoFill		Delete
Acquisition DateTime	DT	0008, 002a	AutoFill		Delete
Acquisition Device Processing Description	LO	0018, 1400	AutoFill		Delete
Acquisition Protocol Description	LT	0018, 9424	AutoFill		Delete
Acquisition Time	TM	0008, 0032	AutoFill		Delete
Actual Human Performers Sequence	SQ	0040, 4035	Delete		Delete
Additional Patient History	LT	0010, 21b0	AutoFill		Delete
Admission ID	LO	0038, 0010	Hash		Delete
Admitting Date	DA	0038, 0020	AutoFill		Delete
Admitting Diagnoses Code Sequence	SQ	0008, 1084	Delete		Delete

Private Tag Action: Do Nothing

Attribute Tag:

Pixel Regions to Anonymize

X	Y	Width	Height	%
0	0	100	10	☑

Certificate

Public Certificate Path:

Misc. Settings

☑ Anonymize Pixel Data

☑ Enable Re-Identification

☐ Retain Date and Time Information

Private Group: 0317

☐ Enable Logging

The **De-Identify Filter Action** provides a mechanism to remove and replace certain attributes within a DICOM dataset that may lead to patient identification.

5.2.1. DICOM Attribute Tags to Anonymize

By default, this list is populated with attributes suggested in **PS 3.15 Annex E Attribute Confidentiality Profile** in the 2011 DICOM specification. Attribute Tags not in the default data dictionary cannot be added. This includes specific private tags. The following options are specified for each attribute in the data grid shown above under **DICOM Attribute Tags to Anonymize**:

- Attribute Tag Name – Specifies the name of the attribute tag to be anonymized if present in a given DICOM dataset's header data.
- VR – Indicates the attribute's Value Representation. This becomes useful when determining an appropriate replacement value for de-identification when "AutoFill" is selected.
- Tag – Indicates the attribute tag of the attribute to be anonymized.
- Action – Specifies the replacement action to use for a given attribute when determining the replacement value. The available replacement actions are determined based on the attribute's VR. The following list contains all available replacement actions:
  - Hash (SH, LO, PN elements) – For SH, LO, and PN elements, the replacement value will be a trimmed hash string (using SHA256) of the original value.
  - GenerateUID – For a given UI element, a new UID will be generated for the replacement value.
  - TransformUID – For a UI element, the existing UID will be transformed in a consistent manner to allow for repeatability. For instance, this option is typically selected for SOP Instance UIDs to allow a given UID to map to the same new UID across multiple instances of the **De-Identify Filter Action**.
  - AutoFill – Replace the current DICOM attribute value with an appropriate replacement value based on the attribute's VR. The replacement value is predetermined and is not configurable.
  - UserDefined – Replace the current attribute value with the given replacement string defined in the "Value" column.
  - Default – Replace the current DICOM attribute value with a user-specified value. For example, specifying the default of 'M' for Patient's Sex will set all instances of Patient's Sex to 'M' by default.
  - Delete – Specifying this option will remove the given attribute from the de-identified dataset. If "Delete" is selected for a given attribute and the attribute is present in a sequence (SQ), that sequence will be removed from the de-identified dataset.
- Value – If "UserDefined" is selected as a replacement value action, the string specified in the Value column will be used as a replacement value for the given attribute. This value will appear as is. Care should be taken when entering a value for non-standard string VR types ("CS" for instance).
- Delete – Press the delete button to remove the given attribute from the list of attributes to de-identify.

5.2.2. Miscellaneous Settings

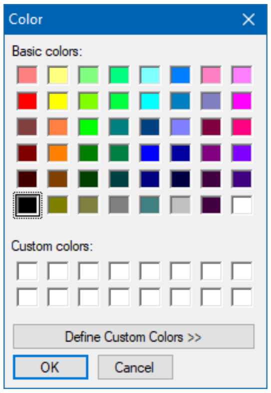
These settings allow for finer-grained control over common options needed during de-identification.

- **Anonymize Pixel Data** – If selected, the list of rectangles defined in the **Pixel Regions to Anonymize** grid will be removed from the DICOM dataset's pixel data. This includes pixel data in (7FE0, 0010), and not any additional overlays or private tags. This option will be skipped if no valid pixel data is present in the DICOM dataset.
- **Enable Re-Identification** – If checked, the original values for each attribute anonymized will be persisted in the resulting de-identified dataset using the specified public certificate. More information about this process is specified later in this section.
- **Retain Date and Time Information** – If this option is checked, all date and time information (DT and TM elements) will not be anonymized. This option may be useful when performing clinical trials, where the DICOM dataset's date and time information may need to be retained after de-identification.
- **Skip Unsupported Images** – When anonymizing a dataset's pixel data (again referring only to pixel data in (7FE0, 0010),) enabling this option will cause the filter to not anonymize the pixel data for all unsupported photometric interpretations. For instance, anonymizing the pixel data for all DICOM datasets with a photometric interpretation of 'YBR_FULL' will automatically be skipped. The header data for these datasets will still be anonymized. For a list of all supported image types, see section 5.2.3, Pixel Regions to Anonymize.
- **Private Group** – The Private Group box specifies which group will be used during the de-identification process. In particular, after De-Identification, this private group will hold the Encrypted Attribute Sequence containing the original data.
- **Enable Logging** – Checking this option will enable logging for the de-identification process.

5.2.3. Pixel Regions to Anonymize

This grid specifies which rectangles to anonymize in a DICOM dataset's pixel data (7FE0, 0010). Each rectangle is defined by indicating the location of each side of the rectangle in relation to the original image, specified in terms of a percentage. For instance, the example form shows two rectangles covering the entire top and bottom 10 percent of an image.

Clicking **Color…** allows the user to define an appropriate replacement pixel value for each type of supported photometric interpretation via the following dialog box:



The supported photometric interpretations for de-identification are as follows:

- MONOCHROME 1
- MONOCHROME 2
- RGB/YBR
- PALETTE COLOR

See the conformance statement for Anonymization for a complete breakdown of the supported image types for pixel data De-Identification.

Note: If you a color is picked that is not grayscale and photometric interpretation is MONOCHROME1 or MONOCHROME2 then grayscale representation for the selected pixel replacement color will be used.

5.2.4. One-Way Anonymization

For one-way anonymization of the patient demographic data and/or pixel data (re-identification cannot be performed), the following feature must be unchecked in the **Misc Settings** group box:

5.2.5. Enable Re-Identification

NOTE: If the **Enable Re-Identification** setting is enabled without a valid **Public Certificate**, the de-identification will fail with the following error:
'LaurelBridge.DCS.DCSException: Failed to apply filter action --->
System.Security.Cryptography.CryptographicException: Cannot find the requested object.'

The **Public Certificate Path** text box will be disabled when performing one-way anonymization. A valid public certificate is only necessary when **Enable Re-Identification** is checked. A valid certificate should either be purchased or generated by the user.

The expected certificate file formats are:

- the public certificate (export format PEM) .crt
- the private certificate (export format PKCS #12) .p12

5.2.6. Additional Notes

Pixel data and header data re-identification are only available with a valid public and private certificate.

Disable **Use Original Attributes Sequence** for all de-identification filters if you are going to anonymize SOP instances. Having this option enabled will defeat the purpose of anonymization by embedding the list of attribute tags and their original values that changed after applying the de-identification filter action.

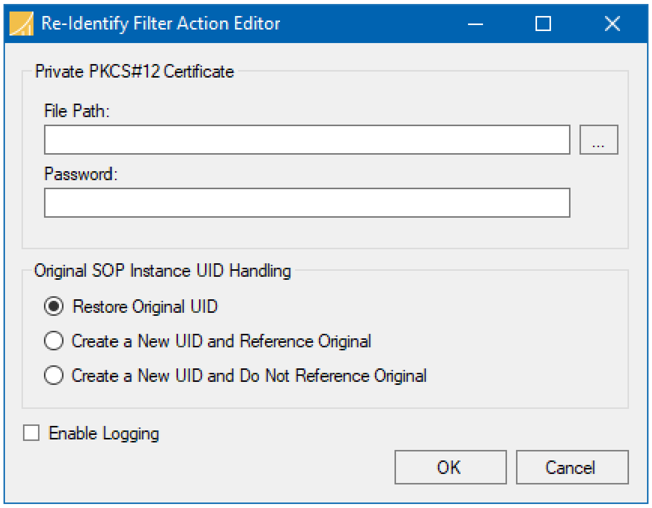
The **De-Identify Filter Action** also supports removing all private tags from the DICOM dataset's header data. The current options and their descriptions are as follows:

- Do Nothing – Leave the private tags as they are. By default, this option is selected.
- Remove All – Remove all private tags from the DICOM dataset's header data. This does not include any private tags added during the de-identification process. This removal is unidirectional and cannot be undone, even during re-identification.
- Encrypt All – Remove all private tags from the DICOM dataset's header data. This does not include any private tags added during the de-identification process. This option can only be enabled if **Enable Re-Identification** is selected and a valid public certificate is provided.

Sequences are De-Identified per the following rules:

- If a given sequence (SQ element) contains an attribute tag that is marked for de-identification, the entire SQ element is anonymized. That is, each of the DICOM elements contained within that sequence are anonymized per either the specified tag replacement action, or AutoFill by default when determining the appropriate replacement value.
- If a sequence is marked as 'Delete', then the entire sequence is removed. A sequence will not be only partially altered. If any of the contents of a sequence are marked for de-identification, regardless of the action, then the entire sequence will be de-identified.

5.3. Re-Identify Filter Action



Re-Identify Filter Action Editor

Private PKCS#12 Certificate

File Path:

Password:

Original SOP Instance UID Handling

● Restore Original UID

○ Create a New UID and Reference Original

○ Create a New UID and Do Not Reference Original

□ Enable Logging

The **Re-Identify Filter Action** allows restoration of previously anonymized patient demographic information and pixel data for a given DICOM dataset.

The patient demographic information and pixel data restoration are only available as long as a valid private certificate (and password) is available. This private certificate must pair with the public certificate used to de-identify the original DICOM dataset.

Select one of the following actions when re-identifying a dataset to dictate how to handle the original SOP Instance UID:

- **Restore Original UID** – Select this option to restore the original SOP Instance UID. This option will not create a Referenced Image Sequence (0008, 1140).
- **Create a New UID and Reference Original** – Select this option in order to create a new SOP Instance UID and create a Referenced Image Sequence (0008, 1140) that references the original SOP Instance UID that was de-identified.
- **Create a New UID and Do Not Reference Original** – This option will create a new SOP Instance UID for the re-identified dataset without creating a Referenced Image Sequence (0008, 1140).

5.3.1. Additional Notes

Enable Logging – This option enables logging for the re-identification process.

Patient Identity Removed (0012, 0062) Attribute Tag will be added to the re-identified dataset in all cases, including selecting **Restore Original UID**.

As per **PS 3.15 Annex E Attribute Confidentiality Profile**, the following Attribute Tags are added when re-identifying a given DICOM dataset, unless restoring the original SOP Instance UID:

- Patient Identity Removed (0012, 0062)
- Purpose of Referenced Code Sequence (0040, A170)
- Referenced Image Sequence (0008, 1140)

6. Console Applications

6.1. Overview

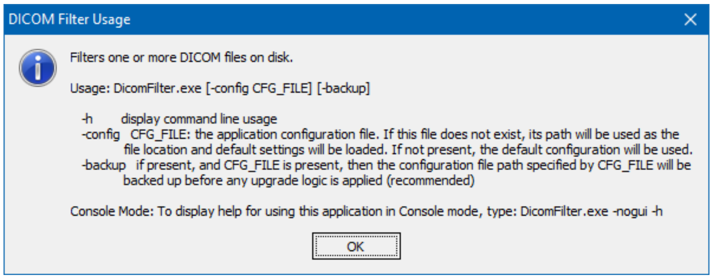
The console applications contained in PowerTools are accessible via the **PowerTools Console** shortcut placed in the Start Menu on installation (see Section 0) and also from the shortcut to the **PowerTools Console** on the **PowerTools Launcher** GUI application. Many of the console applications are combined with the GUI version of the same application, and are run using a **–nogui** flag.

All console (and GUI) applications contain a usage statement which can be displayed by running the application with a **-h** flag, although the **–nogui** flag is also required for those that are combined GUI and console applications. Note that most all of the console applications all are very similar in functionality to their GUI counterparts.

For example, the GUI help message for the GUI version of the Query Client can be obtained by running this command:

```
DicomFilter -h
```

Running this command results is a help dialog popping up that looks like this:

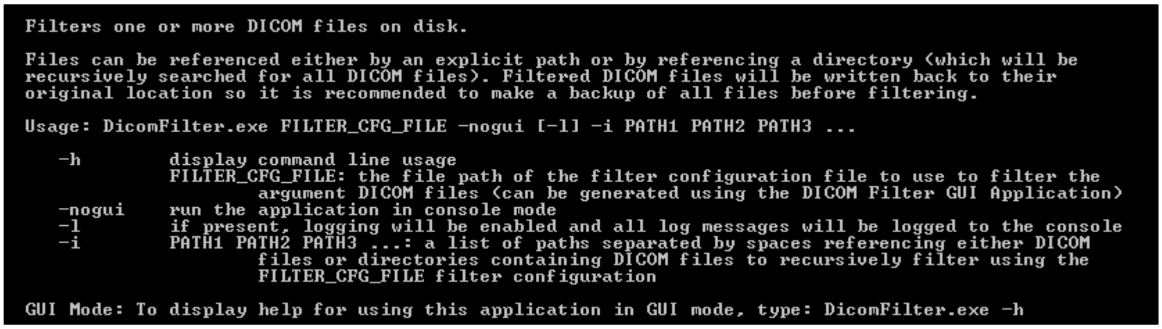


```
Filters one or more DICOM files on disk.

Usage: DicomFilter.exe [-config CFG_FILE] [-backup]

  -h       display command line usage
  -config  CFG_FILE: the application configuration file. If this file does not exist, its path will be used as the
           file location and default settings will be loaded. If not present, the default configuration will be used.
  -backup  if present, and CFG_FILE is present, then the configuration file path specified by CFG_FILE will be
           backed up before any upgrade logic is applied (recommended)

Console Mode: To display help for using this application in Console mode, type: DicomFilter.exe -nogui -h
```

To view usage for the console version of the DICOM Filter, simply append the **-nogui** switch:

```
DicomFilter -nogui -h
```

The resulting output looks like this:



```
Filters one or more DICOM files on disk.

Files can be referenced either by an explicit path or by referencing a directory (which will be
recursively searched for all DICOM files). Filtered DICOM files will be written back to their
original location so it is recommended to make a backup of all files before filtering.

Usage: DicomFilter.exe FILTER_CFG_FILE -nogui [-l] -i PATH1 PATH2 PATH3 ...

    -h          display command line usage
                FILTER_CFG_FILE: the file path of the filter configuration file to use to filter the
                        argument DICOM files (can be generated using the DICOM Filter GUI Application)
    -nogui      run the application in console mode
    -l          if present, logging will be enabled and all log messages will be logged to the console
    -i          PATH1 PATH2 PATH3 ...: a list of paths separated by spaces referencing either DICOM
                        files or directories containing DICOM files to recursively filter using the
                        FILTER_CFG_FILE filter configuration

GUI Mode: To display help for using this application in GUI mode, type: DicomFilter.exe -h
```

The detailed usage statement for each application provides user guidance for most tasks. Descriptions of some of the more common, complex uses are provided here for selected applications.

6.2. Dicom to PDF

DICOM to PDF is a console-only application that extracts Encapsulated PDF documents from one or more DICOM files and saves each PDF as a file.

6.3. Indexer

The **Indexer** is a console-only application iterates over DICOM image files found in one or more file or directory paths and builds a CSV index file with information about those DICOM files.

6.4. MWL Client

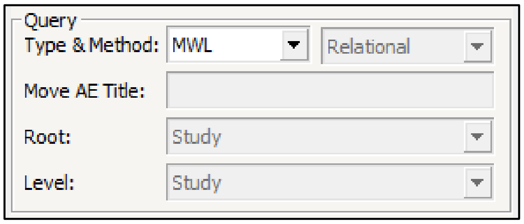
The **MWL Client** is a console-only Modality Worklist Client application that queries a Modality Worklist Server.

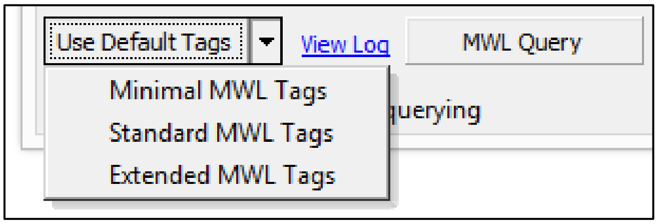
6.5. MWL Server

The **MWL Server** is a console-only Modality Worklist Server application that is distributed with a small worklist database of files. This provides a quick start to exploring the use of MWL Queries, such as using the GUI version of the **Query Client** or the console **MWL Client**. To use the included worklist database, contained in the directory named **worklist** that is found inside the PowerTools installation directory, open a **PowerTools Console** from either the **PowerTools Launcher** or the Windows Start menu, and start the **MWL Server** by typing this:

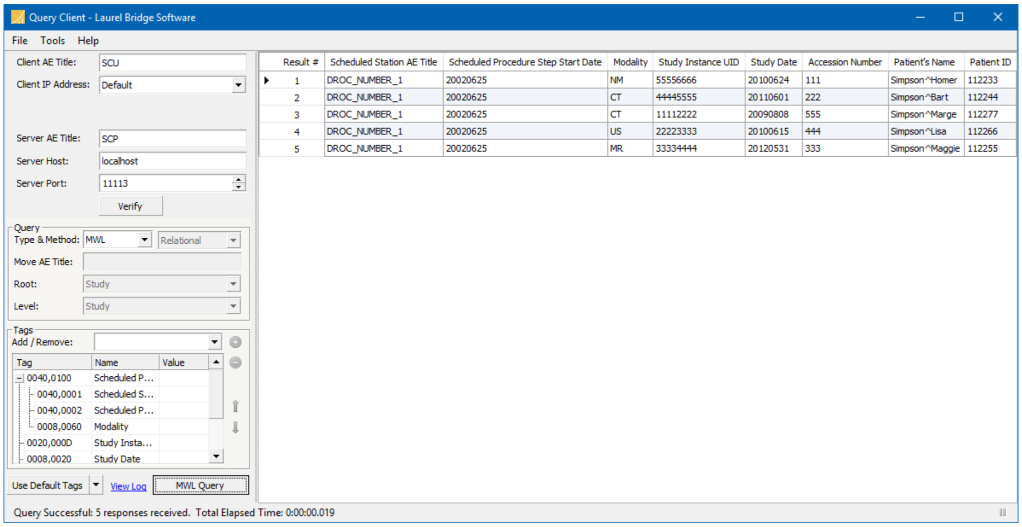
```
MWLServer 11113 worklist
```

To query this worklist, start the Query Client application, enter a **Server Port** to match the port in the command above (`11113`), select a **Type & Method** of MWL, and using the **Use Default Tags** drop down button select **Minimal MWL Tags**.


Query
Type & Method: MWL Relational
Move AE Title:
Root: Study
Level: Study



Then, click the **MWL Query** button and observe the output.



Client AE Title: SCU
Client IP Address: Default

Server AE Title: SCP
Server Host: localhost
Server Port: 11113

Query
Type & Method: MWL Relational
Move AE Title:
Root: Study
Level: Study

Tags
Add / Remove:

Tag	Name	Value
0040,0100	Scheduled P...	
0040,0001	Scheduled S...	
0040,0002	Scheduled P...	
0008,0060	Modality	
0020,000D	Study Insta...	
0008,0020	Study Date	

Result #	Scheduled Station AE Title	Scheduled Procedure Step Start Date	Modality	Study Instance UID	Study Date	Accession Number	Patient's Name	Patient ID
1	DROC_NUMBER_1	20020625	NM	55556666	20100624	111	Simpson^Homer	112233
2	DROC_NUMBER_1	20020625	CT	44445555	20110601	222	Simpson^Bart	112244
3	DROC_NUMBER_1	20020625	CT	11112222	20090808	555	Simpson^Marge	112277
4	DROC_NUMBER_1	20020625	US	22223333	20100615	444	Simpson^Lisa	112266
5	DROC_NUMBER_1	20020625	MR	33334444	20120531	333	Simpson^Maggie	112255

Query Successful: 5 responses received. Total Elapsed Time: 0:00:00.019

6.6. Query Client

6.6.1. Query example

As described in the application's command line help, the Query Client can make use of user-defined query configuration and input filters files. For example, if a user desired to query a server for datasets with a specific study date and filter one or more tags, the following steps can be used:

1. Create a query configuration file containing the tag or tags to be queried for. In this example, create a file called "query.txt" that contains the following lines:

   ```
   0008,0020 = 20070101
   0010,0010 =
   0010,0020 =
   0020,000d =
   ```

   This queries for datasets that have a Study Date (0008,0020) of January 1, 2007 and will return values of the Study Date, Patient's Name (0010,0010), Patient ID (0010,0020) and Study Instance UID (0020,000d) tags.

   Note that the Query/Retrieve level should NOT be put in the query.txt file, as it is set using a command line switch (default level is STUDY).

   For a description of the query configuration file format, see below or view the example QueryClientExample.cfg file in the PowerTools installation directory.

2. Create a filter file using the GUI version of the Query Client application. A simple filter to create for this example would be one that modifies the Patient's Name by changing its case to all lowercase. See below for a description of using the Filter Editor in one of these applications to create an XML filter file, saving it as "filter.xml".

3. Run the Query Server console application, pointing it at a directory that contains at least one dataset that matches the query defined in “query.txt”, like this:

   ```
   QueryServer 11112 path_to_dataset_folder
   ```

4. Query the server using the console version of the Query Client, taking care to use the required “-nogui” switch, like this:

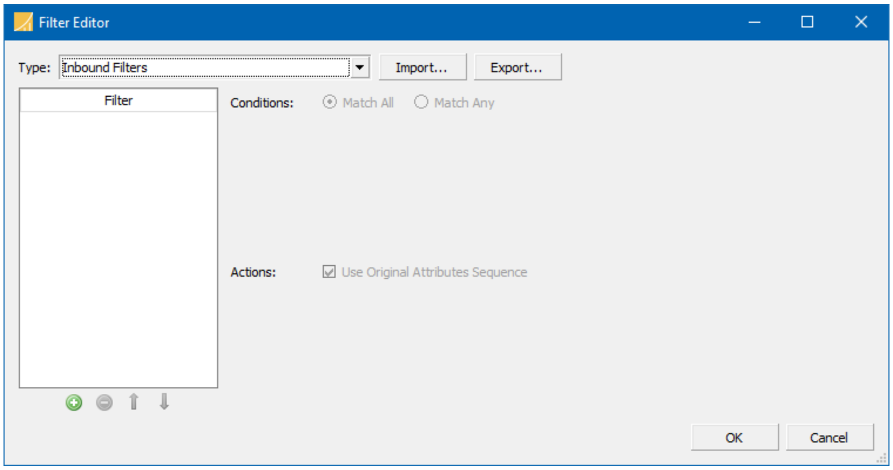
   ```
   QueryClient localhost 11112 -nogui -f query.txt -fi filter.xml
   ```

   Be sure either to have the “query.txt” and “filter.xml” files in the same directory from which you are running the command, or to specify on the command the complete path to each file. The output will look something like this, noting that the Patient’s Name is now lowercase:

```
Query Result 1:
    (0008, 0020) DA(  8) Study Date                   20070101
    (0008, 0052) CS(  6) Query/Retrieve Level         STUDY
    (0010, 0010) PN( 12) Patient’s Name               doe^john
    (0010, 0020) LO( 14) Patient ID                   000003F136E8A
    (0020, 000d) UI( 54) Study Instance UID
1.2.840.114089.1.0.1.3229814446.1265295723.2160.868861
```

6.6.2.Creating a Filter File

To create a filter file using Filter Editor in the GUI version of the Query Client application, run the Query Client, open the Options dialog from the Tools menu, and click on the **Edit Filters** button. The Filter Editor dialog will open.



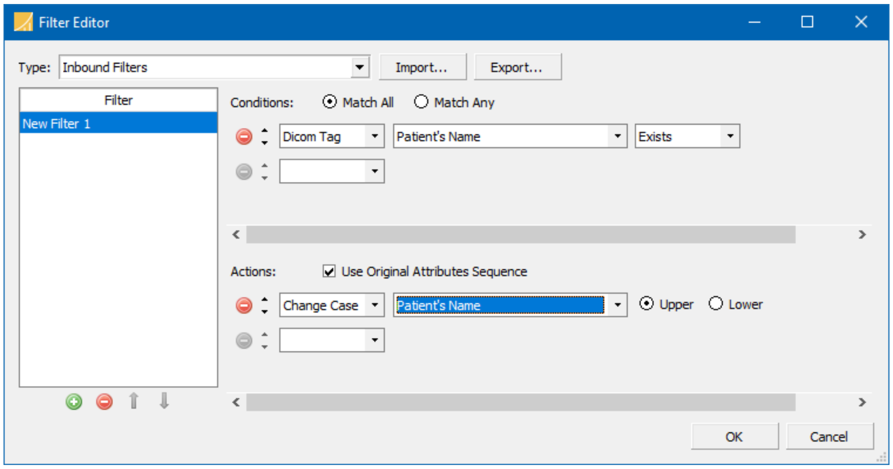
Type: Inbound Filters

Conditions: ● Match All ○ Match Any

Actions: ☑ Use Original Attributes Sequence

Click the ⊕ button to add a new filter. Then, in the **Conditions** area select “Dicom Tag”, and define it as “Patient’s Name” with a condition of “Exists”.

In the **Actions** area, select **Change Case** for “Patient’s Name” and define the action as “Lower”. The dialog should now look like this:



Type: Inbound Filters

Filter: New Filter 1

Conditions: ● Match All ○ Match Any

Dicom Tag | Patient's Name | Exists

Actions: ☑ Use Original Attributes Sequence

Change Case | Patient's Name | ● Upper ○ Lower

Finally, click **Export**, and save this filter with a meaningful name, such as “filter.xml”. Close all dialogs and exit from the GUI version of the Query Client.

For convenience, this same Filter Editor is available in the GUI versions of the DICOM Filter, DICOM File Editor, Store Client, Store Server, Verification Client and Verification Server applications. More details about using the Filter Editor Dialog are found in section 4.1.3 above.

6.6.3. Format of Query Configuration File

The query configuration file described above has a simple name-value pair format. For reference, there are a number of example configuration files (***.cfg**) in the PowerTools installation directory. Each line of the file contains a DICOM group and element number separated by a comma followed by an equals sign and an optional expected value. For example:

```
0008,0020 = 20070101
0010,0010 =
```

Match line - The first line is a “match line” and contains the group and element numbers for a Study Date tag. When used in a query, this line will match a Study Date tag with the specific date defined (January 1, 2007).

Result line - The second line is a “result line” and contains the group and element numbers for a Patient’s Name tag. Because no value is specified, this line will match any Patient’s Name.

Results returned - When all match lines in a query configuration file match those in a dataset on the Query Server, that dataset is deemed a match. The results returned by a query will consist of all tags and values that match any of the match lines or result lines. In the above example, if a dataset is found with the matching Study Date, the results returns will consist of the Study Date and Patient’s Name.

6.7. Query Server

The **Query Server** is a console-only Query/Retrieve Server that responds to C-FIND and C-MOVE requests from a Query/Retrieve Client.

7. Application Summary

There are three forms of applications in PowerTools, combined GUI and console applications, GUI-only and console-only. For clarity, they are listed here. Usage information for the GUI version of applications and console-only applications is displayed using the **−h** flag, while usage information for the console version of combined GUI and console applications is displayed using both the a **−h** and the **−nogui** flags.

7.1. Combined GUI and Console Applications

- DICOMDIR Creator
- DICOM File Editor
- DICOM Filter
- Dictionary Finder
- Query Client
- Store Client
- Store Server
- Study Generator
- Verification Client
- Verification Server

7.2. GUI-only Applications

- PDF to DICOM
- HL7 Receiver
- HL7 Sender
- Launcher
- Structured Report Extractor

7.3. Console-only Applications

- DICOM to PDF
- Indexer
- MWL Client
- MWL Server
- Query Server

8. PowerTools Quick Reference

General

GUI Usage	Appname.exe -h	**List apps in console**	list
Console Usage	Appname.exe -h -nogui	**List cfgs in console**	list
Rename app window	Appname.exe -name "new name" See example_gui_renaming.bat	**Run app from console**	Appname.exe

Applications

Launch any PowerTools app	Launcher	**Create DICOMDIR from images**	DICOMDIR Creator
View, edit, modify DICOM files	Dicom File Editor	**Filter DICOM files, create filters**	DICOM Filter
Lookup SOP Class & Transfer Syntax UIDs, element names, tags, VR types	Dictionary Finder	**Extract Structure Report data, generate mapping file for integrated dictation systems (e.g. PS360)**	SR Extractor
Send HL7 messages	HL7 Sender	**Receive HL7 messages**	HL7 Receiver
Run console apps	PowerTools Console	**Query a PACS (Find, Move, MWL)**	Query Client
Send DICOM dataset to server	Store Client	**Receive DICOM datasets, store to disk**	Store Server
Create encapsulated PDF	PDF to DICOM	**Generate test datasets, send to DICOM server**	Study Generator
Send echo/ping to DICOM device	Verification Client	**Receive & respond to C-Echo ping messages**	Verification Server
Autorun on GUI app start	Store Server & Study Generator, **-run** switch		

Dicom File Editor

View file or directory of images	Drag folder onto Dicom File Editor Use Open or Open Folder menu option	**View hex for an element**	Open image, select element, select Hex view tab
Compare elements in images	Select element in current image, select a different image in hierarchy list	**View element for hex value**	Open image, select hex in Hex view, switch to Header view
Save DICOM image as plain image	Use Save Image As menu option (bmp, gif, jpeg, pbm, pgm, png, ppm, tiff)	**Save multi-frame image as GIF animation**	Use Save Image As to save as Animated GIF
Copy image path to clipboard	Right-click on Header, Hex or Image tab, or image panel, select Copy File Path to Clipboard	**Edit an element**	Double-click on element in Header view
Save image shortcut	Right-click on a tab or image panel, select Save Image As	**Find**	Type Ctrl-F or select Tools>Find in Open DICOM Dataset
Open containing directory	Right-click on a tab or image panel, select Show in Folder	**Find and Highlight**	Open Find dialog, click Find All
Load DICONDE or ext dictionary	Click upper-right DICOM indicator (if present) or Manage button on Options dialog	**Find with Microsoft-style wildcards**	Check “Use wildcards” in Find dialog
Show names for well-known UIDs	Check Show names for well-known UIDs on Options dialog	**Change number of Recent Files shown**	Edit value on Options dialog

Study Generator

Store studies in parallel (max: 32)	Check Store studies in parallel	**Use separate association**	Select Study, Series or Image
Demo multiple study generators	Run example_gui_renaming.bat	**Demo image overlays**	Send images in various sizes, view in Store Server
Quickly change target store server	Use Store Server Profiles, define multiple, easily select desired server	**Add example tags**	Tools>Load Extra Tags, select example set
Delay between stores	Change delay in Options dialog	**Max number of images generated**	2^{31} - 1 2,147,483,647
Set background image	Click on Background Image or Browse button	**Clear background image**	Click Clear button
Show tag overlay	Check Tag Overlay box	**Use “SAMPLE” watermark**	Shown only when Background Image is used
Override image dimensions	Add “Columns and Rows” tags in Tools menu, modify values	**Override bits allocated & stored (see tooltip)**	Add “Bits Allocated and Stored” tags in Tools menu, modify values
Max image size	300 MB		

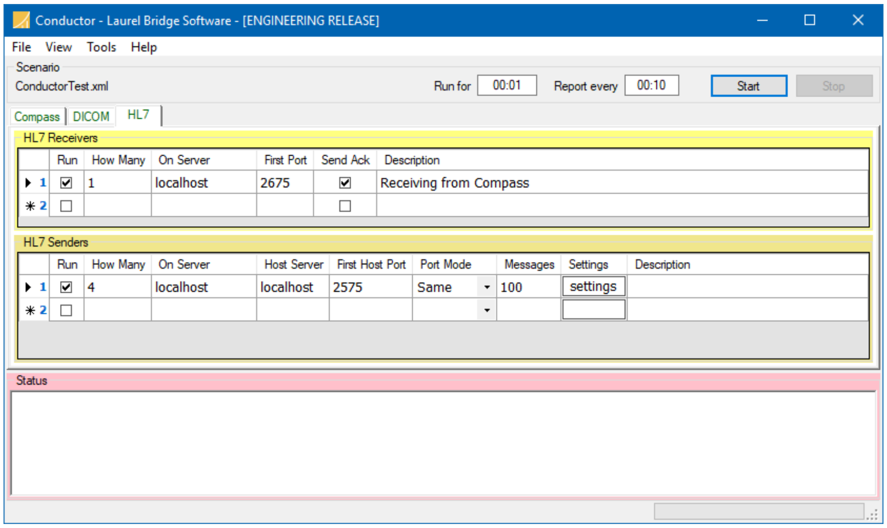
9. Conductor

9.1. Overview of Conductor

Laurel Bridge Conductor is an application controller and performance measurement tool in the Laurel Bridge PowerTools™ suite. Its primary uses are for performance testing proposed scenarios on a virtual network as a means of proof-of-concept or predictive analysis. An add-on feature key must be purchased to enable Conductor functionality in PowerTools.

This user manual covers general installation, set up and licensing of Conductor on a single machine or virtual network, creation of and working with scenarios, and running Conductor from the command line to perform performance regression tests.

Conductor consists of a **Controller Application** and an **Agent Service**. The controller provides an interface that enables the user to create, manage and control scenarios that involve one or more applications, and to gather and view runtime performance data from those applications. The agent service runs on all systems involved in a scenario and is responsible for marshalling commands and data to and from the Conductor controller and the applications being controlled. This marshalling is done using embedded web server technology that accepts command and data via standard HTTP GET and POST requests and responses.



Scenario
ConductorTest.xml

Run for 00:01 Report every 00:10

HL7 Receivers

	Run	How Many	On Server	First Port	Send Ack	Description
1	☑	1	localhost	2675	☑	Receiving from Compass
2	☐				☐	

HL7 Senders

	Run	How Many	On Server	Host Server	First Host Port	Port Mode	Messages	Settings	Description
1	☑	4	localhost	localhost	2575	Same	100	settings	
2	☐								

Status

The first envisioned use of Conductor is to measure performance and throughput of proposed network system configurations, measure the impact on throughput of DICOM images sent across the network under a variety of circumstances, such via different Compass modes or with some amount of HL7 traffic competing for resources. Many other uses are possible, limited only by available resources and the capability of to report and gather the desired runtime information.

Because Conductor is a powerful and complex tool, it is recommended for use by technically knowledgeable users who are familiar with the Laurel Bridge Compass™ product and with PowerTools software generally. Specific beneficial background includes facility with managing and configuring a virtual network and working with PowerTools applications.

9.2. Installing Conductor

Conductor is included by default in PowerTools, beginning with version 1.0.43. To install PowerTools, run the installer executable (Setup.exe) and follow the on screen directions. For reference, see the Installation section of the PowerTools User Manual.

9.2.1. Single System

Installing on a single system is straightforward. Install PowerTools. Optionally, install Compass if you plan to run it locally as part of a test scenario. Follow steps below for starting the agent service and then for configuring and running a scenario using Conductor.

9.2.2. Virtual Network

Installation on a virtual network is a more involved process. These instructions are based on experience with a specific virtual network with every attempt made to write them in a generally applicable way. More details that expand on the general descriptions here are found further below in this user manual. Steps for setting up Conductor on a virtual network are:

1. Acquire PowerTools and Compass installers and necessary license files for running them on your virtual network. The PowerTools license on the server on which you will run Conductor must have the **conductor** feature key enabled, while other installations of PowerTools do not require that feature key at present.
2. Move the PowerTools and Compass installers into a known location on a gateway server on your virtual network, along with PowerTools and Compass license files. A recommended approach is to have a single gateway machine that is the only machine reachable from outside the virtual network. Make sure that the directory containing these installers is available from all other servers on the virtual network.
3. On each server on the virtual network, install PowerTools and a corresponding license. Also on each server start the Conductor Agent Service.
4. On the gateway server (recommended), install the PowerTools license that has the **conducto**r feature key enabled. You will run Conductor on that server so that you have the option to view browser-based output in a browser outside of the virtual network.
5. On the server(s) on which you plan to run Compass, install Compass and the corresponding license. Note that you do not need to manually start the Compass service, as it will be started the first time you open the Compass user interface.
6. On the same Compass server(s), verify that **Receive Side Scaling (RSS)** is **Enabled** and **Jumbo Packet** is set to **Jumbo 9000**, as performance otherwise can be impacted. To do this, find and open the operating system **View Network Connections** panel, right-click on the relevant connection (e.g., “Ethernet 2”), click **Configure** and go to the **Advanced** tab. Scroll down to **Jumbo Packet** and set its value to **Jumbo 9000**, then scroll further down to **Receive Side Scaling** and set its value to **Enabled**, and finally click **OK**. The setting will be applied immediately.

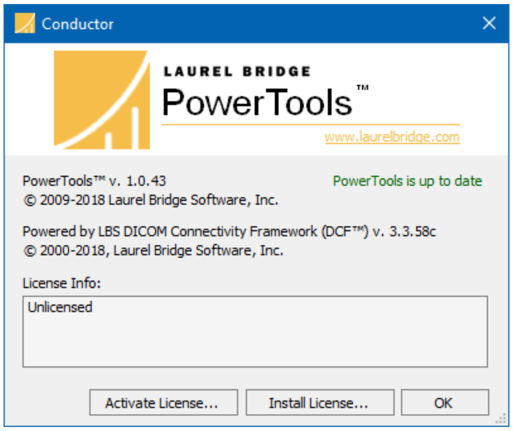
Once these setup steps are complete, you are ready to configure a Conductor scenario and run it.

9.3. Getting Started with Conductor

9.3.1. Installing a License

In order to make use of Conductor, a PowerTools license that includes the Conductor feature key must be installed only on the system on which the Conductor controller will run. It is not necessary on any of the agent systems. This license must be specially acquired from Laurel Bridge Software and saved as a local file. Instructions for installing a license are included in the PowerTools User Manual, though the license can be installed directly using Conductor.

To install directly, run Conductor manually by navigating to the PowerTools installation directory (`C:\Program Files (x86)\Laurel Bridge Software\PowerTools`) and double-clicking on the Conductor icon. Because Conductor is still considered an engineering tool rather than a developer tool, it is not yet included in the Windows start menu or the PowerTools Launcher interface. After the application appears, select **Help > About…** menu option. When the **About Conductor** dialog appears, click the **Install License…** button, browse to the license file, and hit **OK**. Information on the status of the license, including when it expires, can be found on this dialog available at any time by selecting **Help > About…**.



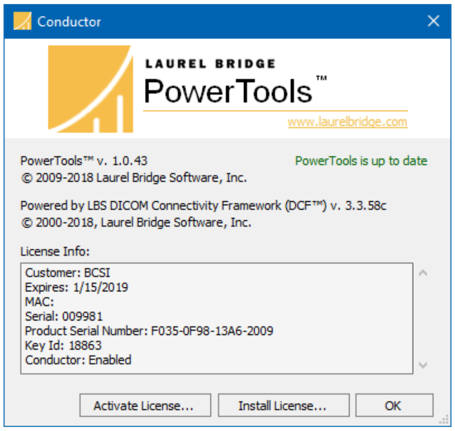
PowerTools™ v. 1.0.43 PowerTools is up to date
© 2009-2018 Laurel Bridge Software, Inc.

Powered by LBS DICOM Connectivity Framework (DCF™) v. 3.3.58c
© 2000-2018, Laurel Bridge Software, Inc.

License Info:

Unlicensed

Before installing license



PowerTools™ v. 1.0.43 PowerTools is up to date
© 2009-2018 Laurel Bridge Software, Inc.

Powered by LBS DICOM Connectivity Framework (DCF™) v. 3.3.58c
© 2000-2018, Laurel Bridge Software, Inc.

License Info:

Customer: BCSI
Expires: 1/15/2019
MAC:
Serial: 009981
Product Serial Number: F035-0F98-13A6-2009
Key Id: 18863
Conductor: Enabled

After installing license

A typical set up for Conductor is within a sequestered virtual network, so activation of the license may not be possible over the Internet. However, if access is available, helpful instructions for **Activating a License over the Internet** are found in the PowerTools User Manual. Additional assistance is available by sending email to: support@laurelbridge.com

9.3.2. Starting the Conductor Agent Service

To enable the Conductor Controller to issue commands and gather runtime data from other PowerTools applications, the Conductor Agent service that is installed when PowerTools is installed must be started.

The Conductor Agent Service can be started in a variety of ways, including:

- Open a command prompt, running as Administrator, and type the following command:

```
net start conductor
```

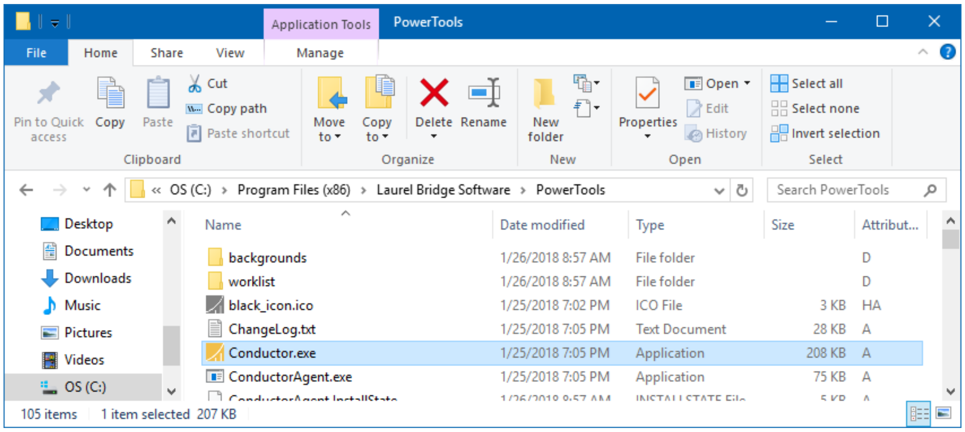
- Open the Windows Task Manager, navigate to the Services tab, scroll down and right-click on the Conductor (Conductor Agent Service) entry, and select **Start**.
- From the Windows Control Panel, open the Administrative Tools, then open the Services interface. Right-click on the Conductor Agent Service entry and select **Start**.

To verify that the Conductor Agent Service is running, view its status in the Services interface you used to start it or run the command:

```
        sc query conductor
```

9.3.3. Starting the Conductor Controller

The **Conductor Controller**, simply called **Conductor**, is run by locating and double-clicking its program icon.



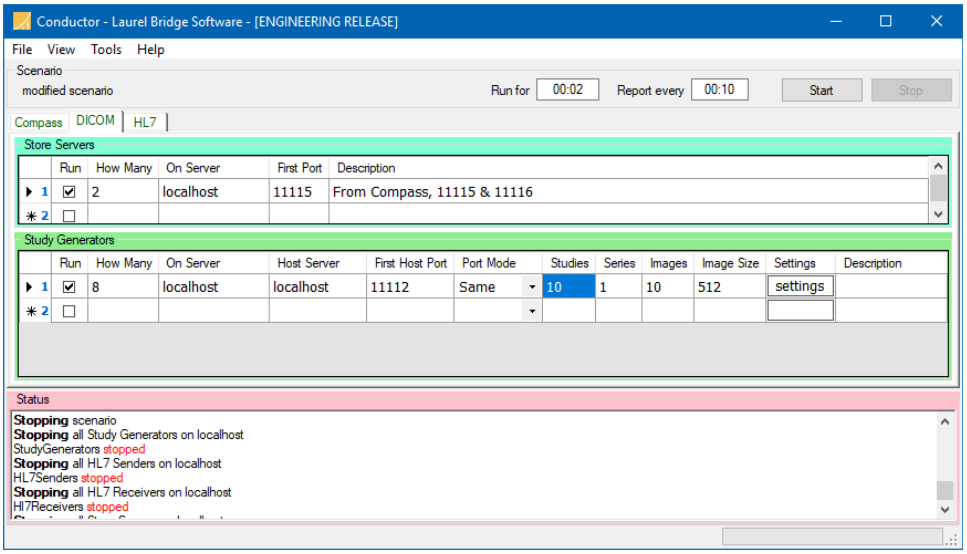
« OS (C:) › Program Files (x86) › Laurel Bridge Software › PowerTools

Name	Date modified	Type	Size	Attribut...
backgrounds	1/26/2018 8:57 AM	File folder		D
worklist	1/26/2018 8:57 AM	File folder		D
black_icon.ico	1/25/2018 7:02 PM	ICO File	3 KB	HA
ChangeLog.txt	1/25/2018 7:05 PM	Text Document	28 KB	A
Conductor.exe	1/25/2018 7:05 PM	Application	208 KB	A
ConductorAgent.exe	1/25/2018 7:05 PM	Application	75 KB	A
ConductorAgent.InstallState	1/26/2018 8:57 AM	INSTALLSTATE File	5 KB	A

105 items   1 item selected 207 KB

9.3.4. Conductor User Interface

The Conductor user interface consists of a menu, general scenario information area, a start and stop button, three application configuration tabs, a status logging window, and a status bar that displays running time information.



Scenario: modified scenario   Run for 00:02   Report every 00:10

Store Servers

	Run	How Many	On Server	First Port	Description
1	☑	2	localhost	11115	From Compass, 11115 & 11116
* 2	□				

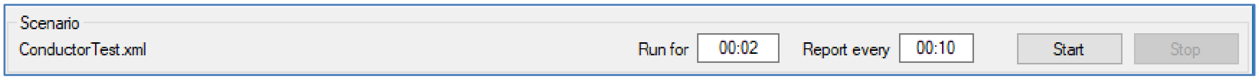
Study Generators

	Run	How Many	On Server	Host Server	First Host Port	Port Mode	Studies	Series	Images	Image Size	Settings	Description
1	☑	8	localhost	localhost	11112	Same	10	1	10	512	settings	
* 2	□											

```
Stopping scenario
Stopping all Study Generators on localhost
StudyGenerators stopped
Stopping all HL7 Senders on localhost
HL7Senders stopped
Stopping all HL7 Receivers on localhost
Hl7Receivers stopped
```

Scenario Information

To use Conductor, a **scenario** is configured and then run. A **scenario** is collection of configuration settings that includes a scenario name, a runtime duration, a reporting period, and specific settings for one or more Compass, Store Server, Study Generation, HL7 Receiver and HL7 Sender applications from the PowerTools suite. Each of these applications has a variety of settings available that can be configured and stored with a scenario.



Scenario
ConductorTest.xml
Run for 00:02
Report every 00:10

The scenario information at the top of the Conductor interface displays the name of the currently loaded scenario (or “modified scenario” if any changes have been made to the current scenario since it was loaded or saved, or empty scenario” if there is no scenario loaded or configured).

The **Run for** text box is where the desired duration of a scenario run can be set. A scenario can be configured to run for a short as 1 minute up to 99 hours, 59 minutes (4 days, 3 hours, 59 minutes). The Report every text box is where the desired stats report period is configured which determines how often all of the running applications in the scenario report their recently gathered runtime stats back to Conductor. This report period can be set to as short as 10 seconds or as long as 99 minutes, 59 seconds.

The **Start** and **Stop** buttons enable a scenario to be manually started and stopped.

Menu

The **File** menu contains the following selections:

- **Load Scenario** - select and load a scenario.
- **Save Scenario** - save the current scenario configuration to a file.
- **Clear Scenario** - clear the current scenario, resetting Conductor to an empty scenario.
- **Save Summary to CSV** - save a higher level summary of the runtime status of a scenario to a CSV file.
- **Save Stats Log to CSV** - save all gathered stats from the most recent or ongoing run of a scenario to a CSV file for further analysis as desired.
- **Exit** - exit Conductor, first stopping the scenario if it is running and offering the user a change to save the gathered log of stats before exiting.

The **View** menu contains the following selections:

- **View Agent Status** - view the agent status of all servers and Compass applications that are active parts of the current scenario. The status dialog may take a few seconds to appear if one or more of the agents are not alive, since it waits for a short time before reporting that an agent service is not alive.
- **View Agent Diagnostics** - view a dialog that displays an explanation and two links that can be used to view any agent service diagnostic interface and to verify that the Conductor built-in web server is reachable.

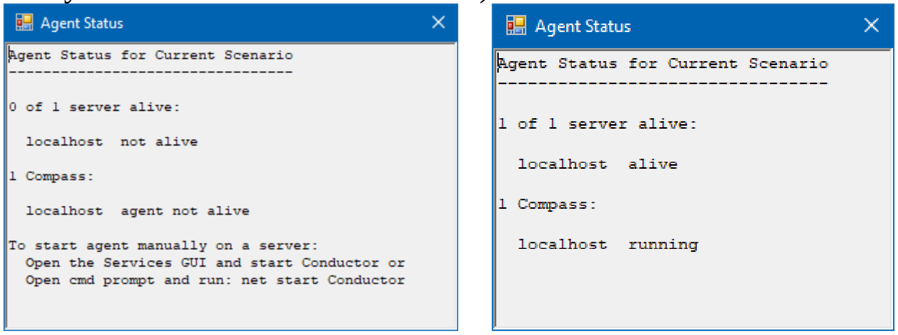
- **View Summary** - displays a quick view summary in a text-only dialog box of the currently running scenario, with information about the applications, run status and throughput of the scenario.
- **View Report in Browser** - displays the same summary information as the quick view summary along with graphs a variety of runtime statistics gathered from any of the active Compass, Store Server, Study Generator, HL7 Receiver and HL7 Sender applications in the current scenario.
- **View Stats Log in Browser** - view the currently gathered runtime stats in a web browser in an easily viewed format.
- **Show Backup CSV Folder** - opens the directory where Conductor periodically saves an automatic copy of the gathered runtime stats. This directory is adjacent to the Conductor application Configuration and Log directories, with default locations in the user's `AppData\Roaming\Laurel Bridge Software\PowerTools\Conductor` directory.

The **Tools** menu contains the following selections:

- **Use Verbose Status Logging** - enabling verbose status logging causes more detailed and frequent messages to be displayed in the Status log area of the user interface. This option can be enabled and disabled while a scenario is running, if desired.
- **Backup Stats to Log Every** - configures how frequently all of the current gathered runtime stats are written to a backup CSV file in the **Backup CSV Folder**. Choices are every 1, 5, 10, 30 or 60 minutes.
- **Set PowerTools Application Path** - enables the default application path, the PowerTools installation directory, to be overridden. This can be helpful if a custom or development version of PowerTools is installed for Conductor testing purposes.
- **Reset PowerTools Path to Default** - resets the PowerTools Application Path to its default value: `C:\Program Files (x86)\Laurel Bridge Software\PowerTools`
- **Clear Compass Database & Images** - sends a command to the agent running on each active Compass system in the current scenario requesting that the Compass database and image directory be cleared. A message with the result of the request is displayed in the Status log.
- **Try to Start Agents with Scenario** - if checked, an attempt will be made to start any stopped agents (**Start All Agents**) before then starting the scenario.
- **Start All Agents** - sends a system level request to each agent system, requesting that its Conductor Agent Service be started if it is not already running. Due to operating system level permissions, it is possible that this command will not work, though it often does.
- **Stop All Agents** - sends a system level request to each agent system, requesting that its Conductor Agent Service be stopped if it is running. Due to operating system level permissions, it is possible that this command will not work, though it often does.
- **Nuke All Agents** - this powerful option sends a command to each agent in the current scenario, requesting that all running applications be immediately terminated. Though rarely needed, this feature can be handy in complex testing environments of many servers running many applications where an occasional application refuses to exit for no discernable reason.
- **Revert to Factory Settings** - restores **Conductor** to its initial configuration including an empty scenario.

The **Help** menu contains the following selection:

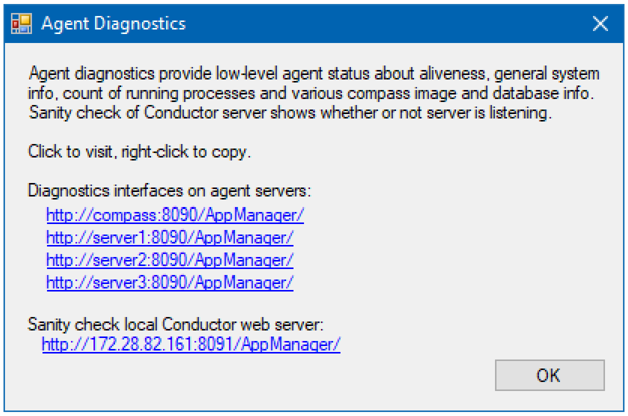
- **User Manual** - Opens the PDF PowerTools User Manual document for viewing.
- **About** - displays the **About Conductor** dialog that includes the version number of the installed PowerTools, copyright and license information, and a status message about whether or not a more recently released version of PowerTools is available (if Internet connectivity is available to make this check).



```
Agent Status for Current Scenario
---------------------------------

0 of 1 server alive:

  localhost  not alive

1 Compass:

  localhost  agent not alive

To start agent manually on a server:
  Open the Services GUI and start Conductor or
  Open cmd prompt and run: net start Conductor
```

```
Agent Status for Current Scenario
---------------------------------

1 of 1 server alive:

  localhost  alive

1 Compass:

  localhost  running
```

Agent Status dialog showing "not alive" and "alive" statuses.



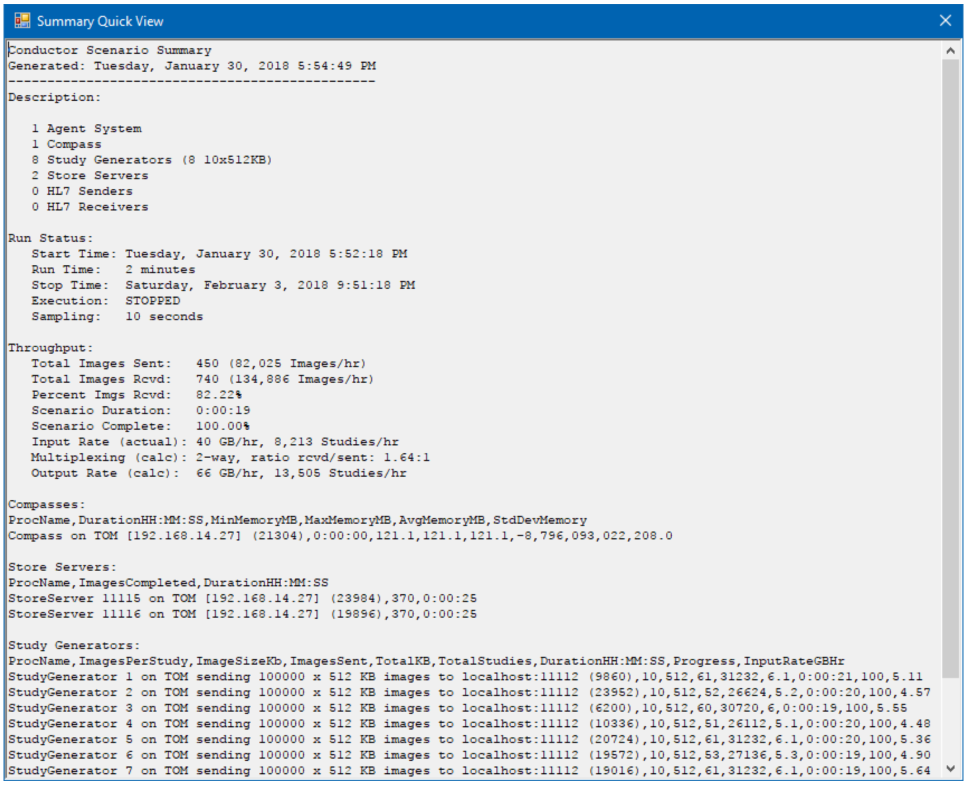
Agent diagnostics provide low-level agent status about aliveness, general system info, count of running processes and various compass image and database info. Sanity check of Conductor server shows whether or not server is listening.

Click to visit, right-click to copy.

Diagnostics interfaces on agent servers:
http://compass:8090/AppManager/
http://server1:8090/AppManager/
http://server2:8090/AppManager/
http://server3:8090/AppManager/

Sanity check local Conductor web server:
http://172.28.82.161:8091/AppManager/

Agent Diagnostics dialog



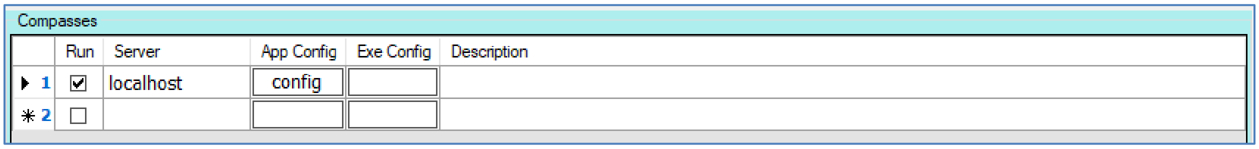
```
Conductor Scenario Summary
Generated: Tuesday, January 30, 2018 5:54:49 PM
-----------------------------------------------
Description:

   1 Agent System
   1 Compass
   8 Study Generators (8 10x512KB)
   2 Store Servers
   0 HL7 Senders
   0 HL7 Receivers

Run Status:
   Start Time: Tuesday, January 30, 2018 5:52:18 PM
   Run Time:   2 minutes
   Stop Time:  Saturday, February 3, 2018 9:51:18 PM
   Execution:  STOPPED
   Sampling:   10 seconds

Throughput:
   Total Images Sent:   450 (82,025 Images/hr)
   Total Images Rcvd:   740 (134,886 Images/hr)
   Percent Imgs Rcvd:   82.22%
   Scenario Duration:   0:00:19
   Scenario Complete:   100.00%
   Input Rate (actual): 40 GB/hr, 8,213 Studies/hr
   Multiplexing (calc): 2-way, ratio rcvd/sent: 1.64:1
   Output Rate (calc):  66 GB/hr, 13,505 Studies/hr

Compasses:
ProcName,DurationHH:MM:SS,MinMemoryMB,MaxMemoryMB,AvgMemoryMB,StdDevMemory
Compass on TOM [192.168.14.27] (21304),0:00:00,121.1,121.1,121.1,-8,796,093,022,208.0

Store Servers:
ProcName,ImagesCompleted,DurationHH:MM:SS
StoreServer 11115 on TOM [192.168.14.27] (23984),370,0:00:25
StoreServer 11116 on TOM [192.168.14.27] (19896),370,0:00:25

Study Generators:
ProcName,ImagesPerStudy,ImageSizeKb,ImagesSent,TotalKB,TotalStudies,DurationHH:MM:SS,Progress,InputRateGBHr
StudyGenerator 1 on TOM sending 100000 x 512 KB images to localhost:11112 (9860),10,512,61,31232,6.1,0:00:21,100,5.11
StudyGenerator 2 on TOM sending 100000 x 512 KB images to localhost:11112 (23952),10,512,52,26624,5.2,0:00:20,100,4.57
StudyGenerator 3 on TOM sending 100000 x 512 KB images to localhost:11112 (6200),10,512,60,30720,6,0:00:19,100,5.55
StudyGenerator 4 on TOM sending 100000 x 512 KB images to localhost:11112 (10336),10,512,51,26112,5.1,0:00:20,100,4.48
StudyGenerator 5 on TOM sending 100000 x 512 KB images to localhost:11112 (20724),10,512,61,31232,6.1,0:00:20,100,5.36
StudyGenerator 6 on TOM sending 100000 x 512 KB images to localhost:11112 (19572),10,512,53,27136,5.3,0:00:19,100,4.90
StudyGenerator 7 on TOM sending 100000 x 512 KB images to localhost:11112 (19016),10,512,61,31232,6.1,0:00:19,100,5.64
```

Example output in the Summary Quick View dialog. Similar summary information is displayed in the web-browser Report view.

Application Configuration Tabs

There are three tabs used for configuration **Compass**, **DICOM** and **HL7** applications.

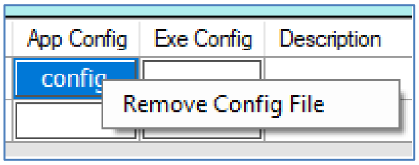
Available configuration options for **Compasses** are:



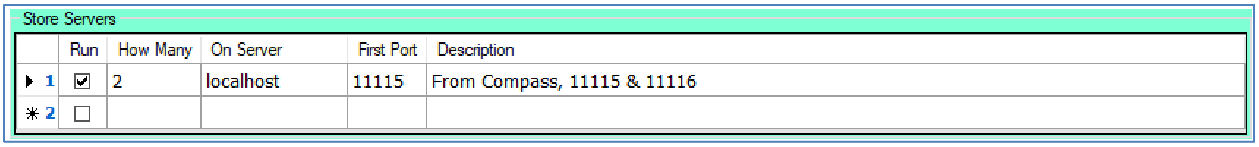
	Run	Server	App Config	Exe Config	Description
▶ 1	☑	localhost	config		
* 2	☐				

- **Run** - when checked, an application entry is “active” and will be included when the scenario is run.
- **Server** - the name or IP address of the server on which Compass is running.
- **App Config** - allows an optional Compass application configuration file to be copied to the correct location the **Server** so that Compass will use it. Use this option when you would like to try different configurations of Compass (e.g., comparing Store & Forward to Direct modes) without having to manually reconfigure Compass. Note that these Compass config files will need to be created manually using Compass and then saved to a file for use by Conductor.
- **Exe Config** - less commonly needed, this allows an optional Compass execution configuration file to be copied to the correct location the **Server** so that Compass will use it.
- **Description** - an optional comment or explanation added by the user for reference.

The **App Config** and **Exe Config** options can be cleared by right-clicking on either and selecting **Remove Config File**.



Available configuration options for **Store Servers** are:

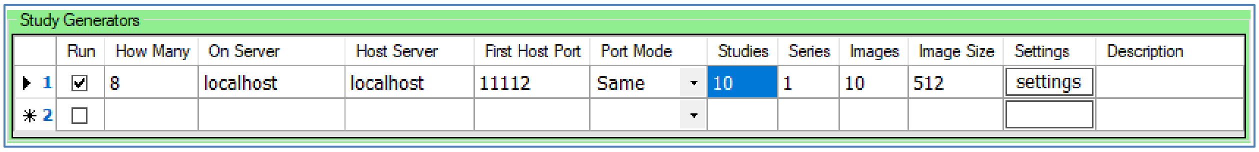


Store Servers

	Run	How Many	On Server	First Port	Description
▸ 1	☑	2	localhost	11115	From Compass, 11115 & 11116
✱ 2	☐				

- **Run** - when checked, an application entry is “active” and will be included when the scenario is run.
- **How Many** - enter how many of this application should be run in the current scenario.
- **On Server** - the name or IP address of the server on which the application should be run.
- **First Port** - indicates the port on which the first Store Server running on the specified server will listen on. If more than one Store Server is to be run, subsequent Store Servers will listen on subsequent ports. If the specific **First Port** is 11115 and four Store Servers are to be run, they will listen on ports 11115, 11116, 11117 and 11118, respectively.
- **Description** - an optional comment or explanation added by the user for reference.

Available configuration options for **Study Generators** are:



Study Generators

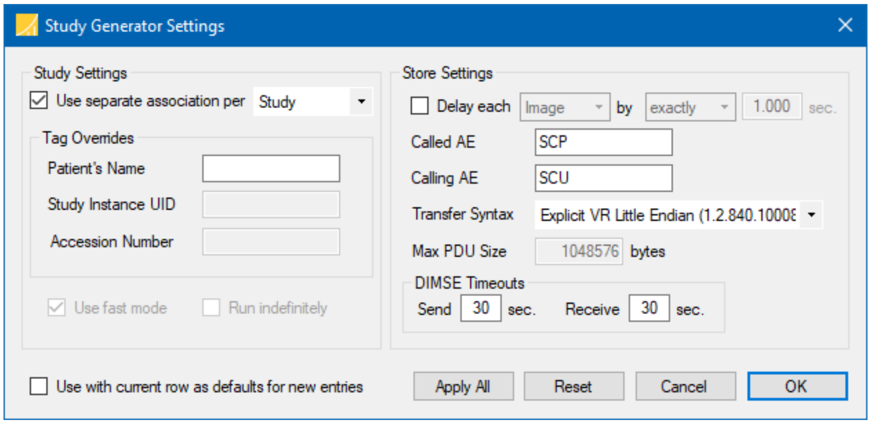
	Run	How Many	On Server	Host Server	First Host Port	Port Mode	Studies	Series	Images	Image Size	Settings	Description
▸ 1	☑	8	localhost	localhost	11112	Same ▾	10	1	10	512	settings	
✱ 2	☐					▾						

- **Run** - when checked, an application entry is “active” and will be included when the scenario is run.
- **How Many** - enter how many of this application should be run in the current scenario.
- **On Server** - the name or IP address of the server on which the application should be run.
- **Host Server** - the name or IP address of the server to which Study Generators should send the images they generate.
- **First Host Port** - indicates the port to which the first Study Generator running will send the images it generates. If more than one Study Generator is to be run, subsequent Study Generators will use the **Port Mode** option to either send images to the same port or to sequential ports.
- **Port Mode** - the port sequencing mode that determines port numbers used by Study Generators. If the **Port Mode** is **Same**, all Study Generators will send to the same port

indicated by **First Host Port**. If the **Port Mode** is **Sequential**, Study Generators will send to sequential port numbers on the **Host Server**, starting with the **First Host Port**.

- **Studies** - total number of studies to generate in the scenario.
- **Series** - number of series to generate for each study.
- **Images** - number of images to generate for each series.
- **Settings** - enables configurations using the **Study Generator Settings** dialog (below).
- **Description** - an optional comment or explanation added by the user for reference.

The **Study Generator Settings** dialog enables a number of additional options to be configured. While most settings are self explanatory, details on each are covered in the Study Generator section of the PowerTools user manual.



Study Generator Settings

Study Settings

☑ Use separate association per: Study

Tag Overrides

Patient's Name:

Study Instance UID:

Accession Number:

☑ Use fast mode □ Run indefinitely

Store Settings

□ Delay each Image by exactly 1.000 sec.

Called AE: SCP

Calling AE: SCU

Transfer Syntax: Explicit VR Little Endian (1.2.840.1000{

Max PDU Size: 1048576 bytes

DIMSE Timeouts

Send: 30 sec. Receive: 30 sec.

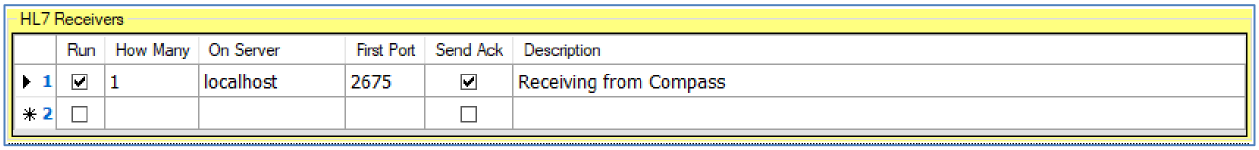
□ Use with current row as defaults for new entries

Of particular note are the following options on the **Study Generator Settings** dialog:

- **Use with current row as defaults for new entries** - sets the default values for creating new rows in the Study Generator configuration section with the current values on this dialog and on the row containing these settings (the row with the **Settings** button you just clicked).
- **Apply All** - applies the settings in this dialog to all other Study Generator entries in the scenario.
- **Reset** - resets the settings in this dialog to their defaults.
- **Cancel** - avoid applying these settings to the current Study Generator entry and returns to the main Conductor screen.
- **OK** - accepts these settings and applies them to the current Study Generator instance.

Some settings on the **Study Generator Settings** dialog are disabled. These grayed-out options are not currently configurable, though they will be in a future version of Conductor.

Available configuration options for **HL7 Receivers** are:

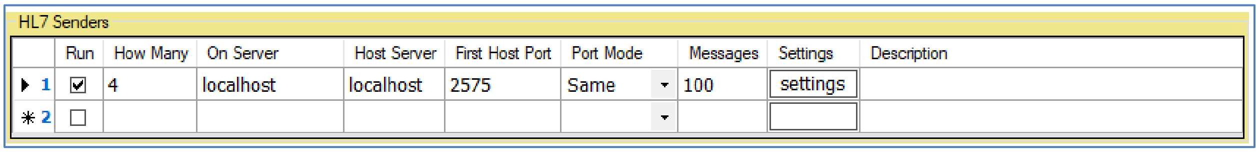


HL7 Receivers

	Run	How Many	On Server	First Port	Send Ack	Description
▶ 1	☑	1	localhost	2675	☑	Receiving from Compass
✱ 2	□				□	

- **Run** - when checked, an application entry is “active” and will be included when the scenario is run.
- **How Many** - enter how many of this application should be run in the current scenario.
- **On Server** - the name or IP address of the server on which the application should be run.
- **First Port** - indicates the port on which the first HL7 Receiver running on the specified server will listen on. If more than one HL7 Receiver is to be run, subsequent HL7 Receivers will listen on subsequent ports. If the specific **First Port** is 2675 and four HL7 Receivers are to be run, they will listen on ports 2675, 2676, 2677 and 2678, respectively.
- **Send Ack** - instructs the HL7 Receiver to send an ACK in response to a received message.
- **Description** - an optional comment or explanation added by the user for reference.

Available configuration options for **HL7 Senders** are:

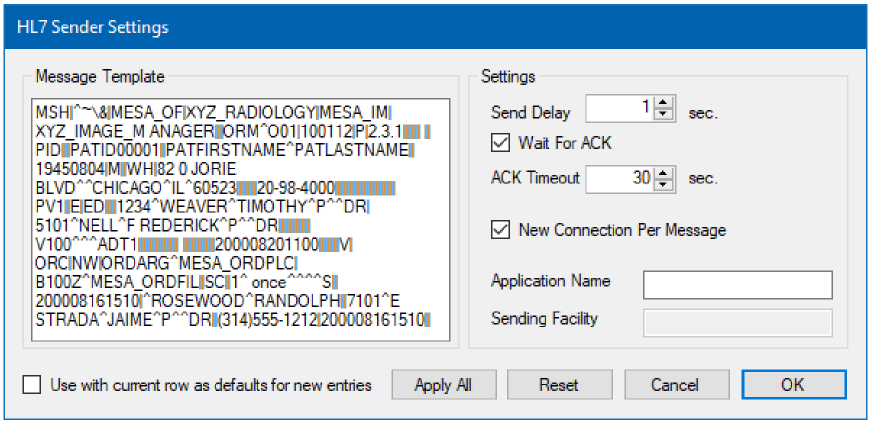


HL7 Senders

	Run	How Many	On Server	Host Server	First Host Port	Port Mode	Messages	Settings	Description
▸ 1	☑	4	localhost	localhost	2575	Same ▾	100	settings	
✱ 2	☐					▾			

- **Run** - when checked, an application entry is “active” and will be included when the scenario is run.
- **How Many** - enter how many of this application should be run in the current scenario.
- **On Server** - the name or IP address of the server on which the application should be run.
- **Host Server** - the name or IP address of the server to which HL7 Senders should send the messages they generate.
- **First Host Port** - indicates the port to which the first HL7 Sender running will send the messages it generates. If more than one HL7 Sender is to be run, subsequent HL7 Senders will use the **Port Mode** option to either send messages to the same port or to sequential ports.
- **Port Mode** - the port sequencing mode that determines port numbers used by HL7 Senders. If the **Port Mode** is **Same**, all HL7 Senders will send to the same port indicated by **First Host Port**. If the **Port Mode** is **Sequential**, HL7 Senders will send to sequential port numbers on the **Host Server**, starting with the **First Host Port**.
- **Messages** - total number of messages to generate in the scenario.
- **Settings** - enables configurations using the **HL7 Sender Settings** dialog (below).
- **Description** - an optional comment or explanation added by the user for reference.

The **HL7 Sender Settings** dialog enables a number of additional options to be configured. While most settings are self-explanatory, details on each are covered in the HL7 Sender section of the PowerTools user manual.



Message Template

```
MSH|^~\&|MESA_OF|XYZ_RADIOLOGY|MESA_IM|
XYZ_IMAGE_M ANAGER||ORM^O01|100112|P|2.3.1|||| ||
PID|||PATID00001||PATFIRSTNAME^PATLASTNAME||
19450804|M||WH|82 0 JORIE
BLVD^^CHICAGO^IL^60523||||20-98-4000||||||||||||
PV1||E|ED|||1234^WEAVER^TIMOTHY^P^^DR|
5101^NELL^F REDERICK^P^^DR||||||
V100^^^ADT1|||||||| ||||||200008201100|||||V|
ORC|NW|ORDARG^MESA_ORDPLC|
B100Z^MESA_ORDFIL||SC||1^ once^^^^S||
200008161510|^ROSEWOOD^RANDOLPH||7101^E
STRADA^JAIME^P^^DR||(314)555-1212|200008161510||
```

Settings

Send Delay 1 sec.

☑ Wait For ACK

ACK Timeout 30 sec.

☑ New Connection Per Message

Application Name

Sending Facility

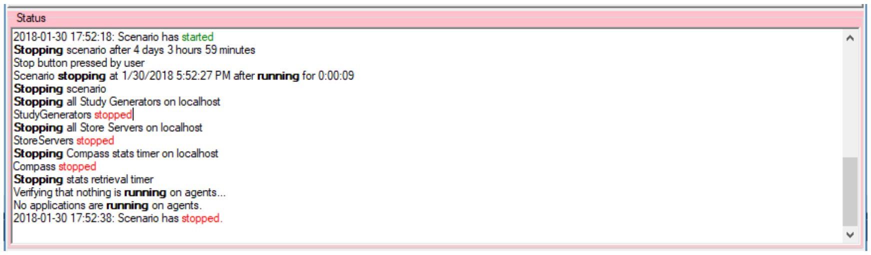
☐ Use with current row as defaults for new entries

Of particular note are the following options on the **HL7 Sender Settings** dialog:

- **Use with current row as defaults for new entries** - sets the default values for creating new rows in the HL7 Sender configuration section with the current values on this dialog and on the row containing these settings (the row with the **Settings** button you just clicked).
- **Apply All** - applies the settings in this dialog to all other HL7 Sender entries in the scenario.
- **Reset** - resets the settings in this dialog to their defaults.
- **Cancel** - avoid applying these settings to the current HL7 Sender entry and returns to the main Conductor screen.
- **OK** - accepts these settings and applies them to the current HL7 Sender instance.

Status Logging Window

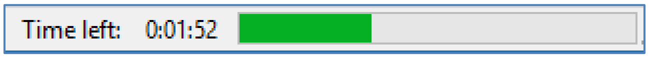
The status logging window at the bottom of the Conductor user interface displays ongoing status messages capturing important events occurring while a scenario is running. Certain key words are highlighted or displayed in bold for emphasis.



```
2018-01-30 17:52:18: Scenario has started
Stopping scenario after 4 days 3 hours 59 minutes
Stop button pressed by user
Scenario stopping at 1/30/2018 5:52:27 PM after running for 0:00:09
Stopping scenario
Stopping all Study Generators on localhost
StudyGenerators stopped
Stopping all Store Servers on localhost
StoreServers stopped
Stopping Compass stats timer on localhost
Compass stopped
Stopping stats retrieval timer
Verifying that nothing is running on agents...
No applications are running on agents.
2018-01-30 17:52:38: Scenario has stopped.
```

Status Bar

The status bar at the very bottom of the Conductor interface displays how much time is left in the current running scenario (based on the original Run for duration) and a progress bar that displays overall progress of all requested images being stored from any running Study Generator applications.



Time left: 0:01:52

Status bar with remaining time and progress bar.

9.4. Conductor Scenarios

9.4.1. What is a scenario?

A Conductor scenario is a collection of servers, applications and their configurations that can be automatically started and stopped and that generates runtime statistics about their behaviors that can be viewed and analyzed.

For example, a simple Conductor scenario to test Compass throughput could be:

- Conductor - running on its own server, controls starting, stopping and data collection from all other applications in the scenario. The scenario is configures to start a Compass, and then start a single Store Server and a single Study Generator, and run for, say, 10 minutes, gathering stats every 30 seconds.
- Compass - running on its own server, configured to run in Direct mode with a receiver and sender configured to pass images from a Study Generator to a Store Server.
- Store Server - running on its own server, the command line version of Store Server will listen on the port designated by the scenario configured in Conductor.
- Study Generator - running on its own server, Study Generator will send images to Compass which will then send those images immediately to the Store Server in the scenario.

After this scenario runs and completes, the gathered statistics can be viewed in a browser or analyzed from a CSV file. The information available includes:

- Number of images sent by Study Generator
- Number of images received by Store Server
- Calculated throughput from Study Generator to Store Server in GB/hr
- Performance over time of Compass memory use and database table entries
- Performance over time of CPU, Disk and Memory use for each of the servers running each application

9.4.2. Configuring a scenario

The following steps walk you through configuration of a basic scenario, similar to the one described above. Specific server names and port numbers will be used. Be sure to substitute names and port numbers that are relevant to your specific system.

1. Startup Conductor.
2. Create a **Compass** entry with server **win2012compass** (or you might need to use its IP address), adding a description if you like
3. Create a **Store Server** entry to run on **vtsink1** with a **First Port** of 7001 (or the port you noted or configured)
4. Create a **Study Generator** entry to run 4 Study Generators each on vtsource1and vtsource2 with a **Host Server** of win2012compass, **First Host Port** of 11112, using a **Port Mode** of **Same** and some sufficient number of images (e.g., 100 Studies, 1 Series/Study and 10 Images/Series).

5. Test for connectivity using **File > View Agent Status** to make sure all agents are reachable and running. Start any agent services that are not running.
6. Once all agents are running, click **Start**. Observe progress and click **Stop** as needed.
7. Refine the scenario to your liking, and when satisfied with it save it from the **File > Save Scenario** menu for future use and reference.

You now have a completed scenario that you can load, run and analyze.

9.4.3. Running a scenario from the user interface

The following describes the sequence of events that occur when you load and run a Conductor scenario. Specific events that involve applications in the scenario are only performed on those applications that are “active” (the **Run** checkbox is checked).

Starting

- Load a pre-existing scenario using **File > Load Scenario**
- Click **Start**
- A status message is logged with a timestamp, noting that the scenario is starting. When **Use Verbose Status Logging** is checked, additional status information will be logged.
- At any point during the startup steps, if a step fails, Conductor cancels the scenario and stops any applications that have already started.
- Conductor verifies that agents in the scenario are alive. For any agents that are not alive, if **Try to Start Agents with Scenario** is checked, it will attempt to start them on their remote servers, subject to permission restrictions.
- Databases and images directories for all Compasses in the scenario are cleared.
- HL7 Receivers in the scenario are started and their stats reporting timers are started. Conductor verifies that all HL7 Receivers are running before continuing.
- Any configured **App Config** or **Exe Config** files are copied to the appropriate servers, and these Compasses are restarted. Stats reporting timers on all agents for the Compasses in the scenario using the **Report every** period. Conductor verifies that all Compasses are running before continuing.
- Store Servers in the scenario are started and their stats reporting timers are started. Conductor verifies that all Store Servers are running before continuing.
- Study Generators in the scenario are started and their stats reporting timers are started. Conductor verifies that all Study Generators are running before continuing.
- HL7 Senders in the scenario are started and their stats reporting timers are started. Conductor verifies that all HL7 Senders are running before continuing.
- Conductor’s **Time Left** timer is started using the **Run for** duration and is displayed in the status bar.
- A status message is logged noting a timestamp for when the scenario started.

Running

Once the scenario has successfully running, the following events occur:

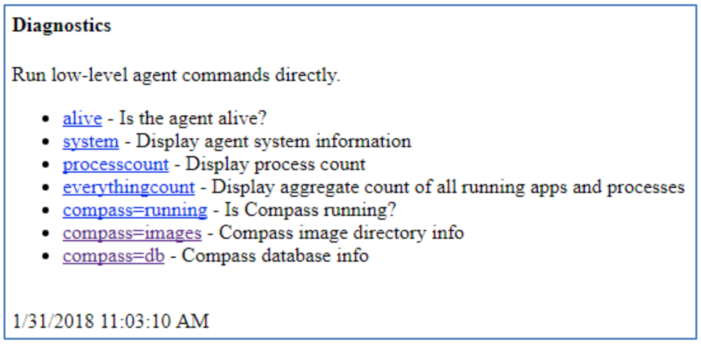
- The agent service on any Compass server in the scenario queries the system and Compass database directly, doing so every period of time indicated by the **Report every** value, to gather runtime information about CPU, Disk and Memory use, and about numbers of images on the Compass file system and numbers of entries in tables in the Compass database. The agent then sends this information to Conductor via Conductor's built in web server.

- The other applications each gather their own runtime statistics specific to their function on the same **Report every** period, and send the gathered information to its local agent via the agent's built in web server.
- For each Report every period that goes by, Conductor request all gathered information from each agent in the scenario. Each agent sends back its gathered information and clears its own copy of gathered information. Conductor appends this incoming information to its collection of runtime stats it is gathering.
- Conductor backs up all of its collected information every period indicated by the **Backup Stats to Log Every** value to the designated data backup directory. This is done primarily as an emergency copy of the gathered data, used in case Conductor crashes for an unexpected reason during a long-running scenario to minimize data loss.
- If the user selects the **View Summary** menu item, a summarized report of the gathered data is displayed in a text dialog to the user.
- If the user selects the **View Report in Browser** menu item, a more in-depth summary report with numerous graphs of gathered data is displayed in the default web browser on the system running Conductor. By noting the URL and system name, this same browser report can be viewed from another system, as long as the Conductor system is reachable from it, if desired.
- If the user selects the **View Stats Log** menu item, a browser-friendly view of all gathered data is displayed in a scrollable table.
- The links available from the **View Agent Diagnostics** menu item enable the user to directly view the web-based diagnostics interface (below) for each agent service and to verify that the Conductor web server is reachable.

Agent Diagnostics

On any system running the **Conductor Agent Service**, an **Agent Diagnostics** interface is available that can be used to troubleshoot unexpected scenario behavior. The following **Agent Diagnostics** interface can be viewed on a web browser on each system that has a running **Conductor Agent Service** by pointing the web browser to:

```
http://localhost:8090/AppManager/
```



Diagnostics

Run low-level agent commands directly.

- alive - Is the agent alive?
- system - Display agent system information
- processcount - Display process count
- everythingcount - Display aggregate count of all running apps and processes
- compass=running - Is Compass running?
- compass=images - Compass image directory info
- compass=db - Compass database info

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The diagnostics interface has the following options:

- **alive** - displays a status indicating whether or not the agent is “alive”
- **system** - displays information about the system on which the agent is running, including server name, IP address, OS version, available memory, disk and CPU resources, load on the server, as well as information about any application processes from the current scenario that are running on it.
- **processcount** - displays a number indicating how many application processes from the current scenario are running on it.
- **everythingcount** - displays an aggregate count of the number of applications and application processes from the current scenario are running on it.
- **compass=running** - displays the status of Compass for this agent, including whether or not Compass is installed and whether or not, if present, it is running.
- **compass=images** - displays information about the Compass image directory on this agent system, its path and how many files and directories are in it.
- **compass=db** - displays a textual table of row counts for all Compass database tables and the connection string used by the Conductor Agent Service to query the database.

Stopping

When a failure occurs during the startup sequence, when the **Run for** time limit expires, or when the **Stop** button is clicked, Conductor initiates the stopping sequence. The events in the stopping sequence are:

- A status message is logged indicating when and why the scenario is stopping.
- Study Generators are stopped.
- HL7 Senders are stopped.
- HL7 Receivers are stopped.
- Store Servers are stopped.
- Compasses are stopped (just the stats reporting timer is stopped).
- Conductor verifies with all agents that all applications really have stopped gracefully and sent back their final gathered stats. If any have not stopped, a **Nuke** message is sent out that directs any agents with still-running applications to forcefully terminate their lingering applications.
- A final status message is logged with a timestamp indicating that the scenario has stopped.

Exiting

When the user decides to exit Conductor, Conductor first checks to see if a scenario is running. If a scenario is running, a dialog queries the user about whether or not the scenario should be stopped. If the user realizes the scenario should not be stopped, it continues running as before. Otherwise, if the user requests that the scenario be stopped, Conductor initiates the stopping sequence described above.

When existing from a stopped scenario, if there are gathered runtime stats that have not yet been saved, a dialog queries the user about whether or not those stats should be saved. If the user decides to save the gathered stats, a Save File dialog is presented that enables the stats to be written to a CSV file, after which Conductor exits. Otherwise, if the user does not want to save the stats, Conductor simply exits.

9.4.4. Running a scenario from the command line

Conductor can be run from the command line in a very limited way. The steps needed to run Conductor from the command line are:

1. Create config files as needed for any custom Compass configurations you want to use when running the scenario.
2. Create a Conductor config file with the desired scenario configuration.
3. Place all config files in a directory on the same server as Conductor.
4. Determine an output directory, recommended as the same directory as the one where you just placed config files.
5. Use the following command line syntax (all on the same line) to run the scenario:

   ```
   C:\PowerToolsExePath\Conductor.exe
         -config C:\LoadTestConfigsPath\ConductorConfig.xml
         -runtest OutputDirPath
   ```

6. Generated output files will be written in the output directory specified by the **-runtest** argument. Output files consist of the textual and browser-friendly summary reports, textual and RTF version of the Conductor status window, and the final CSV file containing all gathered runtime stats.
7. Results can then be analyzed as desired. For example, subsequent automated runs can be used to compare throughput of Compass under differing conditions or configurations.
8. Two helpful scripts are included in the PowerTools distribution that provide a starting point for customizing your own analyses:
   - **RunConductorAutoTest.bat** - a batch script to automate running a Conductor scenario from the command line and initiating comparison of output results
   - **CompareConductorResults.ps1** - a PowerShell script for comparing output results

9.5. Conductor Troubleshooting

The following are descriptions of some of the potential problems that have been seen when using Conductor and some troubleshooting things to try to resolve them.

Description	Things to Try
Conductor Controller won't start	• Verify that there is a PowerTools license installed • Verify that the license includes a **conductor** feature key
An application won't start on one of the agents	• Verify that the agent's server is running • Verify that the agent service on the server is running • Verify that all agents in the scenario are reachable: **View > Agent Status** • View the agent's diagnostic interface for more info: `http://localhost:8090/AppManager/`
General problems with an agent	• Configure the agent to log troubleshooting messages to the Event Viewer by creating a file called **`.TRACE`** in the PowerTools application directory, then restart the service: `net stop conductor` `net start conductor` • **Important**: when Event Viewer logging is no longer needed, be sure to delete the **`.TRACE`** file that you created, then restart the service
Conductor Agent Service cannot be started	• Check Event Viewer for application error messages for clues to the cause of the problem • Turn on **`.TRACE`** logging and try restarting the agent service, examining the Event Viewer log for helpful messages. Try online lookup of error messages for possible solutions. • If running on a virtual network, verify that a connection to the outside is available if there are network lookup errors in the log. Try re-enabling connectivity and retrying agent startup. • Restart the server where the agent is failing to start, then retry agent startup.
Conductor is not receiving data from an agent	• Verify that you included one or more applications to run on that server in the scenario • Verify that one or more applications are running on the server when the scenario is running • Verify that the agent is running on the server • Verify that the Conductor web server is alive, locally: `http://localhost:8091/AppManager/` • Verify that the Conductor web server is reachable from the agent server, using the Conductor server name or IP: `http://`***`conductorserver`***`:8091/AppManager/`

Description	Things to Try
PowerTools fails to install	• Stop **Conductor Agent Service** and retry installation: `net stop conductor` • Uninstall current version of PowerTools and retry installation • Repair currently installed version of PowerTools, then verify **Conductor Agent Service** is stopped, uninstall current version of PowerTools, and then retry installation of new version
An application on an agent does not exit	• Run **Tools > Nuke All** command • On the agent server, manually terminate the application
Agent Diagnostics	• On the agent server, open the interface in a web browser: `http://localhost:8091/AppManager/`
Conductor Web Server Reachability Test	• On the Conductor server, open the sanity check web page in a web browser: `http://localhost:8090/AppManager/`