

Trophy DICOM Patient Management System How to Print within Trophy DICOM

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Reference: 08XC003-D

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1 INTRODUCTION

This document is related to the usage of the Trophy DICOM application for printing purposes on DICOM compliant devices.

Trophy DICOM is a patient management system implementing a subset of the DICOM standard in order to achieve patient information and image data exchange with remote systems as detailed in its DICOM Conformance Statement (see [2]).

Trophy DICOM is actually a front-end application program providing the Trophy Imaging Software (namely Trophy Windows or DIS) with both patient management and DICOM capabilities.

1.1 Revision History

Revision	Date	Author	Description
1.0	2008-05-05	Xavier CARAYOL	Initial Version
2.0	2009-02-24	Xavier CARAYOL	Updated for Trophy DICOM version 6.1.0.0
2.1	2010-02-17	Xavier CARAYOL	Updated for Trophy DICOM version 6.2.0.0
2.2	2013-05-23	Marc LAURENTIN	Rebranding

1.2 Audience

This document is provided for advanced users of the Trophy DICOM application and for Trophy Customer Support representatives.

It is assumed that the reader of this document is familiar with the DICOM 3.0 standard and with the terminology and concepts used in the standard.

1.3 Applicable Software Version

This document is related to the version 6.2.0.0 and above of Trophy DICOM, unless otherwise explicitly stated.

This Trophy DICOM version is associated with the Trophy imaging application version 6.11.0.0 and above, and shall not be used in conjunction with any other earlier version. Therefore this Trophy DICOM version is compatible with the associated 3D imaging application.

1.4 Definitions, Terms and Abbreviations

The following definitions are used in this conformance statement:

Trophy Windows	The imaging application designed and developed by Trophy (also called Dental Imaging Software).
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The following symbols and abbreviations are used in this conformance statement:

AE	Application Entity
DPMS	Dental Patient Management System
FMS	Full Mouth Series
DIS	Dental Imaging Software (also known as Trophy Windows)
V&V	Verification & Validation

1.5 References

- [1]. ACR/NEMA Standards Publications, PS 3 - 2009 DICOM Standard

Copies of the DICOM 3.0 standard may be obtained by contacting:

National Electrical Manufacturers Association
1300 N. 17th Street
Rosslyn, Virginia 22209 USA
<http://medical.nema.org>

Current standard status may be checked also at:

<http://www.dclunie.com/dicom-status/status.html>

- [2]. Trophy DICOM Patient Management System – DICOM 3.0 Conformance Statement

Reference: "04XC001-I Trophy DICOM CS" document

- [3]. Trophy DICOM Patient Management System – Installation and Configuration Manual

Reference: "04XC002-H Trophy DICOM IM" document

- [4]. Trophy DICOM Patient Management System – DICOM Configuration Manual

Reference: "05XC002-E Trophy DICOM DC" document

- [5]. Trophy DICOM Patient Management System – User's Manual

Reference: "04XC004-G Trophy DICOM UM" document

2 PREREQUISITES

It is expected that Trophy DICOM application is properly installed and running on the target system before attempting to execute this procedure.

Refer to [3] for more information on installing Trophy DICOM.

It is also expected that the reader is familiar with Trophy DICOM configuration and usage. Many references to other Trophy DICOM documents are indeed made throughout this document.

Refer to [4] for more information on configuring Trophy DICOM from a DICOM standpoint.

Refer to [5] for more information on using Trophy DICOM.

It is also obviously expected that the Trophy DICOM application already contains patient images within its patient database.

3 STEPS FOR PRINTING IN TROPHY DICOM

Printing using Trophy DICOM application requires following a certain number of steps:

- 1) Configuring one or more DICOM printers.
- 2) Selecting one or more images.
- 3) Selecting a printer and configuring the print parameters.

These steps are detailed in the following paragraphs.

3.1 Configuring a DICOM printer

The first step before printing is obviously to configure at least one DICOM printer.

DICOM printing within Trophy DICOM application does not require installing a particular driver unlike printing under Windows OS.

DICOM printing within Trophy DICOM requires actually configuring a particular system server existing on the network as being a printer server, as specified by DICOM itself.

3.1.1 Creating a new DICOM printer

As explained in [4], creating a new DICOM printer is performed thru the DICOM Server List Screen as shown into the following picture:

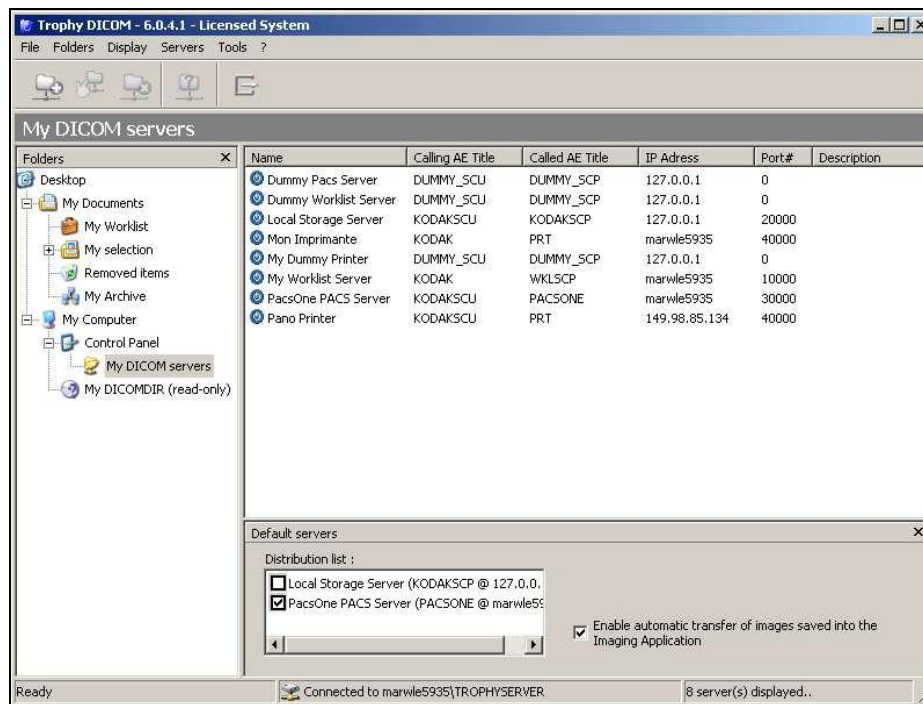


Figure 1: DICOM Server List Screen

In this screen, the user has to create a new DICOM server, but configure it as a printer server as explained into the following paragraphs.

3.1.1.1 Configuring DICOM specific parameters

When creating a new DICOM server for configuring in fact a DICOM printer within Trophy DICOM application, the Server Properties window is used:

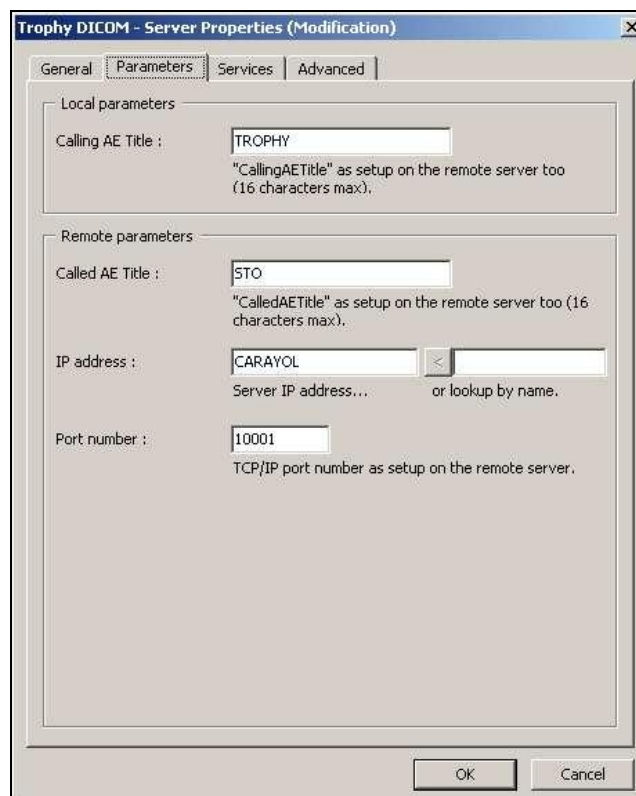


Figure 2: DICOM Server Property Window - Parameters Tab

The DICOM Server Property Window parameters tab allows the user for specifying the DICOM specific parameters of the remote system:

Table 1: DICOM Server Property Window - Parameters Tab Description

Parameter	Description
Calling AE Title	<p>This field is used in a DICOM connection to precisely identify the calling or client system, i.e. in our case the Trophy DICOM application.</p> <p>This field may be used on the server side as a criterion for accepting or rejecting connection request from a client application.</p> <p>Therefore, this value shall be exactly the same as the value configured on the server application, if any.</p>
Called AE Title	<p>This field is used in a DICOM connection to precisely identify the remote server application.</p> <p>This field may be used on the server side as a criterion for accepting or rejecting connection request from a client application.</p> <p>Therefore, this value shall be exactly the same as the value configured on the server application, if any.</p>
IP address	<p>This field is used to specify the network IP address of the remote system hosting the server application.</p> <p>When a DNS server is setup on the network, i.e. when the remote system IP address is not necessary fixed, a DNS name may be entered.</p>
Or lookup by name	<p>This field may be used to help specifying the network IP address of the remote system hosting the server application, but only when its IP address is fixed.</p>
Port number	<p>This field is used to specify on which TCP/IP port the remote server application is listening for incoming connection requests.</p>

As shown in the table above, configuring this part of a DICOM server within Trophy DICOM requires knowledge of information specific to both the remote system and the remote server application. This may require having on site a Customer Support representative of the server (i.e. the printer) manufacturer, since some of these parameters have to be configured also within the remote application.

3.1.1.2 Setting up the DICOM server as a DICOM printer

The second step of creating a DICOM printer within Trophy DICOM application thru its Server Properties window is to configure this DICOM server as a printer:

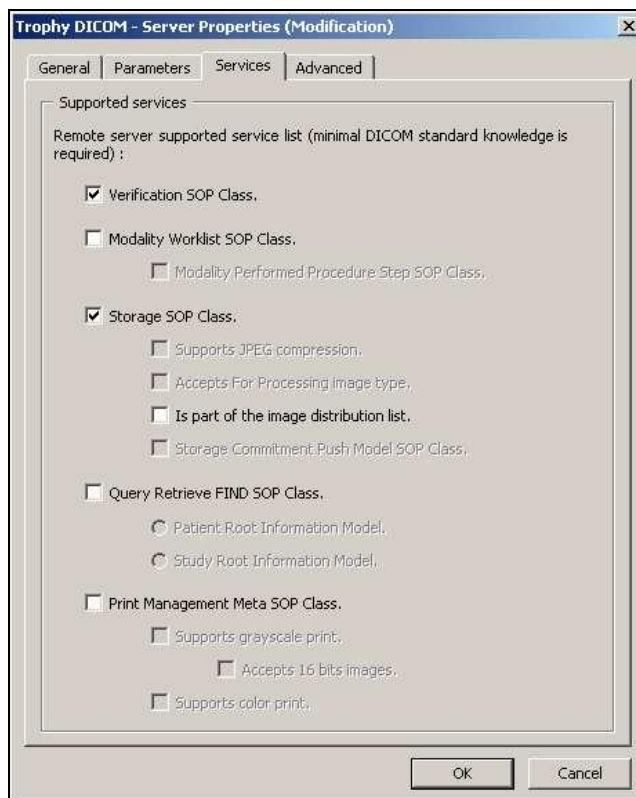


Figure 3: DICOM Server Property Window - Services Tab

The DICOM Server Property Window services tab allows the user for specifying the DICOM services (i.e. functionalities) supported by the remote system.

Note: In the scope of this document, only the printing related parameters are described into the following. Refer to [4] for more information regarding the other parameters.

Table 2: DICOM Server Property Window - Services Tab Description

Parameter	Description
Verification SOP Class	<p>This field is used to specify that the remote application support the DICOM Verification service.</p> <p>Note: support for this service is anyway mostly required by DICOM.</p> <p>The Verification service allows an application to easily check if the connection to another server application is working, i.e. properly configured from a DICOM specific standpoint (refer to 3.1.1.1 above).</p> <p>The Verification service acts as a logical "ping" solution for checking the connection to the remote application.</p>
Print Management Meta SOP Class	<p>This field is used to specify that the remote application support the DICOM Print service, i.e. is a DICOM printer for the Trophy DICOM application.</p>
Support grayscale print	<p>This field is used to specify that the remote application support the printing of grayscale images.</p>
Accepts 16 bits images	<p>This field is used to specify that the remote application support the printing of 16 bits grayscale (only) images.</p>

	Note: this parameter is not really used into the current version of the Trophy DICOM application, since only 8 bits depth images are sent.
Support color print	This field is used to specify that the remote application support the printing of color images. Note: most of the DICOM print devices are grayscale only.

The following acceptable values may be used for printing either Intra-Oral or Panoramic or Cephalometric images:

Table 3: DICOM Server Property Window - Services Tab Acceptable Values

Parameter	Value
Verification SOP Class	Checked
Modality Worklist SOP Class	Not applicable: unchecked
Storage SOP Class	Not applicable: unchecked
Query Retrieve FIND SOP Class	Not applicable: unchecked
Print Management Meta SOP Class	Checked
Support grayscale print	Checked
Accepts 16 bits images	Unchecked
Support color print	Unchecked

3.1.1.3 Importing best default print parameter values for Carestream printers

When the "Print Management Meta SOP Class" checkbox is selected, the following Dicom Printer configuration option is activated within the Server Properties window "Advanced" tab:

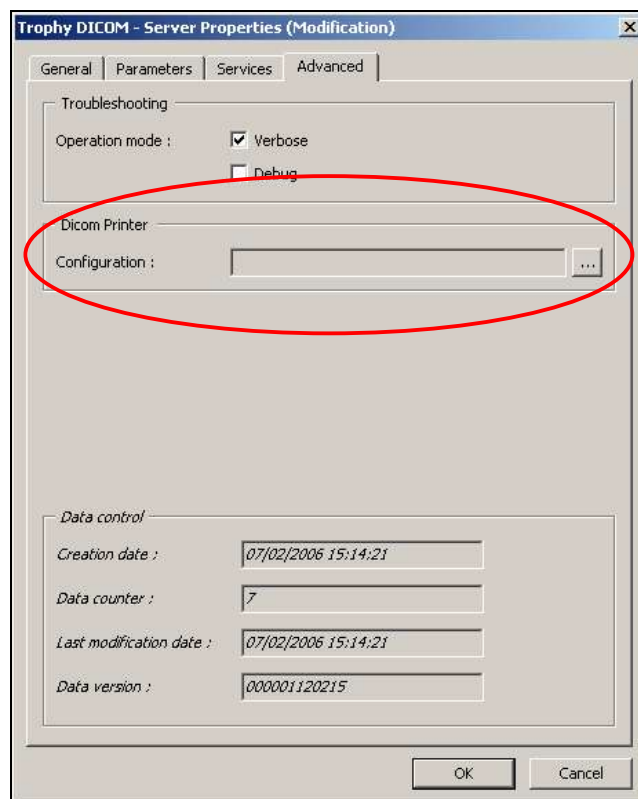


Figure 4: DICOM Server Property Window - Advanced Tab

This option is used to default certain printing parameters to best match some of the Carestream printers' capabilities. This option allows the user to select what is called a printer template for the following printers:

Table 4: Trophy DICOM default Printer Templates

File	Carestream Printer
CMI 1000.xml	Default template for the CMI 1000 printer.
DryView 5800.xml	Default template for the DryView 5800 printer.
DryView 5850.xml	Default template for the DryView 5850 printer.
DryView 6800.xml	Default template for the DryView 6800 printer.
DryView 8100.xml	Default template for the DryView 8100 printer.
DryView 8150.xml	Default template for the DryView 8150 printer.
DryView 8200.xml	Default template for the DryView 8200 printer.
DryView 8300.xml	Default template for the DryView 8300 printer.
DryView 8500.xml	Default template for the DryView 8500 printer.
DryView 8610.xml	Default template for the DryView 8610 printer.
DryView 8700.xml	Default template for the DryView 8700 printer.
DryView 8900.xml	Default template for the DryView 8900 printer.
HQ 969.xml	Default template for the HQ 969 printer.
KELI 160.xml	Default template for the KELI 160 printer.
KELP 1120.xml	Default template for the KELP 1120 printer.
KELP 2180.xml	Default template for the KELP 2180 printer.
MLP 190.xml	Default template for the MLP 190 printer.

Those templates contain default values for some of the attributes provided by the client application when printing images, that best match the printer capabilities and therefore ensure the best print quality.

Such parameters are specific to DICOM printing and may be overwriting when printing images later from within the Trophy DICOM print dialog window (refer to 3.2.2 below).

Best values (from a print quality result standpoint) for such parameters are actually depending on the printer capabilities and characteristics, and usually adjusted by experience, as results of validation and verification processes. Refer to **Erreur ! Source du renvoi introuvable.** for possible parameter values for Carestream printers.

A Printer Template file is an XML file with specific items as described in the following figure (refer to [5] for more information about item definitions).

```

<?xml version="1.0" encoding="utf-8" standalone="yes" ?>
- <DicomPrinter Name="Print Server">
  <CollationFlag>false</CollationFlag>
  <NumberOfCopies>3</NumberOfCopies>
  <PrintPriority>LOW</PrintPriority>
  <MediumType>PAPER</MediumType>
  <FilmDestination>BIN_10</FilmDestination>
  <FilmSessionLabel>TROPHY</FilmSessionLabel>
  <ImageDisplayFormat>STANDARD</ImageDisplayFormat>
  <NbRows>1</NbRows>
  <NbColumns>1</NbColumns>
  <FilmOrientation>PORTRAIT</FilmOrientation>
  <FilmSizeID>A3</FilmSizeID>
  <MagnificationType>NONE</MagnificationType>
  <SmoothingType>SMOOTH_1</SmoothingType>
  <BorderDensity>WHITE</BorderDensity>
  <EmptyImageDensity>WHITE</EmptyImageDensity>
  <Trim>-1</Trim>
  <MinDensity>-1</MinDensity>
  <MaxDensity>-1</MaxDensity>
  <ConfigurationInfo>CONFIG_1</ConfigurationInfo>
  <TrueSize>true</TrueSize>
  <MagnificationFactor>2</MagnificationFactor>
  <PrintText>true</PrintText>
  <TextFont>Arial|21,75|Regular|Bold</TextFont>
  <BurnText>true</BurnText>
  <TextAlignment>1</TextAlignment>
</DicomPrinter>

```

Figure 5: Trophy DICOM Printer Template

3.1.2 Creating different logical DICOM Printers

As we can see, some of the print parameters listed in the previous paragraph are not necessarily adequate when printing different types of images (like Intra-Oral versus Panoramic versus Cephalometric images).

Trophy DICOM provides then the user with the ability to specify as much as necessary "logical" printer tied to the same physical DICOM printer. In other words, when necessary, the user can create as much as she wants different DICOM servers within Trophy DICOM addressing actually the same physical remote device, but with different print parameter values.

The following paragraph explains how to modify such default print specific parameters.

Note: As explained below, all print parameter changes made when printing images using Trophy DICOM are saved within the Trophy DICOM database along with the selected logical DICOM printer, and automatically applied the next time the printer is used again.

Note: Trophy DICOM automatically remembers the last printer used, when more than one printer is configured, the next time the user wants to print images.

3.2 Printing Images

Printing images in Trophy DICOM requires the user special care and good knowledge of medical printing in order to prevent unexpected results.

First of all, depending on the desired output type, the user shall be careful when selecting images for printing (e.g. printing two Cephalometric images onto an A4 film sheet will certainly not provide a diagnostic quality result). In other words, everything is not necessarily feasible or even (medically speaking) reasonable.

3.2.1 Selecting patient images

The first step when printing is obviously the image selection.

Image selection is performed thru the Patient Data List screen of the Trophy DICOM application. This feature has a major impact on the print process itself:

- Only images belonging to the same patient can be printed on the same set of film sheets.

This limitation is due to the Trophy Windows or DIS application itself, which can work only on a given directory and assumes that all images within that directory belong to the same patient.

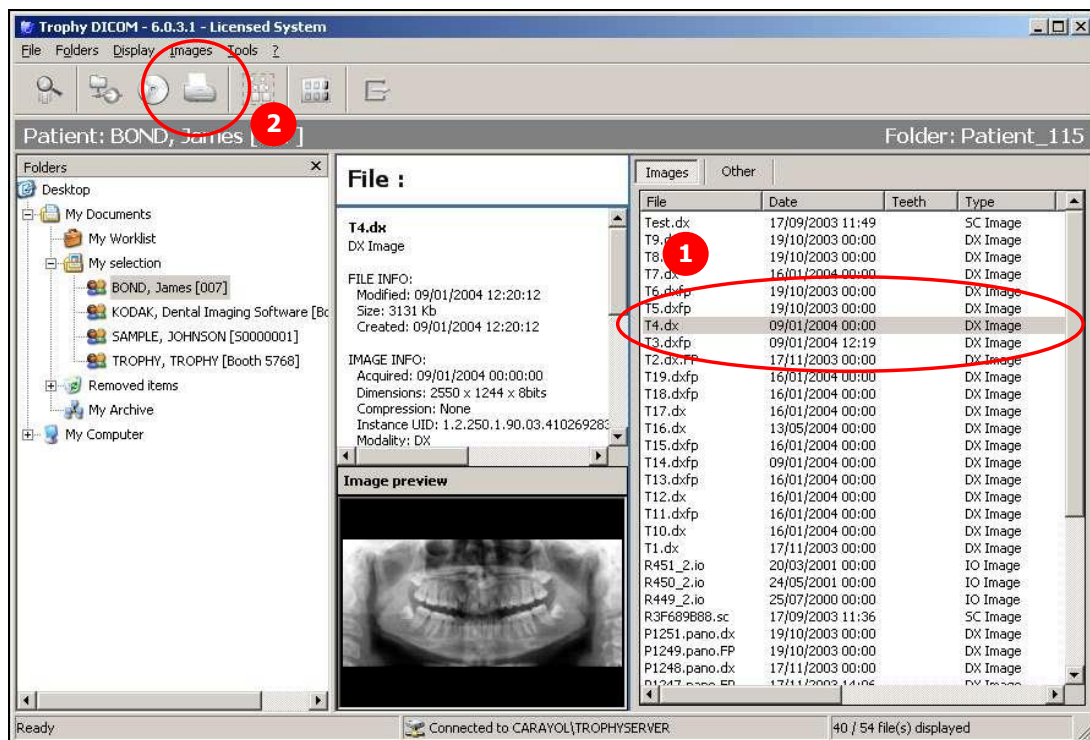


Figure 6: Patient Image Selection

Note: It is possible to select more than one image by maintaining the CTRL key pressed while selecting list entries with a left mouse click.

Note: As explained below, order of selected images on the film sheet can be modified from within the print dialog window.

3.2.2 Modifying default print parameters

Default print parameters, as initialized during associated DICOM print server configuration (if any), can be overridden directly from within the print dialog window of the Trophy DICOM application. This window provides also the user with, not only the ability to specify layout information but also to modified default print parameters or specify true size requirements or reorganize the order of images on the film sheet, as shown in the following figure:

Note: Refer to [5] for more information on this topic.

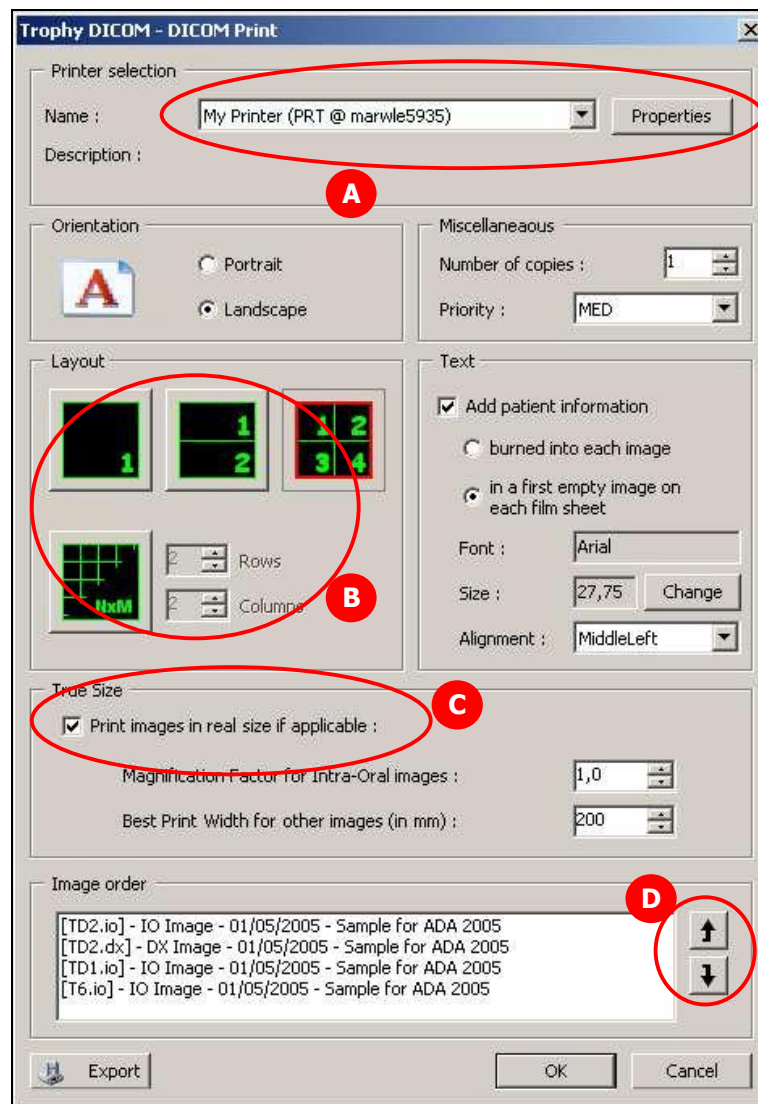


Figure 7: Print Dialog Window

Note: As stated above, any modifications performed in this dialog window are saved within the Trophy DICOM database and re-used per default for the next print session.

3.2.2.1 Selecting a "logical" printer (A mark)

This provides the user with the ability to select a "logical" printer from the configured printer list and to modified the default properties, i.e. print parameters as shown in the following picture:

Note: The default values for those print parameters may be pre-configured thru printer templates as explained in section 3.1.1.3 above.

Trophy DICOM - Printer properties

Film selection

Media: BLUE FILM

Destination: PROCESSOR

Size: 14INX17IN

Zooming

Zooming type: CUBIC

Smoothing type: 11

Miscellaneous

Add a frame: ☐ Yes / No

Border density: BLACK

Empty image density: BLACK

Configuration Information: LUT=Pmsv3k.w87,9

Min Density (Dmin): -1 (Use '-1' for printer default)

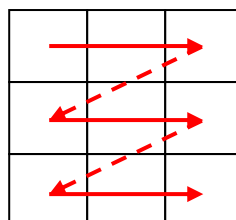
Max Density (Dmax): 300

OK Cancel

Note: As stated above, any modifications performed in this dialog window are saved within the Trophy DICOM database and re-used per default for the next print session.

3.2.2.2 Arranging page layout (B mark)

When printing more than one image on the same film sheet (layout different from 1x1), the images, whose order may be specified at the bottom of this dialog window (D), should be printed the following way on the resulting film sheet:



But the final result may be printer dependent.

3.2.2.3 Printing in True Size mode (C mark)

Printing in True Size mode is a powerful but often misinterpreted notion in DICOM. True Size mode refers actually to the ability, in the DICOM standard, to specify (when printing one image within one image box of the selected page layout) the expected final result width on the film sheet. In other words, only one desired width information expressed in mm is actually really sent to the printer (if required), along with the bytes representing the pixel data (and not the whole original image).

Note: The printer based on the number of rows/columns of the given image, assuming that the pixels are square, calculates the "vertical" final height value.

This means that any True Size calculation has to be performed, first, on the client application side based on the selected images, before printing.

Unfortunately, at the date of this document, the only image type for which automatic calculation can be performed by the Trophy DICOM application is for Intra-Oral images, using the Imager Pixel Spacing DICOM attribute of the image, which provides in fact only an estimated value of the real pixel sizes.

For the other image types used in dentistry (either Panoramic or Cephalometric) the only way to get a desired size when printing is to manually specify the resulting width of the image on the film sheet, by defining the "Best Print Width for other images (in mm)" parameter.

Note: The value for this parameter will be then send to the printer for all non Intra-Oral images that have to be printed on the same film sheet. Caution shall be taken then when different image types must be printed on the same film sheet (i.e. when missing Panoramic and Cephalometric images for example).

Due to either the mechanical components of the equipment (for Cephalometric images) or the habits inherited from the "analogic age" (for Panoramic images) the following Best Print Width values may be used for Carestream Dental equipments:

Equipment	Best Print Width value	
K8000 (Panoramic)	247 mm	
K8000-C (Cephalometric)	172 mm	
K9000 (Panoramic)	247 mm	
K9000-C (Cephalometric)	18 x 18 Collimator	169 mm
	18 x 24 Collimator	169 mm
	24 x 24 Collimator	218 mm
	24 x 30 Collimator	220 mm
	30 x 30 Collimator	257 mm



CAUTION: Usage of such values is conditioned by the selected film size and the expected result.

Note: Even if pixel calibration is possible for Cephalometric images, pixel size information has been only just recently added to the DICOM standard for such type of images, and is not supported yet by Trophy DICOM and Trophy Windows or DIS applications.

Note: True Size printing requirement for Panoramic images is often a mistake made by user. Due to the acquisition principle of such image types itself, pixel size, related to the patient (i.e. expressed into a patient related coordinate system), is not constant within the whole image (in both dimensions). Therefore, True Size notion for Panoramic images is meaningless.

Note: Refer to Annex A, for more information for the K9000-C values.

3.2.2.4 Ordering images on film sheet (D mark)

By selecting an entry in the Image Order list of the print dialog window, the user has the ability to modify the associated printed image order on the resulting film sheet by clicking on one of the arrows on the right of the list.

4 CURRENT LIMITATIONS

Trophy DICOM, as stated above, has been designed to act as a front-end application for the Trophy Windows or DIS application. In that sense Trophy DICOM is not creator of any image, but just a repository holder and a DICOM communicating layer for the associated imaging software, like any other DPMS would be. Also due to the DICOM standard itself and because of this requirement to keep the imaging software as a separate process, many limitations exist while printing images onto a DICOM printer.

4.1 Limitations due to DICOM standard

DICOM does not specify an easy and up-to-date mechanism for printing a set of images together onto the same film sheet.

DICOM does not specify an easy and simple way for adding annotations or drawings during printing. The current specifications of the standard are quite limited or at least not supported (or "differently" implemented) by most printer manufacturers.

Because of that, some dental specific printing requirements, like FMS printing, are not really supported today by the DICOM standard.

Also, dentistry is quite new in the DICOM world. DICOM objects (image specifications) used by the dentistry are still evolving, and every version of the standard adds, fixes, or details their attributes and characteristics. Therefore, Trophy DICOM along with the associated imaging software does not support necessarily all the last evolutions of the standard. This is particularly true when printing in True Size mode, where information regarding pixel size, for both Panoramic and Cephalometric images, were missing originally from the standard.

4.2 Limitations due to printer manufacturers

Conformance to DICOM standard does not mean conformance to all DICOM specifications. Manufacturers have actually to detail in their DICOM Conformance Statement what parts are supported by their application and how. Nevertheless, they are required to list all limitations their products have and any particular implementation/interpretation they have made within their products.

Unfortunately this usually opens the door for, at best poor, at worst wrong interpretation of the standard, resulting in some really frustrating situations for the user, and impossibility to achieve the expected result or even to communicate to the printer!

*Note: In order to limit such situations, Carestream has always setup some V&V processes for any product willing to communicate to its printers. Trophy DICOM has successfully performed such processes. Refer to **Erreur ! Source du renvoi introuvable.** for more information on this topic.*

Examples of limitations due to printer manufactures:

- 1) Wrong interpretation of the DICOM standard, preventing a client application from communicating with the printer.
- 2) Poor True-Size support when expected result reaches the limits of the film size.
- 3) Different interpretation of the DICOM standard specifications related to printed annotations, preventing a client application from implementing a single and simple solution.

4.3 Limitations due to Trophy Windows or DIS application

As stated above, Trophy DICOM totally relies on the associated imaging software for image creation: in other words, Trophy DICOM cannot print what does not already exist.

Also, as stated above, the FMS need of the dentistry is not covered by the DICOM standard. Currently, the associated imaging software does not provide the Trophy DICOM application with a

simple way for extracting a printable bitmap from a FMS. Consequently, FMS printing is not supported by the current implementation.





*Note: A "trick" has been specified, if FMS printing is really necessary. But this procedure is far from being simple and immediate. Refer to **Erreur ! Source du renvoi introuvable.** for more information.*


Also, as stated above, Trophy Windows or DIS application totally relies on the calling application (or DPMS) for managing patient image files, and assumes that all images found within the given current directory are belonging to the same patient. This mechanism and limitation prevents Trophy DICOM from being able to print images from different patient on the same film sheet.

Note: Medically speaking, printing images from different patients on the same film sheet may be quite "dangerous" and may open the door to misinterpretation or wrong diagnostics.

5 ANNEX A: BEST PRINT WIDTH (BPW) FOR K9000-C

The following table details the BPW calculation for the K9000-C, based on the selected collimation, and the expected result:

Collimator 18 x 18	
	(0020,4000) Image Comments [Collimator 18 x 18] (0028,0010) Rows [1511] (0028,0011) Columns [1331] (0028,0030) Pixel Spacing [0.127000\0.127000]
	<div>BPW = 1331 x 0.127 = 169.037 mm</div> <div>169 mm</div>
Collimator 18 x 24	
	(0020,4000) Image Comments [Collimator 18 x 24] (0028,0010) Rows [1847] (0028,0011) Columns [1331] (0028,0030) Pixel Spacing [0.127000\0.127000]
	<div>BPW = 1331 x 0.127 = 169.037 mm</div> <div>169 mm</div>
Collimator 24 x 24	
	(0020,4000) Image Comments [Collimator 24 x 24] (0028,0010) Rows [1847] (0028,0011) Columns [1716] (0028,0030) Pixel Spacing [0.127000\0.127000]
	<div>BPW = 1716 x 0.127 = 217.932 mm</div> <div>218 mm</div>
Collimator 24 x 30	
	(0020,4000) Image Comments [Collimator 24 x 30] (0028,0010) Rows [2012] (0028,0011) Columns [1735] (0028,0030) Pixel Spacing [0.127000\0.127000]
	<div>BPW = 1735 x 0.127 = 220.345 mm</div> <div>220 mm</div>

Collimator 30 x 30			
	(0020,4000) Image Comments [Collimator 30 x 30]		
	(0028,0010) Rows [2012]		
	(0028,0011) Columns [2020]		
	(0028,0030) Pixel Spacing [0.127000\0.127000]		
<table border="1"><tr><td>BPW = 2020 x 0.127 = 256.540 mm</td><td>257 mm</td></tr></table>		BPW = 2020 x 0.127 = 256.540 mm	257 mm
BPW = 2020 x 0.127 = 256.540 mm	257 mm		