

Trophy DICOM Patient Management System Pre-Installation Analysis

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1 INTRODUCTION

This document provides the user with some guidelines to help preparing Trophy DICOM application installation, in order to ensure real interoperability with other DICOM compliant equipments.

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.

This Trophy DICOM version also provides a new background process named CSDServices for dealing with all dataset transfers in an asynchronous manner: this is particularly useful for large dataset, like 3D volume, transfers. This Trophy DICOM version is associated with CSDServices version 1.1.2.0 and above, unless otherwise stated (refer to [8] for more information about CSDServices).

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).
CSDServices	A background process providing Trophy DICOM with asynchronous transfer capabilities.

The following symbols and abbreviations are used in this conformance statement:

AE	Application Entity
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DPMS	Dental Patient Management System
DX	Digital X-Ray
FMS	Full Mouth Series
HIS	Hospital Information System
IO	Intra-Oral
DIS	Dental Imaging Software (also known as Trophy Windows)
LUT	Look Up Table
PACS	Picture Archiving and Communication System
Q/R	Query and Retrieve
RIS	Radiology Information System
SC	Secondary Capture
SCP	Service Class Provider (i.e. server in a client-server relationship)
SCU	Service Class User (i.e. client in a client-server relationship)
SOP	Service Object Pair
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
- [6]. Trophy DICOM Patient Management System – DICOM Connectivity Troubleshooting Guide
Reference: "08XC004-D Trophy DICOM TG" document
- [7]. Trophy DICOM Patient Management System – How to print within Trophy DICOM
Reference: "08XC003-D Trophy DICOM HT-Print" document
- [8]. CSDServices – User's Manual
Reference: "09XC003-C CSDServices UM" document

2 BEFORE INSTALLATION

Pre analysis before installation (or even during tender review) is very important when talking about DICOM: this is the only way to ensure (or at least reduce the risks) the correct interoperability of new equipment and its proper integration within an existing networked environment, i.e. a already established workflow. At this stage, this can only be performed by closely reading the DICOM Conformance Statement of the different equipments that the new equipment will have to connect to, or by checking if V&V procedures have been already successfully performed between those equipments.

But this is not the only step to perform. As explained later in this document, ensuring that all involved persons will be available during the installation is a must (especially connected equipment customer support representatives, or network administrators).

2.1 Understanding DICOM Conformance Statements

Reading and analyzing the DICOM Conformance Statement of all equipments that the Trophy DICOM application will have to connect to, is a preliminary and essential process that cannot be skipped. Even if this process does not guaranty a fully functional installation of the Trophy DICOM application, it may help in highlighting major non-connectivity or operational issues.

Normally, a DICOM Conformance Statement is a formal statement associated with a specific implementation of the DICOM Standard. It specifies the Service Classes (i.e. functionalities), Information Objects (i.e. data types) and Communications Protocols (i.e. network configuration) supported by the implementation. Refer to [1] Part 2 for further information about Conformance Statements.

Even if the DICOM Standard is supposed to ensure interoperability between different manufacturer equipments, unfortunately, it still contains too much optional requirements or user defined options that may end by preventing a connection from properly functioning.

Also, due to the fact that the DICOM Standard is continuously evolving, all equipment manufacturers do not necessarily implement all its features and specifications yet, or even do make misinterpretation or bad interpretation of the Standard (sometimes resulting in strong standard violations).

Thus expecting a DICOM connection to work without preliminary controls can be seen, at minimum as an excess of confidence, at worst as a total ignorance of the reality...

Therefore, nothing can replace (obviously) experiences and V&V procedures, to ensure good DICOM connectivity.

2.1.1 What to check in a DICOM Conformance Statement

Two main things have to be verified when analyzing a DICOM Conformance Statement:

- 1) The list of Services Classes (i.e. DICOM functionalities) supported by the equipment (for example, it is expected that a DICOM printer implements the Print Service Class...).
- 2) The type of Information Object (or SOP Class, i.e. the data types) supported by the equipment (especially true when connecting to a PACS system). This also includes compression support.

Note: DICOM Standard requires any implementations to support uncompressed data exchanges. At the date of this document, all images created by the Trophy Windows or DIS application are uncompressed.

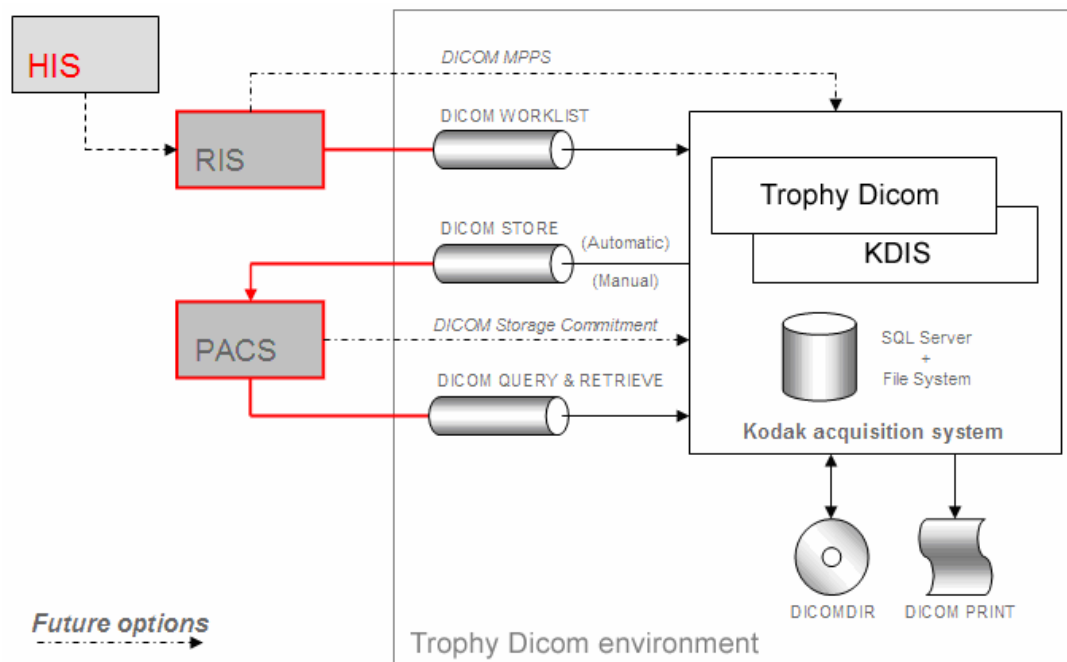
2.1.2 Crosschecking compatibility with the Trophy DICOM Conformance Statement

Any other information found within a Conformance Statement may be obviously interesting too, but the preliminary goal of this document is to ensure compatibility of the Trophy DICOM application.

The Trophy DICOM application states in its DICOM Conformance Statement (refer to [2]) the support of the following network Services and SOP Classes, either as an SCU or an SCP:

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
CR Image Storage	Yes	Yes
DX Image Storage – For presentation	Yes	Yes
IO Image Storage – For presentation	Yes	Yes
SC Image Storage	Yes	Yes
VL Endoscopic Image Storage	Yes	Yes
VL Photographic Image Storage	Yes	Yes
CT Image Storage	Yes	Yes
Other types of Image Storage	Yes	Yes
Query/Retrieve		
Patient Root Q/R Information Model – FIND	Yes	No
Patient Root Q/R Information Model – MOVE	Yes	No
Study Root Q/R Information Model – FIND	Yes	No
Study Root Q/R Information Model – MOVE	Yes	No
Workflow Management		
Modality Worklist Information Model – FIND	Yes	No
Print Management		
Basic Grayscale Print Management Meta	Yes	No
Basic Color Print Management Meta	Yes	No

In the table above, Transfer, Query/Retrieve, Workflow Management and Print Management represent the services that the Trophy DICOM application supports either as a client (SCU) or as a server (SCP) as presented into the following picture:



2.1.2.1 Transfer Service Class

As shown in the Transfer Service section, the Trophy DICOM application can send and receive different types of images as described in the following table:

SOP Class	Description
CR Image Storage	Any Computed Radiography images.
DX Image Storage – For presentation	<p>In dentistry, any Panoramic or Cephalometric images, like K8000 or K8000-C.</p> <p>In DICOM both are indeed sharing the same object definition. The main difference being the Modality (0008,0060) attribute, which shall be PX for Panoramic images and DX for the others.</p> <p>For presentation is related to the fact that such images are ready for display. No filter or other manipulations are required before displaying them.</p> <p>Note: internally, the Trophy Windows or DIS application manipulates the For Processing version of such images, i.e. a raw version of the images without any filter or LUT applied.</p> <p>Note: some PACS system does not support DX images with a Modality (0008,0060) attribute value equals to PX. Refer to [6] for further information.</p>
IO Image Storage – For presentation	<p>Any Intra-Oral images, like RVG images.</p> <p>Same remark as above regarding For Presentation definition.</p>
SC Image Storage	Any Secondary Capture images, i.e. an image that is not the result of the direct acquisition of data information, but is the result of computed manipulation (like screen capture).
VL Endoscopic Image Storage	Any Visible Light but endoscopic images, like STV images.
VL Photographic Image Storage	Any Visible Light but "external" images, like K6000 images.
CT Image Storage	<p>Any Computed Tomography images.</p> <p>At the date of this document, this is also the default image format used by Trophy for 3D volume slices.</p> <p>This format is the most common format used at the date of this document for such images. From a file format standpoint, this format has several limitations, including the fact that one file is created, when necessary, for each volume slice, increasing therefore the number of files associated with one single volume within the Trophy DICOM database.</p>

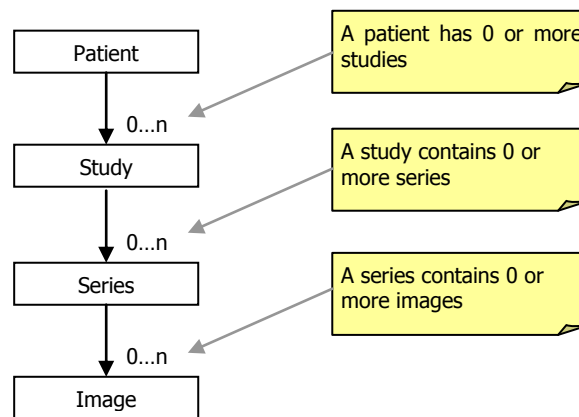
2.1.2.2 Query / Retrieve Service Class

The Trophy DICOM application is able also to query patient and image information from a PACS system, and then retrieve images from that PACS system.

As specified in the DICOM Standard, retrieving an image from a PACS system is a 3-tier mechanism using different network connections and requiring the original client application to act as a server for any subsequent push operation initiated by the PACS system to transfer back images.

DICOM Information Model:

The DICOM Q/R information models a based on the representation of the real world made by the DICOM standard, as described into the following simplified picture:



In this model, a Study may be seen as a particular exam or visit made by the patient.

A Series is just a group of images, usually together related, but always resulting of acquisitions performed on the same equipment, called in DICOM "modality".

Note: In this case, a Study can "contain" images acquired on different modalities.

Normally retrieving a set of images, request the client application to query for a set of patients (based on some criteria) first. Then to query for a set of studies (based on some criteria) for a given patient, then for a set of series of images (based on some criteria) for a given study of a given patient, and finally for a set of images for a given series of a given study of a given patient.

Note: Some implementation, like the Trophy DICOM application, may decide to hide intermediates queries for the user in order to simplify GUI manipulations and data access.

Note: The set of criteria that may be used for filtering answers are implementation dependent. Refer to [2] for a complete list of criteria supported by the Trophy DICOM application. Refer to [6] for more information related to connectivity issues when using filter criteria.

Q/R SOP Classes:

The Trophy DICOM application supports SOP Classes of the Q/R Service Class, as explained in the following table:

SOP Class	Description
Patient Root Q/R Information Model – FIND	References the Query part of the Q/R Service Class, but for the first information model, i.e. way of accessing patient information from a PACS system, where the Patient is the top initial level of all queries. In other words, data can be retrieved only for a given patient.
Patient Root Q/R Information Model – MOVE	References the Retrieve part of the Q/R Service Class, but for

	the first information model (patient root based), i.e. the ability to ask the PACS system to transfer back images.
Study Root Q/R Information Model – FIND	References the Query part of the Q/R Service Class, but for the second information model, i.e. way of accessing patient information from a PACS system, where the Study is the top initial level of all queries. In other words, data can be retrieved only for a given study. Obviously, in that case, a minimum set of patient information is also returned by the PACS system, in order to properly identify the patient of a given study.
Study Root Q/R Information Model – MOVE	References the Retrieve part of the Q/R Service Class, but for the second information model (study root based), i.e. the ability to ask the PACS system to transfer back images.

Note: Based on the supported information model configured for a given DICOM server within its internal database, the Trophy DICOM application changes its GUI as explained in [5].

2.1.2.3 Workflow Management Service Class

The Trophy DICOM application is able also to query procedures (work items) information from a RIS system in order to initiate properly data acquisition for a given patient.

This Service Class provides the user with the ability to integrate the regular workflow of her organization, and ensure proper and correct patient and image identification for later retrieval from within the PACS system. This is done by providing along with procedure (or exam) specific parameters, any information related to the patient or the study that have to be attached with all images acquired during execution of that procedure, in order to include then such images into the right patient folder within the PACS system.

SOP Class	Description
Modality Worklist Information Model – FIND	Describes the Query (based of some criteria if necessary) of procedure information from a RIS system. A procedure in DICOM should be seen as a set of acquisitions (or procedure steps) that have to be performed during a patient visit.

Note: The set of criteria that may be used for filtering answers are implementation dependent. Refer to [2] for a complete list of criteria supported by the Trophy DICOM application. Refer to [6] for more information related to connectivity issues when using filter criteria.

2.1.2.4 Print Management Service Class

The Trophy DICOM application is able also to request a printer device to print images as explained in the following table:

SOP Class	Description
Basic Grayscale Print Management Meta	Describes the ability to request a printer device to print grayscale images.
Basic Color Print Management Meta	Describes the ability to request a printer device to print color images. Note: the expected result depends obviously on the device capabilities.

Note: Details of such print functionality implementation within the Trophy DICOM application is outside the scope of this document: refer to [7] for further information.

2.2 Preparing DICOM configuration

This step is necessary to ensure that all required parameters for establishing DICOM connection are available and known. This also provides the customer with the ability to pre-configure her equipments to connect to, in order to ease the Trophy DICOM application setup.

For each equipment, acting as a DICOM server, the parameters to request are:

Parameter	Comments
Calling AE Title	This is how the Trophy DICOM application identifies itself to the connected equipment.
Called AE Title	This is the parameter identifying the connected equipment for the Trophy DICOM application. The customer shall provide this value.
IP Address or Hostname	This is the parameter identifying, within the Trophy DICOM application, the connected equipment on the network. The customer shall provide this value. In case of DHCP, hostname will be preferred.
Port Number	This is parameter identifying, within the Trophy DICOM application, the application running onto the connected equipment on the network. The customer shall provide this value.
Supported services and options	These are parameters identifying the connected equipment characteristics related to DICOM services.

For each equipment, willing to transfer (push) images onto the Trophy DICOM application database (i.e. the PACS system involved in the retrieve sub operation of the Query & Retrieve Service Class), the following parameters may be either (re) configured or transmitted to the customer:

Parameter	Comments
AE Title	This is the parameter identifying the Trophy DICOM application for the connected equipment. By default it can be: CSSERVER
Port Number	This is parameter identifying the Trophy DICOM application onto the target system (i.e. the system on which the Trophy DICOM application is installed) for connection request made by remote equipment. By default it can be: 10000

Note: The parameters in the table above are actually related to the Trophy DICOM application local import server configuration. Refer to [4] for further information.

3 DURING INSTALLATION

As detailed in [6], many connectivity issues require specific person to be present during installation. This includes (but not limited to):

- DICOM equipment manufacturer representatives, for configuring connected equipments.
- Network Administrators, for configuring both network information and firewall parameters (if any).

Obviously access (either physical or networked) to connected equipments is necessary during installation in order to ensure proper installation testing and verification.

Indeed, some equipment configuration tools or network access are password protected or require special authority privileges, and failure to check configuration of connected equipment or firewall security policies may result in impossibility to complete the Trophy DICOM application installation, and such waste of time and effort.

Finally, refer to [6] to further information regarding preliminary testing and verifications that may be performed after installation in order to check correct configuration and installation of the Trophy DICOM application.