GE Medical Systems
Information Technologies

Mac-Lab/CardioLab
Mac-Lab/CardioLab to GE X-Ray Interface
Operation Overview and System Configuration

(5.1D, 5.2, 6.0 Mac-Lab/CardioLab Versions)

Introduction

Revision History

Revision	Date	Comments
A	01 January 2005	Initial release of document.

Overview of Modality Worklist and Exam Data Export Interface

The bi-directional interface between the Mac-Lab®/CardioLab® acquisition system and the Innova/Advantx X-Ray system uses the Modality Worklist (MWL) and Exam Data Export interface functions. Demographic information is queried from the Mac-Lab/CardioLab system to the X-Ray system prior to the examination using Modality Worklist, while X-Ray information is sent to the Mac-Lab/CardioLab system once the examination is completed using Exam Data Export.

Benefits

The customer benefits of a bi-directional interface are:

- Eliminate duplicate entry of patient demographics to reduce the likelihood of manual data entry errors and increasing staff efficiency.
- Allows the Mac-Lab/CardioLab and X-Ray system to share a unique patient identifier to avoid patient mismatches.
- Provides comprehensive X-Ray documentation within the Mac-Lab/CardioLab system automatically. X-Ray information is saved as part of the patient record and can be printed as part of the case report on the Mac-Lab/CardioLab system.

Configurations

Network configuration

The X-Ray system must be connected to the Mac-Lab/CardioLab system through the network via 100BaseT Ethernet (TCP/IP).

Product configurations

The X-Ray system must have the MWL and Exam Data Export options to communicate bi-directionally with the Mac-Lab/CardioLab system.

Innova

Innova System	Required Components
4100	Modality Worklist: All new systems ship with Modality Worklist Exam Data Export:·Innova 4100 M4 release (for installed base and new systems)
3100	Modality Worklist: All new systems ship with Modality Worklist Exam Data Export: Innova 3100 M3 release (for installed base and new systems)
2000	Modality Worklist: - ·Heroic2 M3 FMI 11491 (for installed base up to Q1 2003) - Modality Worklist Option part number S18721AW (for new systems) Exam Data Export: - Heroic Service Pack FMI 11495 release (for installed base through 2003) - Heroic VCP M3 release (for new systems)

Advantx

Advantx System	Required Components
2000	Advantx DLX Software version C21 or greater. Modality Worklist: Advantx DLX HIS/RIS Option P/N S18411HS Exam Data Export: Advantx DLX MPPS Option P/N S18411PP

Mac-Lab/CardioLab

Mac-Lab/CardioLab System	Required Components
IT	Software Version 6.0 with GE X-Ray Interface Software Option
7000/4000/2000	Software Version 5.1D/5.2 X-Ray interface option part number LK-XRAY-A (2015798-001) for 5.2 X-Ray interface option part number LK-XRAY1-A (2008182-001) for 5.1D

Interface Operation

The block diagram below shows the flow of information between the Mac-Lab/
CardioLab and X-Ray systems.

001

Patient demographic information is entered directly into the Mac-Lab/CardioLab
system either manually or imported via an optional ADT interface (1). On the
Mac-Lab/CardioLab system, patient information is entered on the screen below.

002

When the exam is ready to begin, the patient is confirmed into Mac-Lab/
CardioLab system. At this moment, Mac-Lab/CardioLab system becomes a
"Modality Worklist provider" and is ready to send the information of the active
patient upon a Worklist Query from the X-Ray system.

On the X-Ray system, a "Worklist Query" to Mac-Lab/CardioLab system is
performed to obtain the information of the active patient. The demographic

information is automatically exported to X-Ray system via the network connection.

The patient information from the Mac-Lab/CardioLab system is automatically populated in a new patient and exam on the X-Ray system (2).

The following patient and exam information is transferred from Mac-Lab/CardioLab system to the X-Ray system:

Innova Field	Advantx Field	Mac-Lab/CardioLab Field	Mac-Lab/ CardioLab 6.0	Mac-Lab/ CardioLab 5.2
Patient ID#	Patient ID#	MRN (Medical Record Number)	X	X
Patient First Name	Patient First Name	First Name	X	X
Patient Last Name	Patient Last Name	Last Name	X	X
Patient Birthdate	Patient Birthdate	Date of Birth	X	X
Patient Gender	Patient Gender	Gender	X	X
Patient Height*		Height	X	
Patient Weight*		Weight	X	
Accession Number*	Accession Number**	Accession Number	X	X
Physician Name*	Admitting Physician**	Admitting Physician	X	X
Exam Type*		Procedure Type		
Study ID Number*		Study Number		
	Phone Number		X	X
	City		X	X
	State		X	X
	Country		X	X
* Fields manually editable at the Innova system.				
** Fields sent from the Orders dialogue on the Mac-Lab/CardioLab system				

The exam on X-Ray system is started manually by selecting the exam previously retrieved from Mac-Lab/CardioLab system and pressing the Start Exam button. The exam started on the X-Ray system must always be the same exam that is active on Mac-Lab/CardioLab system. If you start a different exam, the exam data export will fail.

The patient remains active on Mac-Lab/CardioLab throughout the examination. Any changes made to the Mac-Lab/CardioLab patient demographics during the examination will not update the X-Ray patient information.

The fluoro time and the dose information of the X-Ray acquisitions performed on the X-Ray system are stored in the X-Ray database along with the exam information. The dose information is characterized by the Total Dose and the Total/Fluoro/Record Dose Area Product (DAP).

This information is displayed on the Exam Browser at the end of the exam. After each record acquisition (Cine run) performed on the X-Ray system, the run information is stored in the X-Ray database along with the exam information, and displayed on the X-Ray Sequence Browser.

After closing the X-Ray exam by pressing the "End Exam" button, the information of the exam is sent automatically to the Mac-Lab/CardioLab system (3). It is displayed on the Radiology Dialog Window, in the Study menu.

The X-Ray information passed from the X-Ray system to Mac-Lab/CardioLab includes the following fields. Abbreviations used in the Radiology dialog window are shown in brackets.

X-Ray Parameter	Mac-Lab/ CardioLab 6.0	Mac-Lab/ CardioLab 5.2
Run time [TIME]	X	X
Run number [RUN]	X	X
Plane [PL] or [Plane]	X	X
Angulation [ANG] or [RAO/LAO]	X	X
Rotation [ROT] or [CRA/CAU]	X	X
Number of frames [FRAMES]	X	X
Frames per second [FPS]	X	X
Kilo-volts [KV]	X	X
Milliamps [MA]	X	X
Milliseconds [MS]	X	X
Focal Distance [SID (cm)]	X	X
Image Intensifier mode [FOV (cm)]	X	X
Exam Fluoro DAP* (cGycm^2)	X	
Exam Total DAP* (cGycm^2)	X	
Exam Cine DAP* (cGycm^2)	X	
Total Runs	X	X
Total Fluoro Time (minutes)	X	X
*DAP = Dose Area Product		

Worklist Limitations

- The Admitting Physician field in the Mac-Lab/CardioLab system is mapped to the Innova Physician Name field. The Reading Physician, Referring Physician and Operator Name fields are not filled by Mac-Lab/CardioLab system.

- When retrieving the worklist from the Mac-Lab/CardioLab system, the Exam Type is systematically filled with "Mac-Lab procedure" by the Mac-Lab/CardioLab system. This string is hardcoded in the Mac-Lab/CardioLab worklist interface at this time but it is editable on the Innova side.
- Study ID in Mac-Lab/CardioLab system is returned to Innova as "1000". This is editable on the Innova side.
- The X-Ray system to Mac-Lab/CardioLab Worklist Query must contain at least one of the following: MRN, Patient Name, or Study Date.
- The Mac-Lab/CardioLab system does not send patient data if the worklist from DL filters by Any Modality or Any AETitle (i.e. wild character in the query).
- The Mac-Lab/CardioLab system does not send patient data if the worklist from DL filters by Any Date (i.e. wild character in the query for the study date)

Exam Data Export Limitations

- The Cine Frames field in the Radiology Window of Mac-Lab/CardioLab system does not get auto-populated from the Innova. It displays as a blank but is editable.
- The Milliamps (MA) field may not be populated by Innova in some of the Innova2000 versions, and shows up as "0" on the Mac-Lab/CardioLab system Radiology Window.
- The dose information sent from Innova is estimated from the X-Ray acquisition parameters. The estimation model is accurate at ±30%.
- The angles are displayed as signed in the Mac-Lab/CardioLab system, while in Innova they are always positive and followed by the indication of LAO, RAO or CRA, CAU. In the Mac-Lab/CardioLab system, LAO and CRA angles are displayed as positive values, while RAO and CAU angles are displayed as negative values (e.g., if the primary angle in Innova is 30 RAO, in the Mac-Lab/CardioLab system is -30).
- If there is a Dose Measurement Device connected to Innova, the display and storage of the estimated dose may be disabled and the dose data will not be sent to the Mac-Lab/CardioLab system.
- If some sequences are deleted on the Innova system before the end of the examination (i.e., before pressing the End Exam button), the information related to the deleted sequences will not be transferred to Mac-Lab/CardioLab system. However:
  - The number of Total Runs will contain all the runs acquired during the examination, including the deleted runs.
  - The Cine Dose and Total Dose information will contain the dose delivered during the examination, including the dose of the deleted sequences.

Procedures

Configure Mac-Lab/CardioLab 6.0 system

1. Log in to the Acquisition system as an Administrator.

    a. Press **Ctrl** + **Action** + **Del** and click *Log Off*.

    b.   Click *OK* at the log off message and immediately hold down the **Shift** key to stop the auto-login sequence.

    c. Log in to the Windows XP OS locally as **mlcltechuser**.

        To log in locally, select the computer name in the *Domain* field.

    d. Log in to the Mac-Lab/CardioLab Custom shell locally as **mlcltechuser**.

2. Verify Software Option is enabled:

    a. Double-click on the *Service Console* icon on the desktop.

    b. Browse to the *Software Options Manager > Software Options*.

        Verify that the *GE X-Ray Interface* option has a valid key and is enabled. If this option is not enable, contact GE Technical Support to have this option enabled.

3. Double-click the GE icon on the desktop to launch the Mac-Lab/CardioLab application.

4. Select *System Settings* from the Administration menu.

5. Click *Connectivity* in the *System Settings* window. The following window is displayed:
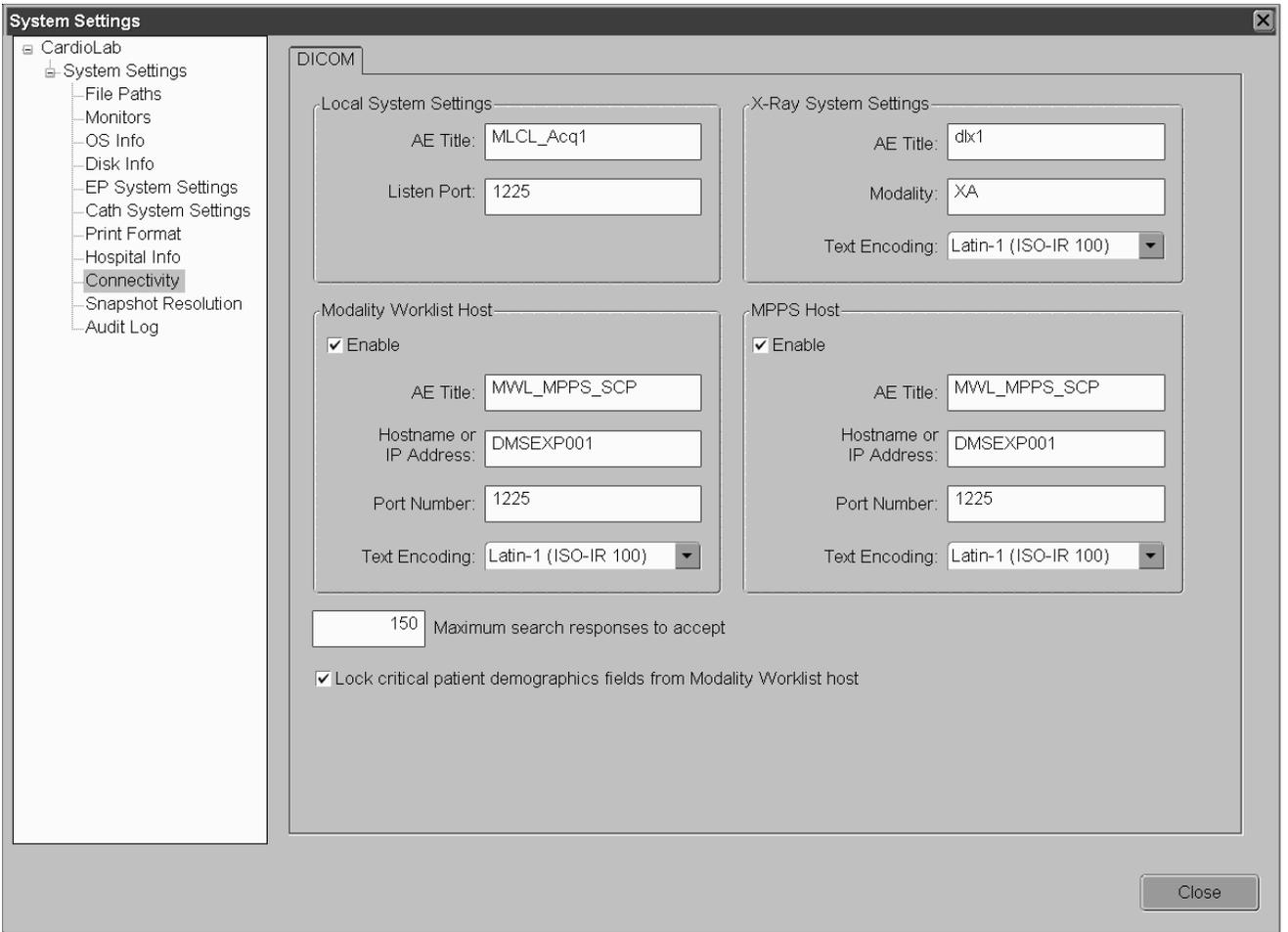
003

6. Enter the following settings:

Local System Settings: These settings are for this Mac-Lab/CardioLab system.

■ *AE Title*: The DICOM name for the Mac-Lab/CardioLab system. An AE Title may only contain letters, numbers and the underscore character, and must be 16 characters or less.

NOTE

AE Titles are case sensitive.

■ *Listen Port*: this is the port number that the Mac-Lab/CardioLab system listens for connections from the X-Ray system. The default is 1225, and should not be changed.

X-Ray System Settings: These settings apply to the GE X-Ray system.

■ *AE Title*: The DICOM name for the X-Ray system. This is found in the X-Ray system's configuration settings (default is "dlx_root" for DLX systems and "TERRA" for the Innova systems)

■ *Modality*: This is the imaging system's modality. The default is XA, and should not be changed.

■ *Text Encoding*: This is how text sent to the X-Ray system is coded. The default is Latin-1, and should not be changed.

NOTE
> *Modality Worklist Host* and *MPPS Host* settings refer to the CVIS server and do not need to be modified for the GE X-Ray interface configuration

7. Restart the Mac-Lab/CardioLab system to initialize the system with the new configuration.

8. Allow the system to auto login to the Windows XP OS. At the Mac-Lab/ CardioLab custom shell, login as the local **mlcluser**.

9. Go to the appropriate Configure the X-Ray system section.

Configure Mac-Lab/CardioLab 5.1D/5.2 system

1. Log in to the Acquisition system as an Administrator.

   ■ For a 5.2 system, login to the system as **mlcltechuser** (password: **mlcl!techuser**).

   ■ For a 5.1D system, login to the system as **administrator** (password: **cardiolab!**)

2. Verify if the X-Ray interface software is already installed on the acquisition system:

   a. Right-click the *My Computer* icon on the desktop and select *Explore*.

   b. Navigate to *D:\Gemms\Prucka.*

   If a sub-directory named *Config* under the *Prucka* directory, then the interface is already installed. Close Windows Explorer.

   If the directory does not exist, skip to step 3.

   c. Select *Start > Settings > Control Panel > Services*.

   Browse through the list for a service named MWL MPPS Service. Verify that the service has an automatic startup type and that the service is started. If not restart the service by either manually starting the service or rebooting the acquisition system. Skip to step 4.
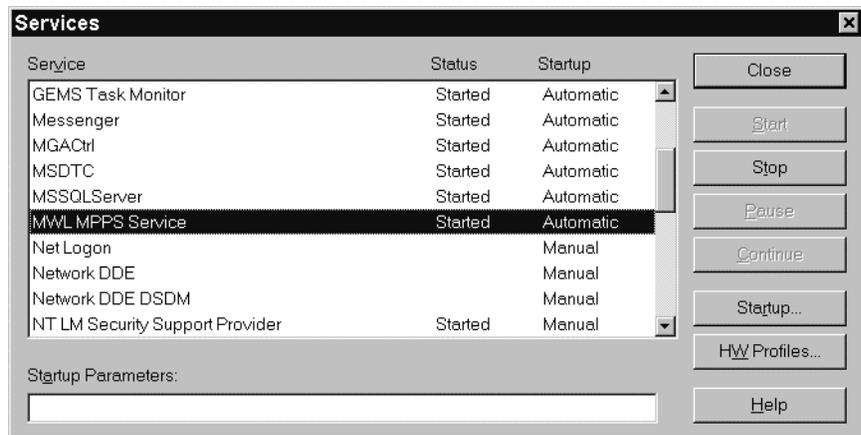
3. Install the X-Ray Interface:

   a. Insert the **GE X-Ray Interface Installation CD** into the CD-ROM drive (for version 5.1D systems, use P/N 2008182-001; for version 5.2 systems, use P/N 2015798-001).

   b. Right-click *My Computer* on the desktop and select *Explore*.

   c. Navigate to the CD-ROM drive and double-click *setup.exe*.

   d. At *Choose Setup Language*, choose the appropriate language for the installation program and click *OK*.

   e. At the *Welcome* window, click *Next*.

f.   Click *Yes* at the *Software License Agreement* window.

g.   Click *OK* at the warning message.

h.   Click *Next* at the *Microsoft XML Parser Setup Wizard* window.

i.   Select the *I accept the terms…* radio button at the *End User License Agreement* window, and click *Next*.

j.   Enter the appropriate user information at the *Customer Information* window and click *Next*.

k.   Click *Install* at the *Ready to Install* window.

l.   Click *Finish* at the *Complete* window.

m.   Click *Finish* at the *Completing the Microsoft XML Parser Setup Wizard* window.

n.   Restart the Mac-Lab/CardioLab system in order to initialize the system with the new configuration.

o.   Log into the Acquisition system as an Administrator.

   ■   For a 5.2 system, login to the system as **mlcltechuser** (password: **mlcl!techuser**).

   ■   For a 5.1D system, login to the system as **administrator** (password: **cardiolab!**)

4.   Launch the Mac-Lab/CardioLab application.

5.   Select *System Settings* from the *Administration* menu.

6.   Click *Connectivity* in the *System Settings* window. The following window is displayed
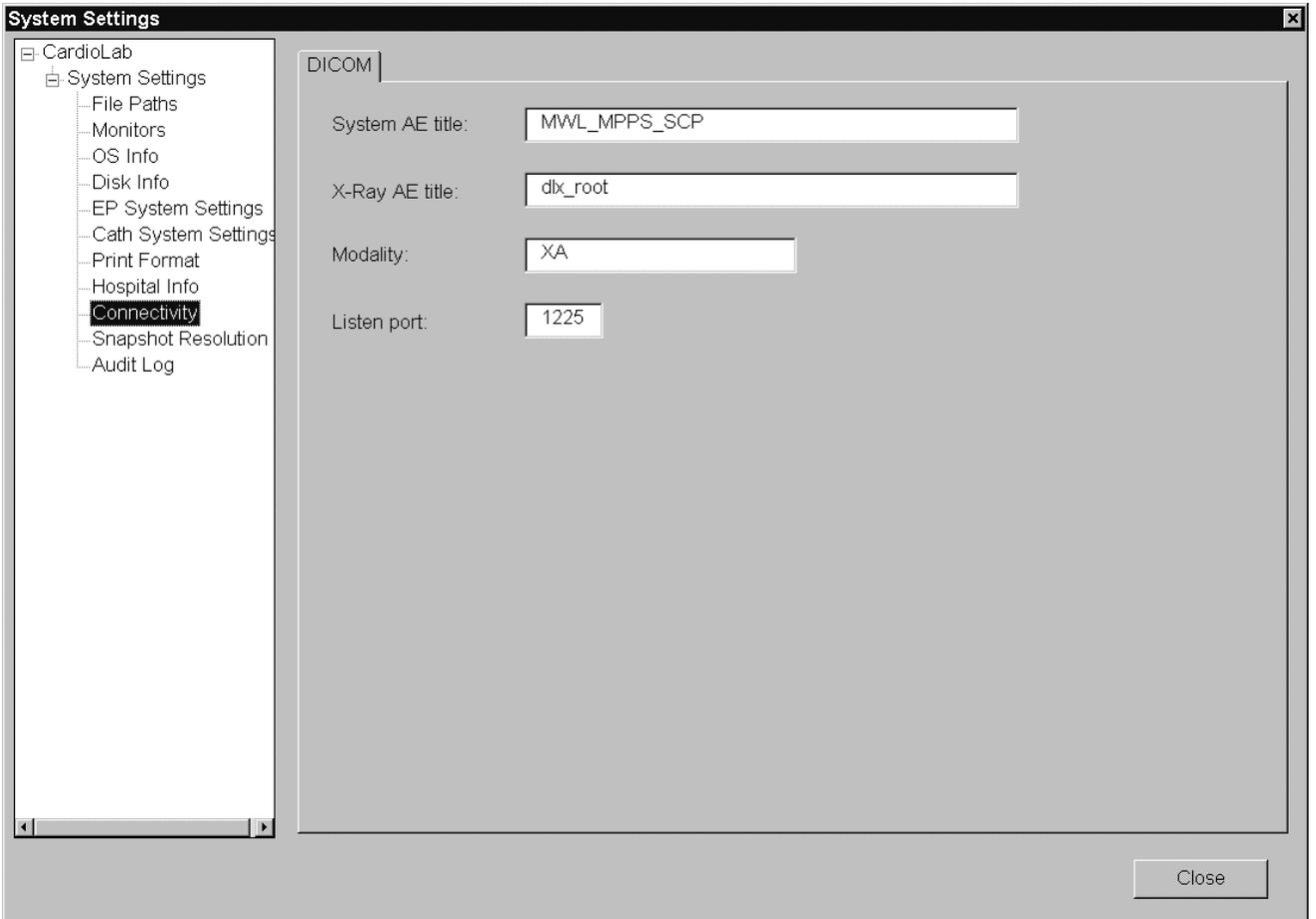
7. Enter the following settings:

- *System AE Title*: This is the Application Entity title for the Mac-Lab/ CardioLab acquisition system. By default, this is set to MWL_MPPS_SCP, but should be changed to something unique. An AE Title can be up to 16 characters, containing upper and lower case letters, numbers and the underscore "_" character. For example, enter MLCL_Lab1 for the local AE title.

  NOTE

  AE Title is case-sensitive.

- *X-Ray AE Title*: This is the Application Entity title for the GE X-Ray system. By default, this is set to dlx_root for DLX systems and TERRA for Innova systems. This should be unique if there are multiple X-Ray systems at the facility. The AE Title information for the X-Ray system can be obtained from the X-Ray System Application.

- *Modality*: This is the imaging system's modality. Leave as the default of *XA*.

- *Listen port*: This is the port number on which the Mac-Lab/CardioLab system listens for connections from the X-Ray system. This should be left as the default value of 1225.

8. Restart the Mac-Lab/CardioLab system to initialize the system with the new configuration.

9. Log in to the Acquisition system as a user (local **mlcluser**).

10. Go to the appropriate Configure the X-Ray system section.

Configure the Innova X-Ray System

This setup procedure applies to the Innova 2000/3100/4100 DL.

1. Log in to the DL box using **Dlservice** account. If necessary:

    a. Select *Start > Shutdown*.

    b. Select the *Close all programs and log on as a different user* radio button and click *Yes*.

    c. Hold down the **Shift** key to stop the auto login process.

    d. Login as **Dlservice** (password **HEROIC**), at the windows login screen.

2. Right click *Network Neighborhood* and select *Properties*.

3. Record the computer name at the Identification tab.

4. Highlight *TCP/IP* and select *Properties* from the *Protocols* tab.

5. Select *adapter #2* in the adapter drop-down box.

6. Record the X-Ray system IP information.

7. Click *OK* to the *Microsoft TCP/IP Properties* window.

8. Click *OK* to the *Network Properties* window.

9. Log off and log into Windows as **DL** (password **innova**).

    Wait until the application has fully loaded.

10. Click on the *Service* icon and select *Service* from the list in the main application screen.

11. Click the *Configuration* button in the *Service User Interface (SUIF)*

007

12. If the system is an Innova 2000, click *System > Options* from the left pane and check the *Worklist Option* checkbox from the list.

13. Select *DICOM Configuration* from the list on the left.

NOTE
> If the system is an Innova 2000 Pre SVC Pack, the following screen will be displayed: *Exam Data Export not enabled* (below).

NOTE
All other systems will display a screen similar to the *Exam Data Export enabled* screen (below).

010

14. Record the system's AE title and port number as listed under Local DL Identification

15. Record the following under the *Worklist server*:

    ■ Select *TRUE* from the list in the *Enable worklist* field.

    ■ Enter the Mac-Lab/CardioLab system IP address in the *Worklist SCP IP address* field

    ■ Enter the Mac-Lab/CardioLab system *AE Title* in the *Worklist SCP AE Title* field

    ■ Enter the Mac-Lab/CardioLab listening port (1225) in the *Worklist SCP port number* field

    ■ Select *YES* from the list in the *Automatic retrieve of Worklist at boot*.

16. Enter the following in the Exam Data Export section:

    ■ Select *TRUE* from the list in the *Enable Exam Data Export* field.

    ■ Enter the Mac-Lab/CardioLab system IP address in the *Exam Data Export SCP IP address* field

    ■ Enter the Mac-Lab/CardioLab system *AE Title* in the *Exam Data Export SCP AE Title* field

- Enter the Mac-Lab/CardioLab listening port (1225) in the *Exam Data Export SCP port number* field

17. Click *Set Configuration* when complete.

18. Click the *Exit* button.

19. Restart the Innova system.

    The system will reboot, auto-login, and begin loading the application. Wait until the application is fully loaded

Configure the AdvantxE DLX X-Ray system

1. If the application is not started at the DLX console:

   - If a *dlx login:* prompt is displayed, type *dlx* and press **Return**.
   - If an *ok:* prompt is displayed, type *boot* and press **Return**. This will bring the system to the *dlx login:* prompt. At this prompt, type *dlx* and press **Return**.

   Wait for the DLX application to fully load.

2. Check the software version and IP configuration:

   a. Move the mouse into the black area at the bottom of the screen (see diagram below) and press **Control** + **Shift** + ♦ + ~ to open an xterm console.

011
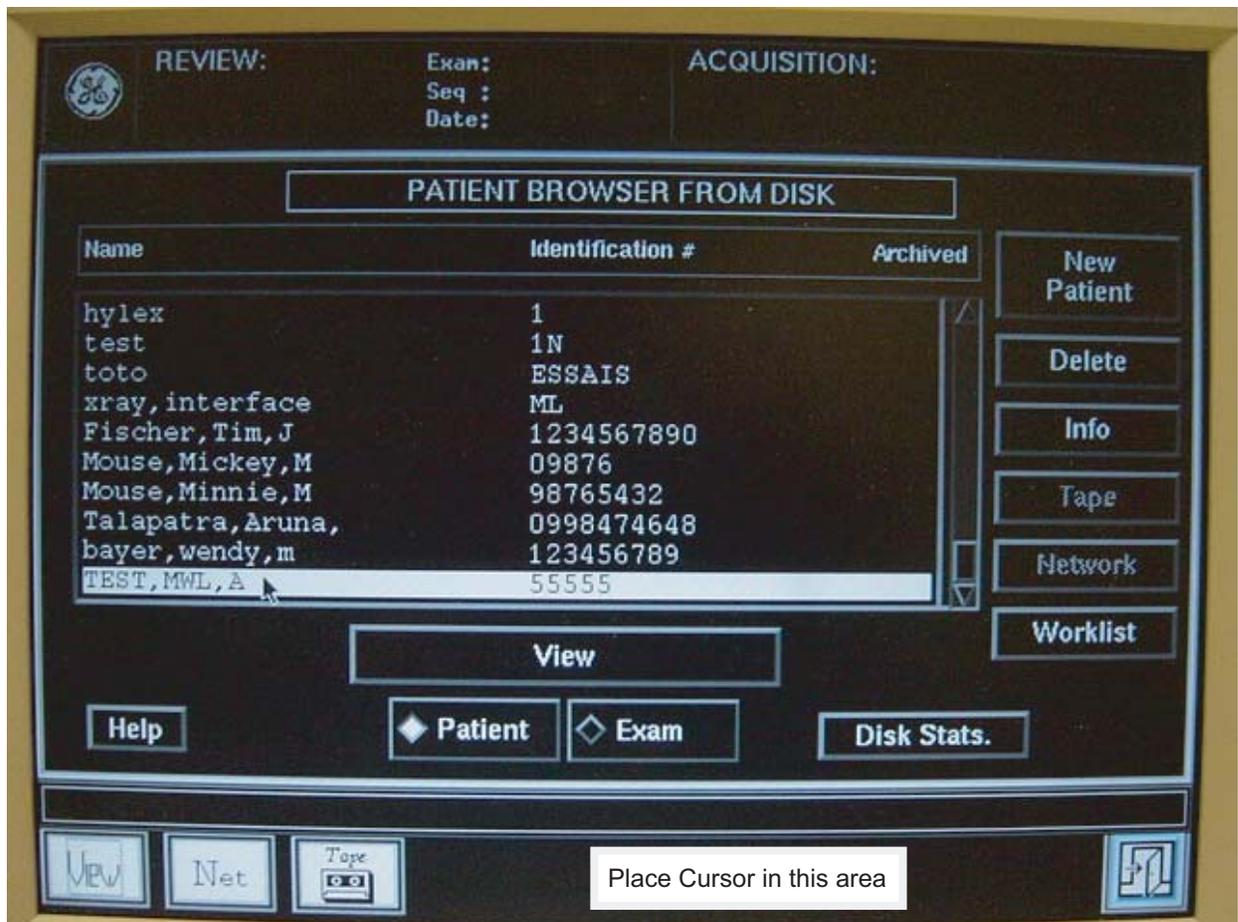
   b. At the prompt, type *tail -100 errlog* and press **Return**.

   The DLX Application Version is displayed (e.g., C25.60).

   c. At the prompt, type *ifconfig -a* and press **Return**.

   The information after *hme1:* are the details for the gateway NIC: flags=863 <UP, BROADCAST, NOTRAILERS, RUNNING, MULTICAST> mtu inet 3.231.48.171 netmask ff000000 broadcast 3.255.255.255)

d. Type *exit* and press *Return* to close the console.

3. Verify that the MWL and MPPS options are enabled

    a. Move the mouse into the black area at the bottom of the screen. Left click (and hold) and select *DLX Others > DLX INSTAL.*

    Wait until the DLX INSTAL application finishes loading.

    b. At the *Enter Command Number:* prompt, type *5* (for Other Options) and press **Return**.

    c. At the *Enter Command:* prompt, type *5* (for Network Configuration Menu) and press **Return**.

        ■ If *4: Patient Worklist Management Option = YES*, the MWL option is installed.

        ■ If *5: Modality Performed Procedure Step Option = YES*, the MPPS option is installed

    d. Type *99* (to go back to the upper menu) at the *Enter Command:* prompt, and press **Return**.

    e. Type *99* at the *Enter Command:* prompt, and press **Return**.

    f. Left click on the black screen and select DLX Application.

    Wait for the Application to finish loading.

4. Configure the MWL and MPPS options:

    NOTE
        You must be running the application in Service mode (rather than application mode).

    a. Click the *Door* icon in the lower right corner of the screen and click *Exit*

    b. Type *service* at the *dlx login:* prompt press **Return**.

    c. Type *proprietary* at the password prompt and press **Return**.

    d. Left-Click into the black area at the bottom of the screen, and select *DLX Application*.

    e. Configure the MPPS service:

        i. Left-click into the black area on the bottom of the screen and select *DLX Others > Settings > MPPS*.

        ii. When prompted for *Remote IP Address*, type the IP address of the MacLab/CardioLab system and press **Return**.

        iii. When prompted for *Application Title*, type the AE Title of the MacLab/CardioLab system and press **Return**.

        iv. When prompted for *Application Port*, type *1225* and press **Return**.

        v. Type *Y* to confirm the values entered.

    f. Configure the Worklist service:

        i. Left click into the black area on the bottom of the screen and select *DLX Others > Settings > Worklist*.

      ii. When prompted for *Remote IP Address*, type the IP address of the Mac-Lab/CardioLab system and press **Return**.

      iii. When prompted for *Application Title*, type the AE Title of the Mac-Lab/CardioLab system and press **Return**.

      iv. When prompted for *Application Port*, type *1225* and press **Return**.

      v. Type *Y* to confirm the values entered.

g. To find and set the AE title for the DLX, click in the black space at the bottom of the screen and select *DLX Others > Settings > DLX AE-Title*.

The *DLX AE Title* is displayed. If it needs to be changed, enter a new AE Title and click *Apply*.

5. Restart the DLX application to reflect any changes to the configuration.

a. Click the door icon in the lower right corner of the screen and select *Exit*.

b. At the *dlx login:* prompt, type *restart* and press **Return**

c. At the *dlx login:* prompt, type *dlx* and press **Return**.

Interface Testing

Enter Patient Information on the Mac-Lab/CardioLab system

1. At the Mac-Lab/CardioLab system, double-click the GE icon to launch the application.

2. Click on *New-Study* icon to open a Mac-Lab or CardioLab study (either may be selected).

3. Enter the appropriate patient demographic information.

   If you also want to transfer the Admitting Physician and Accession Number data, enter this data into the *Orders* dialog (under the *Study* menu).

Test with the Appropriate X-Ray System

1. Innova DL:

    a. The main window displays a Patient Browser window and a Worklist browser window.

012

    b. Click the *Settings/Search* button.

c. In the *Modality Worklist* section, verify both the *This room* and *This modality* checkboxes are checked.

d. Verify the *Today* radio button is selected in the *Date* field.

e. Click the *Refresh Now* button. The patient will be listed in the *Worklist* Browser.

f. With the patient selected, click the *Add to Database* button.

g. Click Start Exam at the *Patient Information* window.

h. Acquire X-Ray images (create a fluoro sequence).
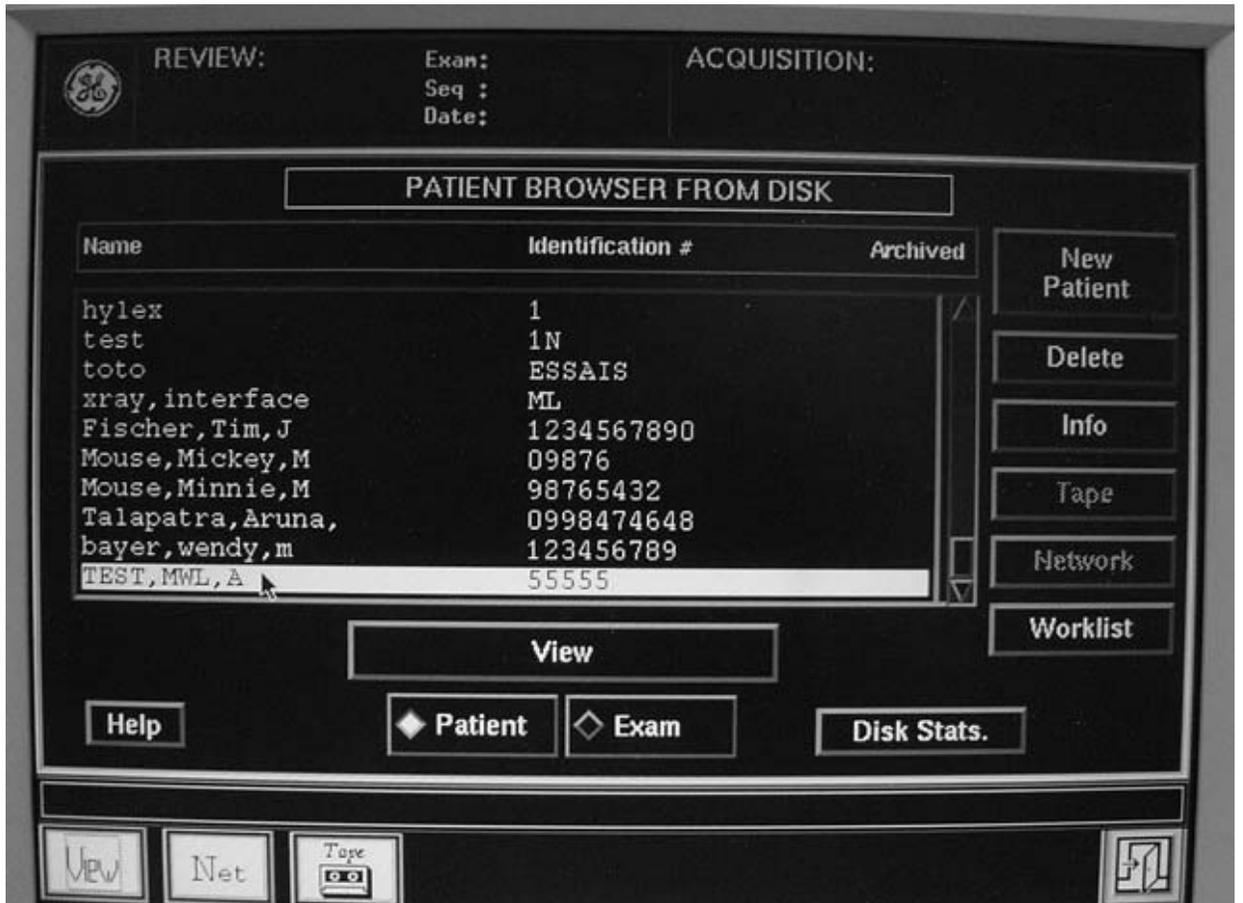
i. Click the *End Exam* button.

NOTE

Always close the study on the X-Ray system before closing the study on the Mac-Lab/CardioLab system so the run information can be transferred.

MPPS information should now be populated into the Mac-Lab/CardioLab study. At the Mac-Lab/CardioLab system, you can verify that the data from the X-Ray system is transferred by opening the *Radiology* dialog under the *Study* menu and clicking the *Refresh* button.

This information can also be included in the Mac-Lab/CardioLab report by adding the "X-Ray Run Information" section to your report format.
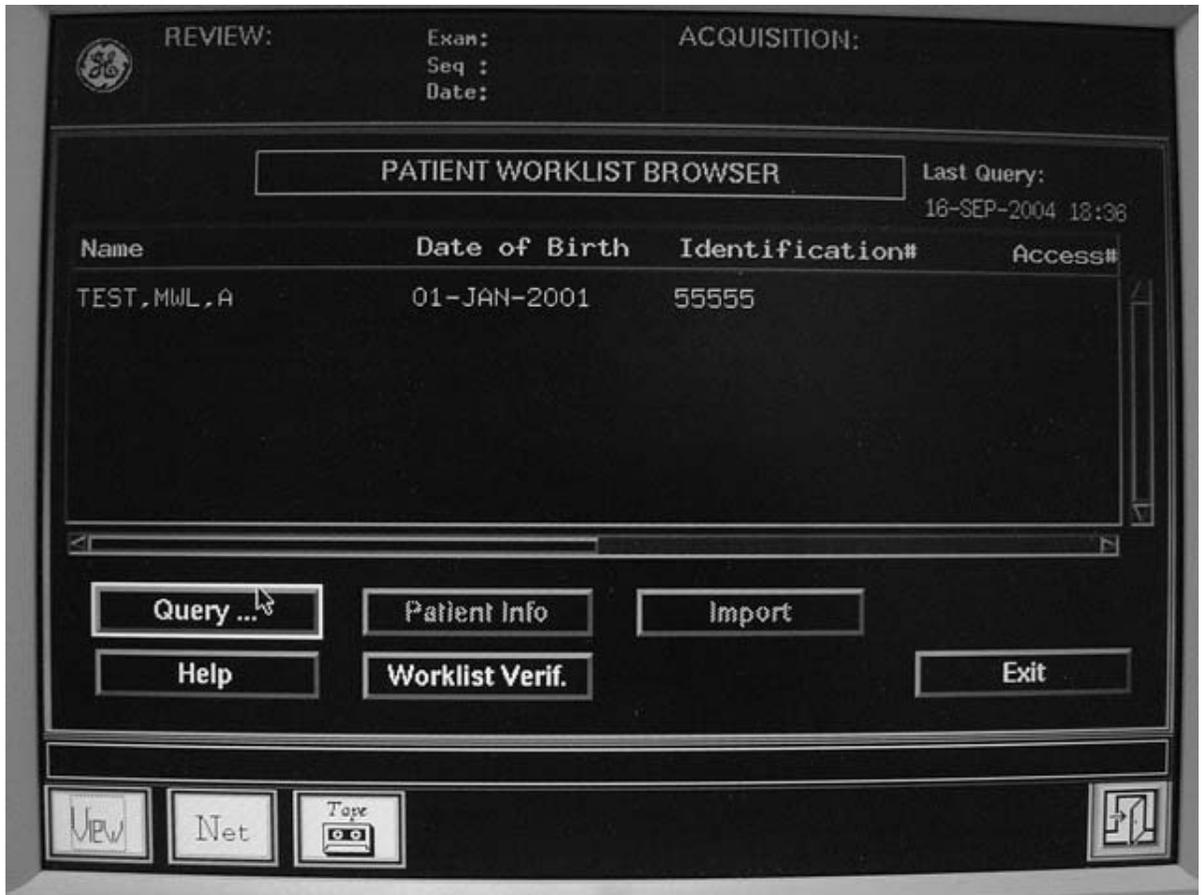
Refer to the Mac-Lab/CardioLab Operator's Manual for additional information on Report Formats.

    j.   Close the study on the Mac-Lab/CardioLab system.

    2.   DLX system

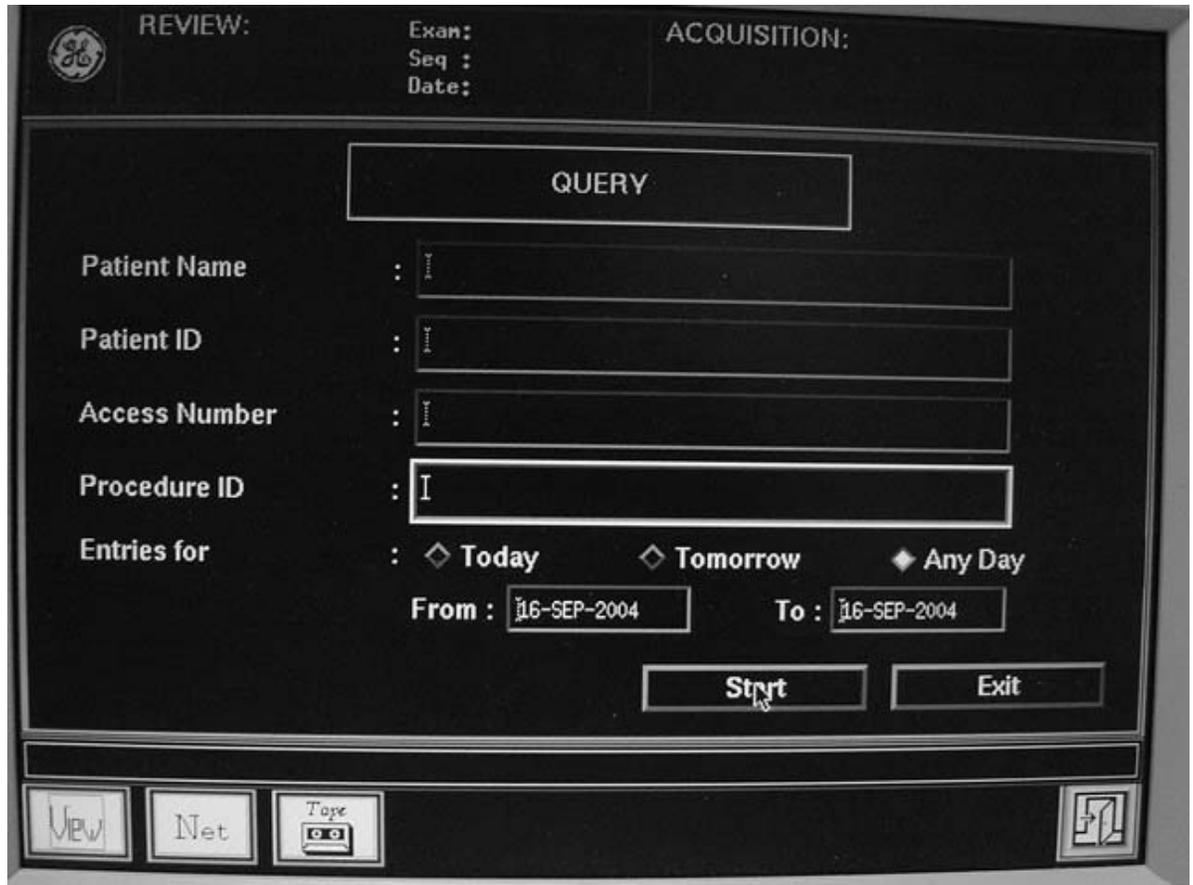   a.   From the DLX Application, click the *Worklist* button on the right side of the screen.

014

        b.   Click on the *Query* button at the *Patient Worklist Browser* window.

QUERY

Patient Name   :

Patient ID   :

Access Number   :

Procedure ID   :

Entries for   : ◇ Today   ◇ Tomorrow   ◆ Any Day

From : 16-SEP-2004   To : 16-SEP-2004

Start   Exit

View   Net   Tape

016

c. Verify the *Today* radio button is selected and click *Start*.

  If no patient is returned, enter the first letter of the patient's last name and verify the *Today* radio button is selected and click *Start*.

d. Highlight the patient and click the *Import* button.

e. Click *Close* at the *Worklist Import Request Status* message box.

f. Click *Exit*.

g. Find the patient in the *Patient Browser* window and click the *Exam* button

h. Click the *New Exam* button.

i. Click the *Start Exam* button.

j. Acquire X-Ray images (create a fluoro sequence).

k. Click the *End Exam* button.

  NOTE
  It is important to close the study on the X-Ray system prior to closing the study on the Mac-Lab/CardioLab system in order for the run information to be transferred.

  MPPS information should be now populated into the Mac-Lab/CardioLab study. At the Mac-Lab/CardioLab system, you can verify that the data

from the X-Ray system is transferred by opening the *Radiology* dialog under the *Study* menu and clicking the *Refresh* button.

This information can also be included in the Mac-Lab/CardioLab report by adding the "X-Ray Run Information" section to your report format. Refer to the Mac-Lab/CardioLab Operator's Manual for additional information on Report Formats.

l.   Close the study on the Mac-Lab/CardioLab system.