IMAGING DICOM GATEWAY INSTALLATION GUIDE

Version 3.0*69
November 2007

Department of Veterans Affairs
System Design and Development
VistA Imaging

Preface

This guide is written to assist in the installation of the VistA Imaging DICOM Gateway. The recommended background of those installing this software includes knowledge of Windows™ and network component installation.

This guide also provides configuration specifications needed by the commercial DICOM vendors to properly interface their equipment to VistA.

Revision History

9 March 2000	Original version checked in - Ed
1 August 2000	Many editing revisions – Pete and Ed
16 August 2000	Editing revisions – Pete
30 August 2000	Added reviewer comments from Amy Padgett – Pete
8 September 2000	Update names of accounts and groups to latest convention
20 September 2000	Incorporated final review comments from Dr. Ruth Dayhoff – Pete
21 September 2000	Incorporated final review comments from Dr. Ruth Dayhoff – Pete
30 August 2002	Added information about interface to Healthcare Provider
31 Oct 2002	Changes for Patch 10 – replaced references to Clinical Specialties with Healthcare Providers
3 Nov 2003	Patch 10 – updated footer dates
22 Dec 2003	Formatting updates
14 Jan 2004	Patch 11 - Incorporated revisions from developer feedback
6 Mar 2004	Patch 11 - Incorporated revisions from developer feedback
20 April 2004	Removed “draft” wording
23 Nov 2004	Updated Section 4.7 to reflect default partition size of 500
12 Dec 2005	Patch 57 changes: Updated obsolete information in sections 3.2, 3.5.2, 3.5.3, 4.5, and A.4. Verified removal of sensitive data and references to NT. A. McFarren, C. Huesman.
30 Jun 2006	Patch 51 changes: Updated sections B.4.2.2.1, B.4.4, G.1. A. McFarren, R. Coney.
20 Jul 2006	Patch 50 changes: Added Appendix H. S.Davis, A. McFarren, R. Coney.
20 March 2007	Updates for Patch 69. Updated content in sections 1.2, 2.1, 2.4, 2.7, 2.8.1-2, 3.2, 3.4-11, 4.3.1, 4.3.12-13, 4.3.20, 4.3.26-27, 4.5, 4.5.7-9, 5.2.1-3, A.1-4, B.3.4, and B.4. Additional cosmetic updates reflecting shift to Caché made throughout manual. Remove obsolete section B.3.7. E. DeMoel, A. McFarren, S. Davis.
15 August 2007	Updated section 4.3 for Patch 69. S. Davis

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ADAC	ADAC Laboratories, Milpitas, CA
AGFA	Agfa Division of Miles Laboratory, Inc., Ridgefield Park, NJ
ACR-NEMA	National Electrical Manufacturers Association, Rosslyn, VA
Auscon	Auscon Corporation, Mountain View, CA
BRIT	Brit Systems, Dallas, TX
Caché	InterSystems, Corp., Cambridge, MA
Cemax-Icon	Cemax-Icon, a Kodak Company, Fremont, CA
CT/i	General Electric Medical Systems, Milwaukee, WI
DICOM	National Electrical Manufacturers Association, Rosslyn, VA
EasyVision	Philips Medical Systems, Shelton, CT
eMed	eMed Technologies Corporation, Lexington, MA
EndoWorks	Olympus America, Inc., Melville, NY
GEMS	General Electric Medical Systems, Milwaukee, WI
ImageShare	DeJarnette Research Systems, Towson, MD
Lumisys 75	Lumisys, Inc., Sunnyvale, CA
MediShare	DeJarnette Research Systems, Towson, MD
MSM	InterSystems, Corp., Cambridge, MA
OEC C-Arm	OEC Medical Systems, Inc., Salt Lake City, UT
PACS Broker	Mitra Imaging Inc., Waterloo, Ontario Canada
Siemens	Siemens, Iselin, NJ
VistA	U.S. Department of Veterans Affairs
Windows 2000, XP, etc.	Microsoft Corporation, Redmont, WA

Note: All patient and provider names, as well as all IP addresses used in example scripts are fictional.

Table of Contents

Chapter 1 Introduction

1.1 Overview

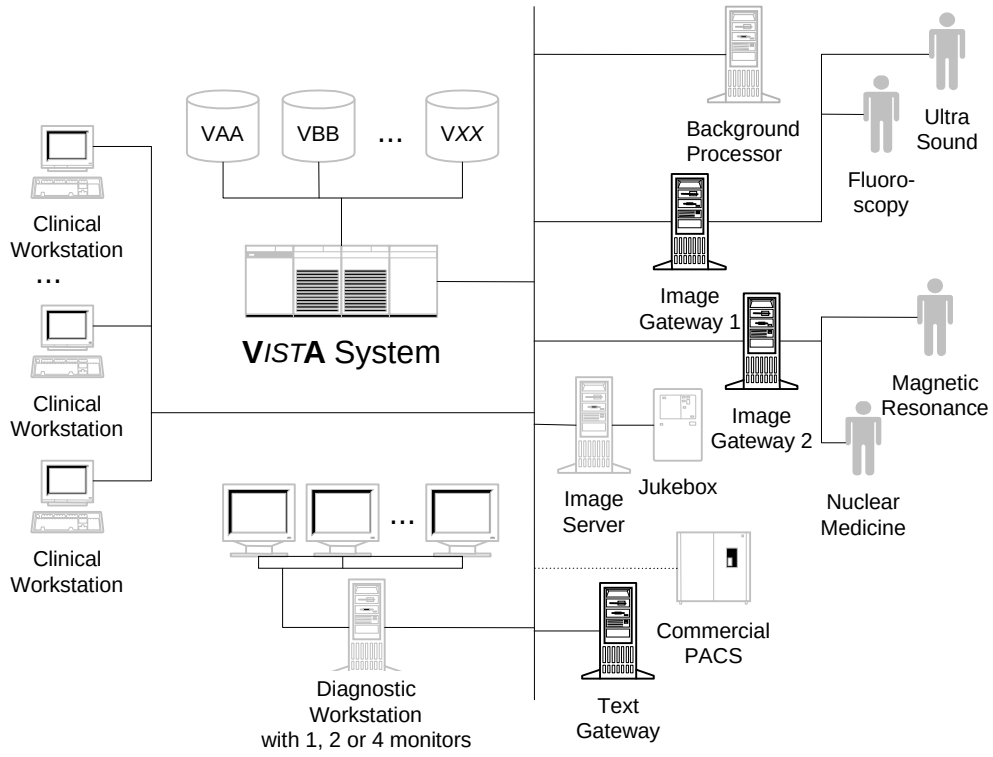
DICOM is the abbreviation for the **D**igital **I**maging and **C**ommunications in **M**edicine standard. DICOM brings open systems technology to the medical imaging marketplace and enables VistA to communicate directly with commercial medical imaging equipment.

DICOM is a set of networked client/server applications that are implemented on top of TCP/IP. DICOM is part of the VistA networked application suite, along with CPRS, Kernel Broker, MS Exchange, and Windows file servers. Similar networking techniques are used for installing and maintaining all of these applications.

The VistA Imaging DICOM Gateway is written in MUMPS and runs on Microsoft Windows platforms. The interface uses the TCP/IP protocol to communicate with commercial DICOM devices and Windows file servers, and the VistA hospital information system (HIS).

1.2 Typical configuration

The diagram below shows the most common configuration of a system in which the VistA Imaging DICOM Gateway will be deployed.



The software described in this document should be installed on the DICOM Text and Image Gateways that are highlighted in **bold** in this diagram. Depending on the purpose of the system, several different installation options may be chosen.

In the diagram above, each highlighted computer has a dedicated function. It is possible to assign any combination of functions to any of these computers.

In theory, one computer could perform all tasks. In practice, however, it is much more efficient to assign specific tasks to specific computers. The typical configuration is one text gateway and one or more image gateways.

Based on considerations of needed screen real estate on displays and available licenses on a system, an Image Gateway should not serve more than three or four image acquisitions instruments (modalities).

1.3 Networking Topology Options

The VistA Imaging Project has a need for Ethernet capabilities in order to test equipment configurations that are being placed in the medical centers.

VistA DICOM Gateways may use either one or two networking interfaces depending upon whether the commercial DICOM devices are connected directly to the main network backbone or are located on separate physical networks.

1.4 Commercial DICOM devices connected to Main Network Backbone

Some sites may choose to have all devices (workstations, main hospital computer, DICOM imaging producing equipment, etc.) connected to a single high-speed switched network backbone. In this case, the VistA Imaging DICOM Gateway will have a single network connection to the backbone (see Figure 1.4).

Single High-Speed Switched Network

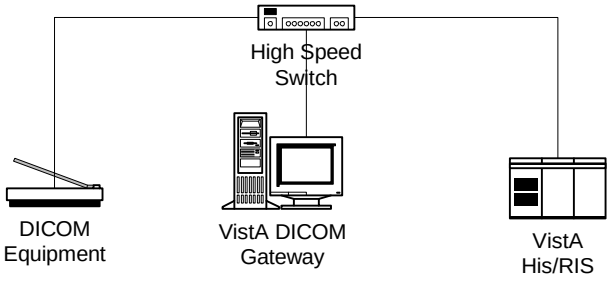


Figure 1.4

1.5 Commercial DICOM devices on Separate Physical Networks

Other sites may choose to have a separate dedicated network for the commercial DICOM devices. In this case, the VistA Imaging DICOM Gateway should have two network interfaces: one to connect the main hospital network backbone; and the second to connect to the dedicated network for the commercial DICOM devices (see Figure 1.5).

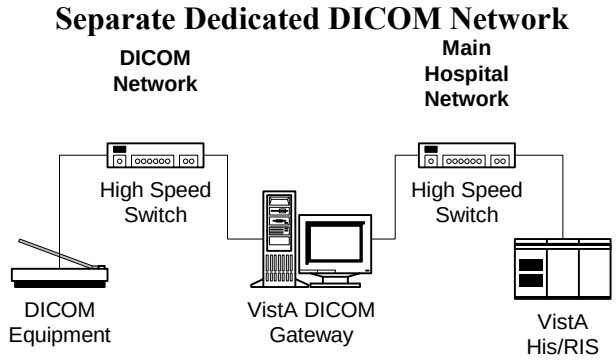


Figure 1.5

1.6 System Administration

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1.7 Documentation Conventions

The following conventions are used in this manual.

Convention	Description
Bold type	User Keyboard Entry.
<Enter>	Return key or Enter key.
<Control-x>	A keystroke that involves pressing the control-key, keeping it depressed, and then pressing another key.
<**SHIFT**>	Shift key.
<**ESC**>	Escape key.

Convention	Description
<**Num Lock**>	Top left key on the numeric keypad (above the 7), may also be labeled Numeric Lock; this makes any keypad key activate the number shown on its surface; it is the equivalent of a SHIFT LOCK for alphabetic keys.

Chapter 2 Pre-Initialization Instructions

2.1 Hardware and Software Requirements

A site may have one or more PC's running the VistA Imaging DICOM Gateway software. It is assumed that a network be present with sufficient capacity to transport image files in a reasonable amount of time. See Appendix C for details about network set-up, which needs to be completed **before** any VistA Imaging DICOM Gateway computer can be installed.

The hardware requirements for each processor are the same.

- The PC should have enough memory (RAM) to run the operating system and 4 or more megabytes of VRAM. A 17" (or larger) color monitor should be used configured to 1280 x 1024, true color. This configuration is identical to the one used for a "Clinical Workstation" (Higher resolution, 1600 x 1200, or dual monitors is even better, since it provides more screen real estate on the workstation and allows more windows to be visible at a time).
- The VistA DICOM Gateway software will run under any flavor of the Microsoft Windows™ operating systems. However, the VA restricts the versions of Microsoft Windows™ that are permitted to be used. Check current VA Policies and Procedures to determine permitted versions of the Microsoft Windows™ Operating System.
- Any disks that are permanently mounted on the system must be formatted using the NTFS format (the FAT format is no longer permitted at the VA).
- Caché ™ for Windows NT (Intel/P4) 20-User license, Version 5.0.20 or newer.
- Symantec PC-Anywhere™, Version 11.0 or newer.
- VA-Mandated, up-to-date, virus protection software.
- Last, but definitely not least: be sure to have "local administrator privileges" on any machine for the duration of the installation procedure.

Typically, it will take less than one hour to complete the entire installation process for one PC. Configuration and interfacing with DICOM devices will take additional time.

Caution: When performing an installation as an upgrade to an older installation of the VistA Imaging DICOM Gateway, review Appendix B.4 for details about master files that may need to be upgraded manually.

Instructions for setting up the network between the various DICOM related processors and the VistA system are described in Appendix C.

Instructions for adding a "modality" are described in the VistA Imaging DICOM Gateway User Manual.

Instructions for creating icons to start components of the Gateway software are described in Appendix A.

2.2 VA Security Policy

VA Security Policy requires that on many computers specific software is installed to ensure that the machines are running the most up-to-date virus protection software.

While it is acknowledged that any computer that is connected to the network must have adequate virus protection, it cannot be permitted that software is installed on a medical device that causes it to reboot while it might be processing essential data.

As a result, it cannot be permitted that the VA's SMS and EPO software is installed on any VistA DICOM Gateway.

Each site must appoint a person who is responsible for applying Microsoft updates to the DICOM Gateways when Microsoft makes mandatory patches (also known as "Critical Updates and Service Packs") available. The easiest way to make this work is to enable the feature called "Automatic Updates" in the Windows Control Panel, and to set this option to "Download the updates automatically and notify me when they are ready to be installed".

The responsible person should check at least once per week whether any "critical updates" are available, and make certain that they are installed while the medical software is not active.

The virus protection software should be configured such that it automatically downloads and applies new updates for the virus definition files on a daily basis.

2.3 Sequence of activities

In a nut-shell, the sequence of activities for most patches should be:

1. Perform KIDS install for any Kernel components (e.g. MUMPS-to-MUMPS Broker)
2. Stop all C-Store processes; leave image processing running
3. Complete DICOM Correct
4. Perform KIDS install for Imaging patch on VistA
5. Perform any updates to user accounts on VistA
6. Stop all gateway processes
7. Load Imaging patch on gateways
8. Configure gateways
9. Connect to VistA (using MUMPS-to-MUMPS Broker)
10. Test user accounts

11. Start regular gateway processing

2.4 Master Files and Software Required to Run the DICOM Applications

Software for the VistA Imaging DICOM Gateway is distributed as a single executable file. This file performs an installation using the tool-set from InstallShield™. This file may be downloaded across the network (see Section 3.4) or it may be distributed on a CD-ROM. A distribution on CD-ROM will be "self-starting" when the disk is inserted into the computer.
When the installation process is completed, all software for the VistA Imaging DICOM Gateway will be installed, and the documentation will be copied onto the end-user's computer.
When a patch contains components that reside on a DICOM Gateway as well as components that reside inside the VistA Hospital Information System, the distribution will include a VA-Kernel KIDS file as well as an InstallShield set-up executable.

2.5 System Configuration and Global Placement

Some global variables are local to the DICOM Gateway, while other global variables are maintained on the VistA system. The global variables that reside on the VistA system are:

Name	Initial Size [MB]	Growth
^MAGD	0.1	Does not grow beyond 0.5 MB
^MAGDAUDT	0	1 MB per 250,000 studies
^MAGDHL7	0[1]	Should be purged when size exceeds 5 MB
^MAGDOUTP	0	Does not grow beyond 0.5 MB

^MAGD is for the "DICOM Correct" application and error handling procedures. It contains information about every image file that fails a patient and study lookup on the main system. When manual corrections are made, the entries are deleted from ^MAGD, so it does not continually grow.

^MAGDAUDT counts the number of different types of messages per day, as well as the number of images acquired from each instrument.

^MAGDHL7 contains all of the HL7 messages passed from the HIS/RIS to the DICOM Gateway. The data in it can be periodically deleted, so that it will plateau to some maximum size and then be trimmed back.

[1] For VistA installations, the data for ^MAGDHL7 accrues as events happen in the system and HL7 messages are being transmitted.

^MAGDOUTP contains the requests for DICOM Image transmission from VistA to a remote Application Entity. Since the requests are deleted after being satisfied, the global remains very small.

Note: The global variables ^MAGDHL7 and ^MAGDWLST will be created as the system is being used, ^MAGDHL7 on the main VistA System, and ^MAGDWLST on the VistA DICOM Text Gateway System.

2.6 Resources (unique or unusual) Required for Software Product

The VistA Imaging DICOM Gateway will require a high-speed network capability. Storage of acquired images will require a multi-gigabyte storage capability (typically a juke-box).

2.7 Sizing Considerations

A typical installation uses about 300MB of disk space for the Caché system and the various supporting files. As images are acquired, disk space will be used temporarily, until the images have been processed by the DICOM Gateway application, and moved to their permanent storage. When a site acquires a new modality and images cannot be processed until parameters are set up properly to support that modality, the temporary image storage may grow to several gigabytes.

2.8 Recommendations for Software Installation and Testing

The installation procedure described in the following chapters involves the following steps.

2.8.1 For an "initial" installation

To install the VistA Imaging DICOM Gateway on a new PC, perform the following steps:

1. Create a number of files and directories on the target system.
2. Create a number of icons on the target system.
3. Create Caché environment.
4. If Caché is not installed on a "C" drive, adjust internal registration of drive letter.
5. Enter "translation table" information into Caché.
6. Establish master files containing site-specific information (lists of modalities, instruments, port numbers, and so forth).
7. Load master file information into Caché database.
8. Create icons for the various instruments.
9. Establish Caché logon security.

Steps 1 through 6 above are described in Chapter 3; steps 7 through 9 are described in Chapter 4. Most of these steps can be executed in an automated fashion using the scripts from Chapter 3.

2.8.2 For an "upgrade" installation

Perform the following steps to upgrade an old version of the VistA Imaging DICOM Gateway to the current revision:

1. Upgrade application software to current version.
2. Modify master files containing site-specific information to reflect all parameters that are required by the current version of the software.
3. Load master file information into Caché.
4. Create icons for any new instruments in the upgraded set-up.

Note: Step 1 is described in Chapter 3; steps 2 through 4 are described in Chapter 4.

2.8.3 Software to be installed in the main VistA System

In addition to software to be installed on the PCs, there is also software to be installed in the main VistA system. This installation procedure is described in Chapter 5.

Chapter 3 Installation or Upgrade of the VistA Imaging DICOM Gateway

3.1 Prerequisites for Getting Started

- Windows™ operating system is installed on the target computer.
- Suitable up-to-date virus protection software has been installed.
- The installer is logged in with full "administrator" privileges.
- The VistA Imaging KIDS package must be installed. See the VistA Imaging Installation Guide for details.

3.2 Setting up the Operating Environment

The following steps will generally make the use of the system easier.

1. Complete the installation of the Windows™ operating system.
2. Apply the latest approved Service Packs for Windows operating system and Internet Explorer™.

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6. Configure the Network Interface Cards (NICs) for usage through TCP/IP. **Do not** use Microsoft's DHCP to assign any addresses. For each system, hard-code a specific IP address and a default gateway address.
7. Make sure that the WINS/DNS information is defined according to the VA's national mandates. Contact your local LAN Administrator if you're not sure about any settings.
8. If a local Domain Name Server (DNS) system is being used, make sure that this local DNS is the first DNS server in the list.
9. From this point forward, login as `Content removed; FOIA exemption b2/high 2` to perform the rest of the installation.

   Note: Any changes to the desktop are made only for the current account. If specific changes to the desktop are also needed for user accounts, first complete the installation. Then, login into the desired user accounts and make the desired changes in those accounts.
10. Install either **Dameware** or **PCAnywhere 32** and set up the selected remote control application to use TCP/IP for its communication.

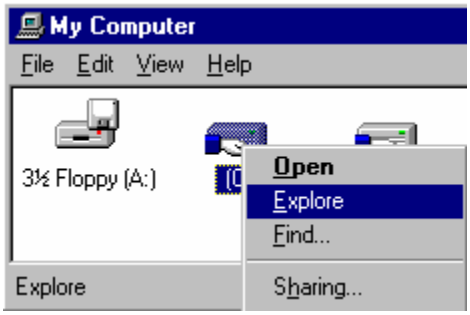
11. Follow the instructions published on https://vaww.ocis.va.gov/ to set up **Dameware** and/or **PCAnywhere** according to the latest VA policies.
12. If any new disk-drives are installed, they must be formatted using the NTFS format.

3.3 Map a network disk to be the "F:" drive

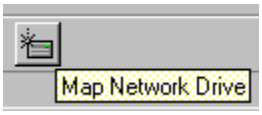
When only one single computer is to be installed at a site and this computer will perform all DICOM Gateway tasks, this step may be skipped. However, in a networked configuration with multiple DICOM Gateways, it is usually beneficial to use a "networked" drive to store the dictionary files and master files, so that all processors on the network can share the same resources. Such networked usage will also make future maintenance a lot easier. In the examples throughout this manual, the assumption is made that the "data" is mounted as drive "**f:**".

Double click on the icon labeled "**My Computer**".

In the window that pops up, right-click on any disk drive, and select "**Explore**".

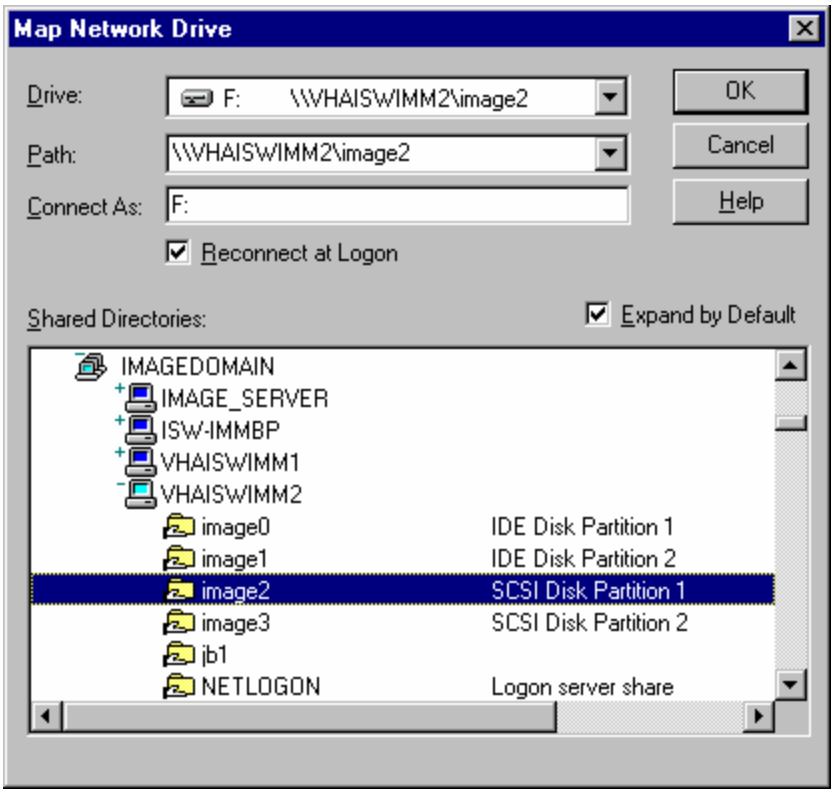


In the Explorer window, click on the button for "**Map Network Drive**"



and fill in the parameters that select a disk drive and directory that will be generally available to all processors that perform a task related to the VistA Imaging DICOM Gateway.

The drive letter that is selected in this step is the same drive letter that will be used as the "dictionary" drive.



3.4 Getting the Distribution Kit

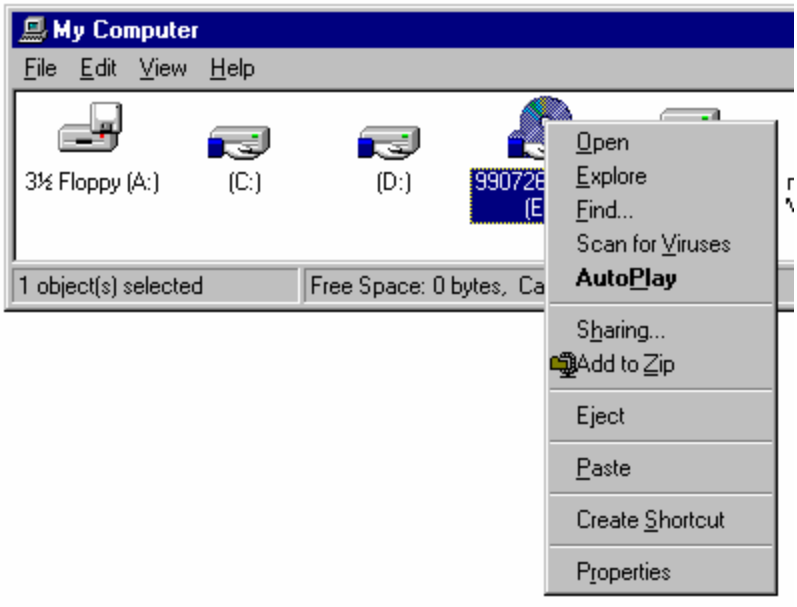
Note: The distribution kit may be downloaded across the VA network (contact your Implementation Manager for details about access to network copies of the software). When the software is downloaded, it may be stored in a directory that can be mounted as a "shared" disk drive. (The software may also be obtained on CD ROM.)

The VA distribution kit for the VistA Imaging DICOM Gateway consists of a CD ROM and a printed copy of this manual. The CD ROM contains electronic copies of all the manuals for the VistA Imaging DICOM Gateway in Adobe Acrobat™ format in the directory named "**Documentation**".

Insert the distribution medium into the appropriate drive, or "network mount" the "disk-share" that contains the software. Normally, the installation procedure will be started automatically.

If this procedure is not automatically started…

1. Double-click on the icon labeled "My Computer".
2. Right-click on the icon for the distribution directory.
3. From the pop-up menu, select the menu-option labeled "AutoPlay".



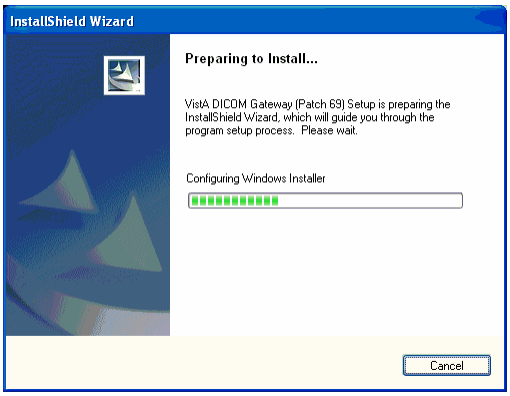
If the distribution dataset is accessed through the network, double-click on the file named MAG3_0_P***nnn***_Install.exe to start the installation process (where ***nnn*** is the number of the patch to be installed).

3.5 Installing the Software

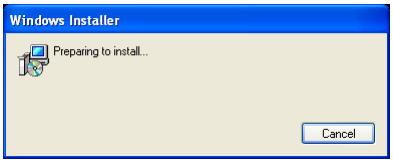
Note: The DICOM Gateway requires a custom installation. Please be sure to select **Custom** when you choose the setup type (See step 7 for details).

1. After the InstallShield setup is activated, it will take a little time for InstallShield to initialize. The following window may remain on the screen for about half a minute (new, "fast" computer) to 5 minutes (older, "slow" computer).

   Do not press any buttons while this window is displayed. The progress bar will advance at an irregular rate and may pause for extended periods of time.



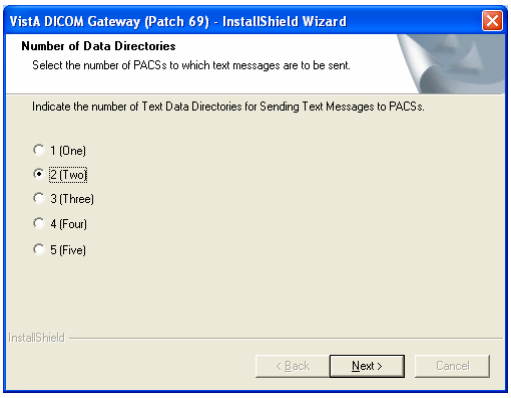
2. After InstallShield has performed its initialization, Microsoft Windows also needs to initialize its installer. This initialization takes a lot less time.



Do not press any buttons while this window is displayed.

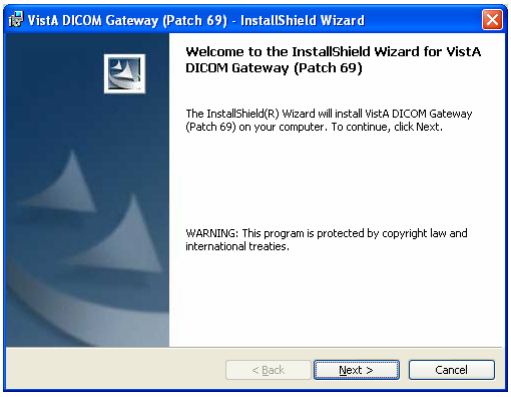
3. When all initialization is complete, InstallShield will present its first dialog window.

   This asks how many "Text Data Directories" are to be created. These directories are used when text messages are transmitted to PACSs. For each PACS that needs to receive text messages from the DICOM Gateway, one such directory needs to be created. The default setting is 2. In most cases, 1 will suffice.



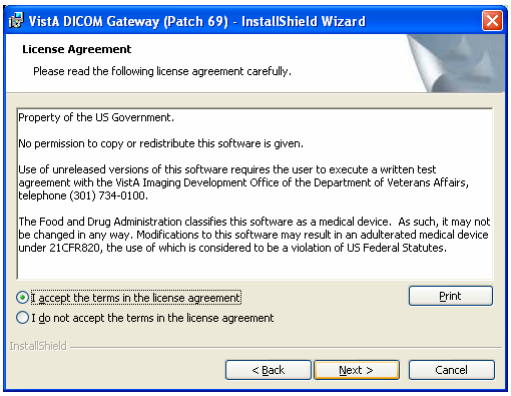
   Left-click the option for the appropriate number (1 – 5) and then left-click the **Next>** button.

4. InstallShield then displays the next dialog window:



   In this window, left-click the **Next>** button, so that InstallShield will continue with the installation.

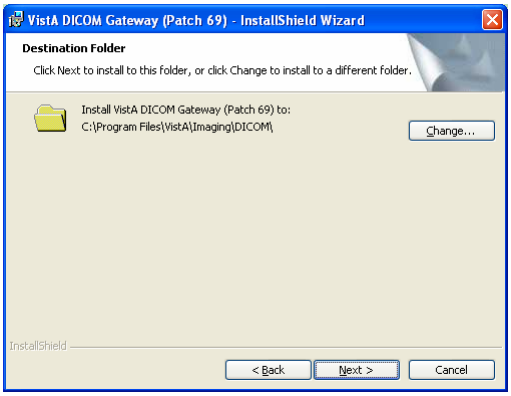
5. Installshield then displays the License Agreement for the software.



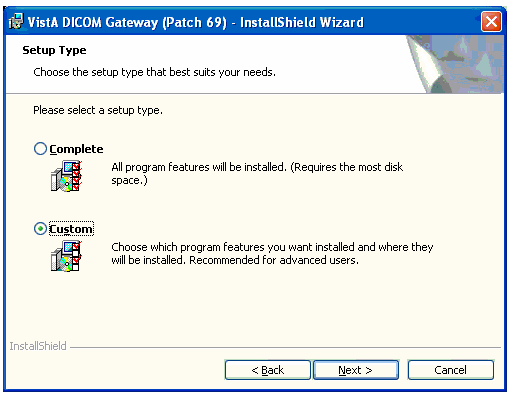
In this window, first read the license information. Keep in mind that use of the VistA Imaging software is controlled by FDA regulations, and that not everyone is authorized to use this software. Indicate agreement with this license only when it is actually legal to proceed with the installation, otherwise left-click the **Cancel** button at this point.

When installation may proceed, left-click the "**I accept the terms of this license agreement**" option and then left-click the **Next>** button.

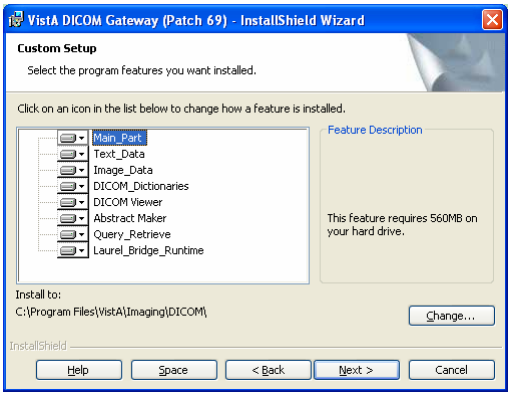
6. At this point, Installshield asks where to install the product. It is a rare exception that any changes are needed in this window, so left-click the **Next>** button to proceed. (If any changes are needed, they may be made in a later dialog window.)



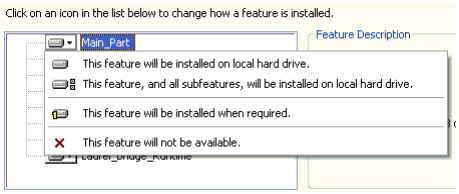
7. The next window offers a choice of installation types. **IN ORDER TO BE ABLE TO FILL IN SITE-SPECIFIC DETAILS LATER, IT IS REQUIRED TO SELECT A CUSTOM INSTALLATION IN THIS WINDOW.** So, left-click the **Custom** option and then left-click the **Next>** button.



8. The next window offers the ability to select which features of the product are to be installed and which drive they are to be installed on. It is a rare exception that any features are to be omitted. Under normal circumstances, all features are intended to be fully installed on one of the local disk drives of the target system.



9. In the case that a component is not to be installed, left-click on the down-arrow to the left of the name of that feature. When this arrow is clicked, a menu will pop up:



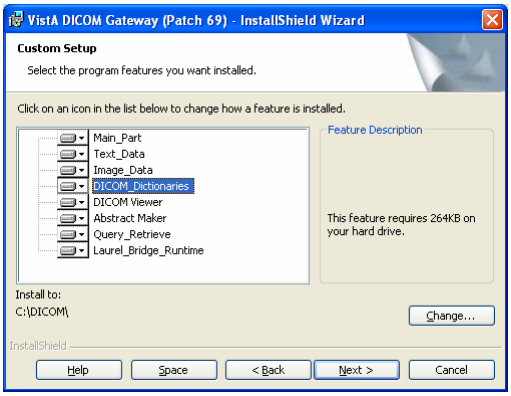
From this menu, select the appropriate choice.

Again: under normal circumstances, the appropriate selection is "**This feature will be installed on local hard drive**" for all features.

10. Left-click on the names of all features to verify that they are to be installed onto the correct disk drive. Especially the features labeled Text_Data, Image_Data and DICOM_Dictionaries may need to be installed on a disk drive other than **C:**.

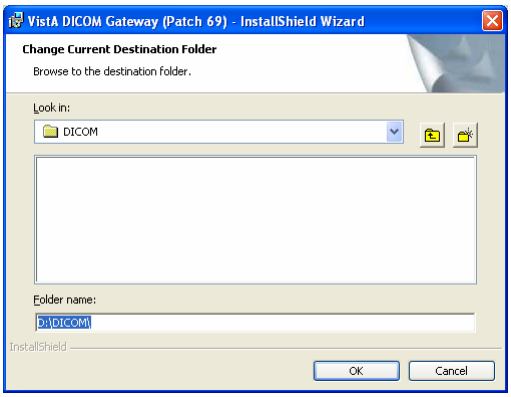
    The sample session below assumes that Text Data is to be installed on a drive labeled T:, Image Data on a drive labeled I: and DICOM Dictionaries on a drive labeled D:. (These drive letters are chosen as a mnemonic aid and to illustrate the possibility to install on drives other than the C: drive. On most installations, Text and Image Data will be installed on the C: drive and DICOM Dictionaries will be installed on a networked drive, and the drive-letter for that drive will be site-specific, of course).

    For each feature that is to be installed on a disk drive other than the C: drive, left-click on the name of that feature (the name of that feature will be highlighted):



    Then, left-click the **Change…** button to modify the disk drive assignment.

11. In the window that appears, replace **C:\DICOM** with the name of the appropriate location and then left-click the **OK** button.

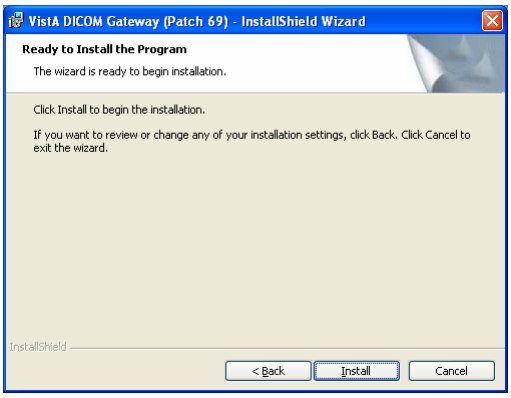


    For the location of Text Data, Image Data and DICOM Dictionaries, note that the value to be entered must look like “drive-letter, colon, and then **\DICOM**”, otherwise the installation will abort later.

Any other features may be installed in any location that is accessible to the computer.

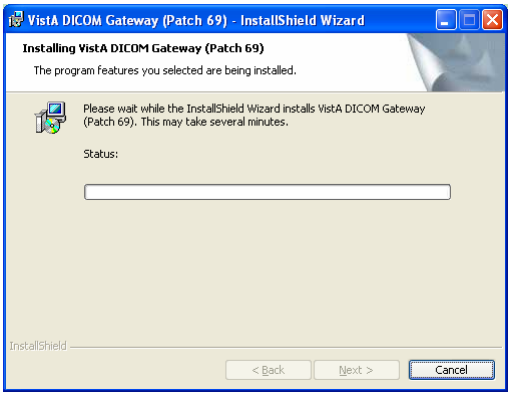
12. When all appropriate feature-destinations are chosen, left-click the **Next>** button in the features window.

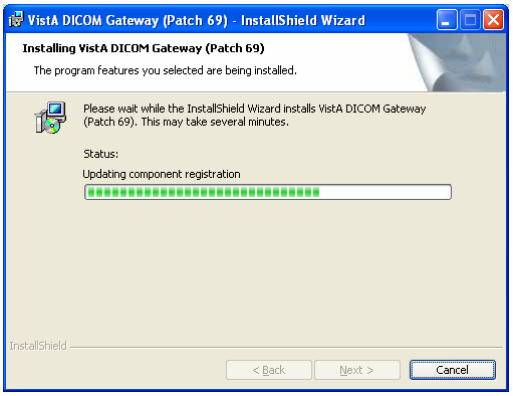
13. At this point, InstallShield offers a final chance to modify any parameters to be used for the installation:



If there is any uncertainty about the value of a parameter, left-click the **<Back** button to go back to the window where that setting may be modified, otherwise left-click the **Next>** button to start the actual installation.

14. While the installation is proceeding, the status of the installer will be displayed in a progress window.

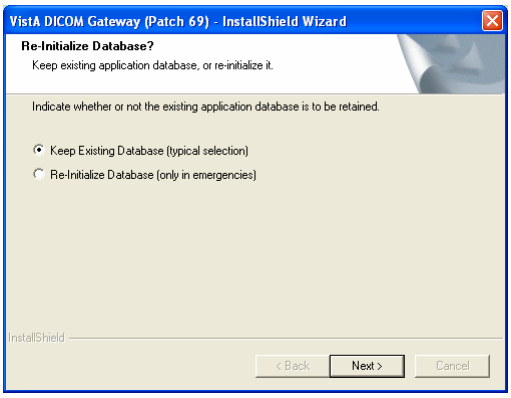




Do not press any buttons while this window is visible (the only button available is labeled *Cancel*, and pressing it will abort the installation).

As the installer works its way through the various installation steps, the progress-bar will fill up. The total duration of the installation may vary from about a minute (modern, "fast" computer) to about 10 minutes (older, "slow" computer).

15. If this is the very first installation of the DICOM Gateway software, the installation will proceed without any further questions. If the software is already present on the current computer, the following window will appear:



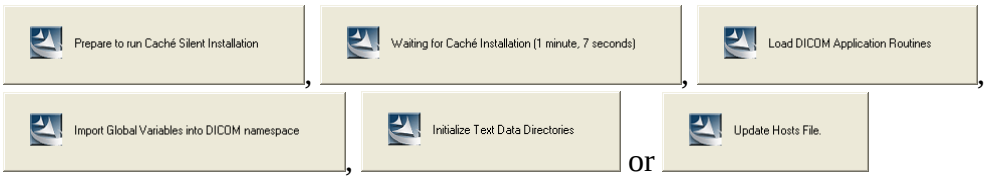
Normally, of course, one would keep the existing database, so that any existing data will continue to be available after the installation is complete.

If a situation arises where incorrect information has been entered into this database and it is no longer clear whether the database contains information that allows the DICOM Gateway to run properly, one may opt to discard the existing database and start with a fresh one.

Normally, one would left-click the **Next>** button to continue.

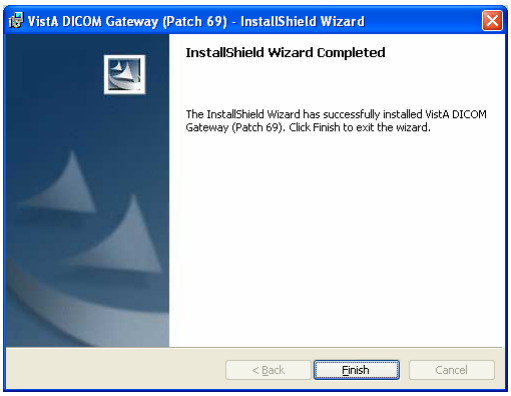
In those rare cases where the database has to be re-initialized, left-click the **Re-Initialize** button, and then left-click the **Next>** button.

16. As the installation proceeds, various little message boxes will pop up and disappear, such as:



These boxes are intended to inform the end-user about the progress of the installation, and no user-interaction is needed while these message boxes are visible.

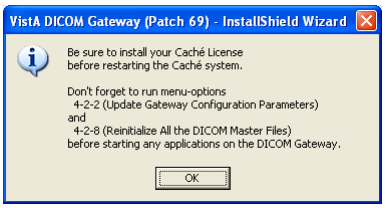
17. When the installation is complete, the final window will appear:



This window signals that the installation is complete. Left-click the **Finish** button to exit out of the installation program.

18. In some cases, there may be left-over tasks that the installation program could not perform. When this happens, a message box will be displayed that indicates the remaining installation steps:

- Install a valid Caché license
  While an installation can be performed without a valid license on the computer, the application can only be used after a valid license is installed.
- Import all “master files”
  On an upgrade-installation, the “master files” are updated automatically. Since this action can only be performed after the connection parameters for the VistA Hospital Information system have been entered, an “initial” installation cannot perform this step automatically.



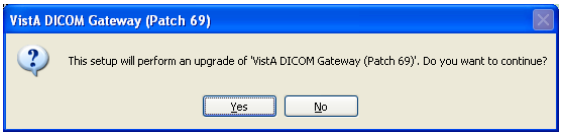
When a reminder-message like this appears, left-click the **OK** button, and don’t forget to carry out the actions mentioned in the reminder.

3.6 Updating an Existing Installation

During an upgrade, many of the same dialog windows will be the same as those shown for an initial installation. The user-actions related to these windows are the same as for an initial installation.

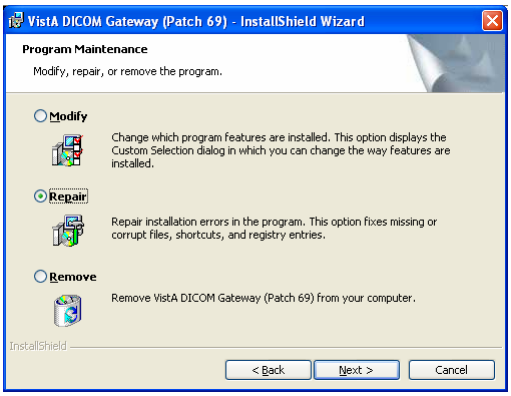
There are a couple of dialog windows that are specific to an upgrade, and that need to receive specific user-responses.

1. The first is the window that notifies the end-user of the start of an InstallShield update execution. This window will appear only the first time that a specific upgrade is started on a computer.



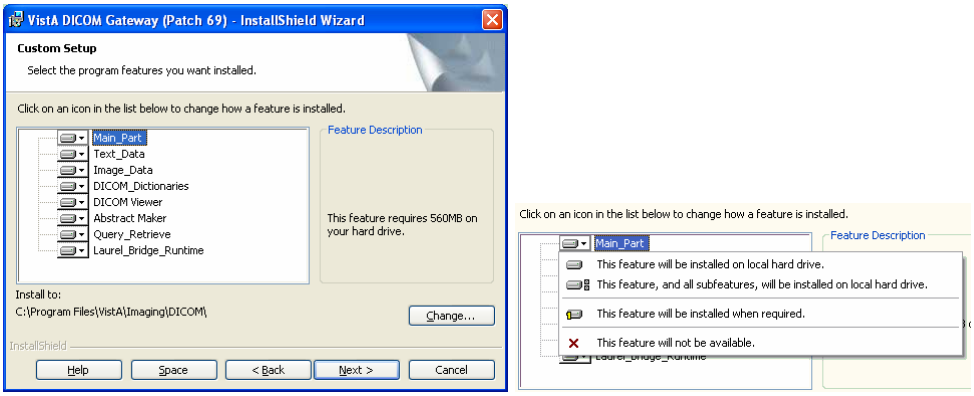
When this window appears, left-click the **Yes** button.

2. The second is the window that allows the end-user to change installation parameters:



When this window appears, the typical action is to select the **Repair** button to obtain correct copies of any component-files that may have been corrupted.

When the **Modify** button is selected, the window for selecting or deselecting features will re-appear:



Using this dialog window, the end-user may select to add features that were omitted during an earlier installation, or remove features that are no longer needed.

When the **Remove** button is selected, all features of the VistA Imaging DICOM Gateway will be removed (**un**-installed).

Note: when the end-user chooses to un-install the "main" feature, all application-related files will be removed. In order to also remove the Caché system, the option to **Add/Remove Programs** will need to be executed from the Microsoft Windows Control Panel.

3.7 Further Set-Up

Further set-up and configuration of the VistA Imaging DICOM Gateway is divided into two areas:

- Configuration of the Caché system
- Configuration of the VistA Imaging DICOM Gateway application

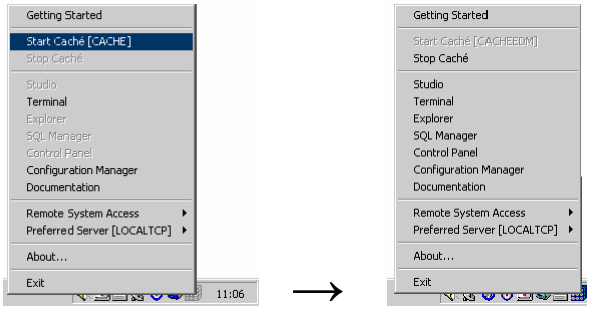
3.7.1 Configuration of the Caché System

For the configuration of the Caché system, there is an icon in the "system tray" (usually located on the lower right side of the display) that gives access to the various management functions in Caché. This icon is usually called the "Caché Cube".

When Caché is inactive, this icon is grey:

When Caché is active, this icon is blue:

"Clicking" on this icon will cause a menu to appear that can be used to manipulate the Caché system, e.g. to start Caché, right-click on the grey cube and select "**Start Caché**":



Note: Once Caché is started, the icon will change color from grey to blue, and the selection of available menu options will change.

Note: Once Caché has been installed using the automated procedure shown in the previous sections, it will be started automatically each time the computer is re-booted. I.e., under normal circumstances, there is no need for end-users to start or stop the Caché system.

The various options related to configuration of the Caché system are described in the documentation that comes with the Caché system and are provided through the menu that is shown above. Some configuration options are accessed through the menu option labeled **Configuration Manager**; some options are accessed through the menu option labeled **Control Panel** (greyed-out on the menu shown, this menu option is only accessible when Caché is up-and-running).

Note: Printed documentation about Caché is available through its vendor (InterSystems Corp.). The menu option labeled **Documentation** (see above) provides a searchable "on-line" version of all information that is available in printed form.

3.7.2 Configuration of the VistA Imaging DICOM Gateway Application

Configuration of the VistA Imaging DICOM Gateway Application is performed using the menu options in the VistA Imaging DICOM Gateway application itself. The most important parameters are maintained using menu option **4-2-2** (Update Gateway Configuration Parameters), described later in this document.

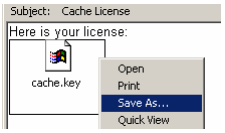
```
Gateway Configuration and DICOM Master Files – Caché Demo System

   1  Display Gateway Configuration Parameters
   2  Update Gateway Configuration Parameters
   3  Update INSTRUMENT.DIC
   4  Update MODALITY.DIC
   5  Update PORTLIST.DIC
   6  Update SCU_LIST.DIC
   7  Update WORKLIST.DIC
   8  Reinitialize All the DICOM Master Files
   9  Create Shortcuts for Instruments
  10  Validate Access/Verify Codes for Modality Worklist
```

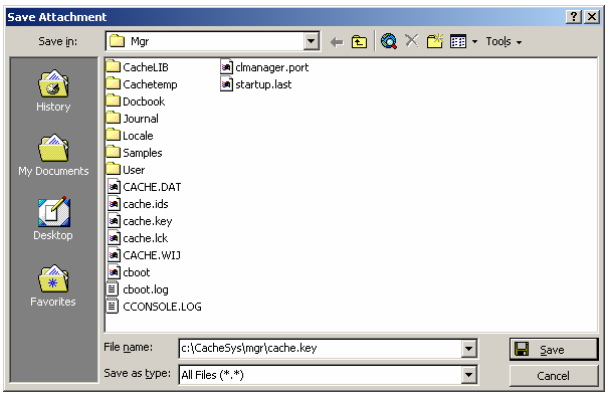
3.8 Creating a Caché License

Licenses for Caché may be provided in a number of ways. If a license is provided in the form of a file, all that is needed is to copy that file into the appropriate directory. The name of this directory is `x:\CacheSys\mgr`, where `x` represents the drive-letter for the disk on which Caché is installed.

E.g. If a license is received as an attachment to an e-mail message.

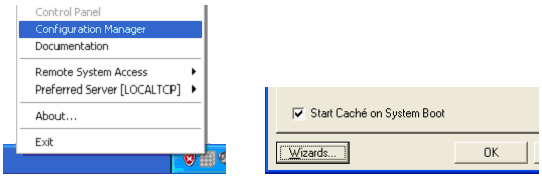


Save the attachment in the appropriate directory:

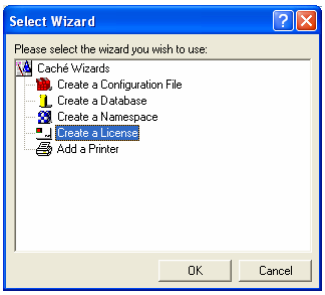


If the license-information was received in a different format, it is necessary to use the Caché License Manager Wizard to enter the license.

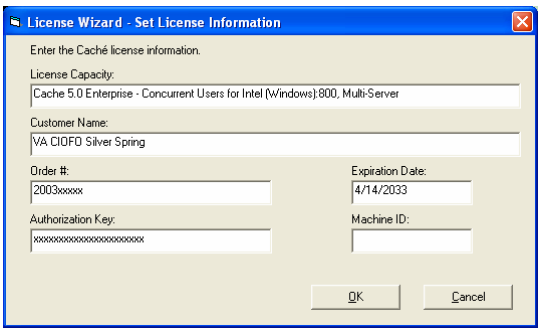
In order to set start the License Manager Wizard, right-click on the Caché Cube (either blue or grey). Select **Configuration Manager**.



When the window for the Configuration Manager appears, left-click the **Wizards** button (left lower corner).



In the next window that pops up, select the line labeled ‘Create a License’ and then left-click the **OK** button. The window for the actual data entry will appear:



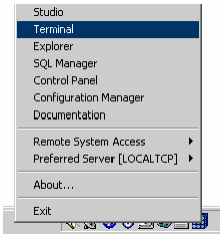
Fill in all fields as appropriate, and then left-click the **OK** button.
After the edit-window has closed, left-click the **OK** button in the Configuration Manager window.

3.9 Security Issues

Detailed information about security issues related to the VistA Imaging DICOM Gateway is documented in the VistA Imaging Security Manual. This section highlights some general issues that are relevant during the installation of the VistA Imaging DICOM Gateway software.

3.9.1 Application-Related Passwords

In order to set up definitions for application-related passwords for the VistA Imaging DICOM Gateway, first start up Caché (if necessary) and then click on the (blue) Caché Cube. Select **Terminal**.



A new window will open. This "console" window will provide direct (programmer's) access to the Caché environment that supports the VistA Imaging DICOM Gateway.

Note 1: In the sample text below, the text "**password**" appears several times. For each instance, use a site-specific password that is appropriate. Passwords must be six or more characters in length and must consist of a combination of letters and numbers. Passwords are case-insensitive, however.

Note 2: When an end-user logs on using the password for "**Print/View Only**", the only menu options that will be available are those that cannot modify the database.

Note 3: Use different passwords for ACCESS code, VERIFY code, PROGRAMMER ACCESS code, PRINT/VIEW ONLY code, and SUPPORT code.

Conduct the following dialog:

```
USER> D ^%CD <Enter>
Namespace: DICOM
You're in namespace DICOM
Default directory is c:\dicom\cache\
DICOM> Do INIT^MAGDLOGN <Enter>

Enter new ACCESS code: password <Enter>
Re-enter ACCESS code (to make sure I got it right): password <Enter>

Enter new VERIFY code: password <Enter>
Re-enter VERIFY code (to make sure I got it right): password <Enter>
```

```
Enter new PROGRAMMER ACCESS code: password <Enter>
Re-enter PROGRAMMER ACCESS code (to make sure I got it right): password <Enter>

Enter new PRINT/VIEW ONLY code: password <Enter>
Re-enter PRINT/VIEW ONLY code (to make sure I got it right): password <Enter>

Enter new SUPPORT code: password <Enter>
Re-enter SUPPORT code (to make sure I got it right): password <Enter>
DICOM>
```

Note: Normally, a session will start up in the namespace "**DICOM**". The first step of this dialog is only needed after a session has changed to a different namespace.

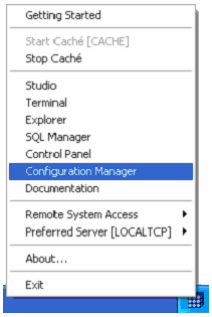
3.9.2 Access to Networked Disk Drives

Some processes in the Caché system run "in the background", i.e. they are started in a way that makes them independent of the user who is currently logged on into the Windows operating system. In order to make sure that these processes have access to any disk drives that need to be accessible to the VistA Imaging DICOM Gateway application software, credentials need to be set up that will be used by these "background" processes.

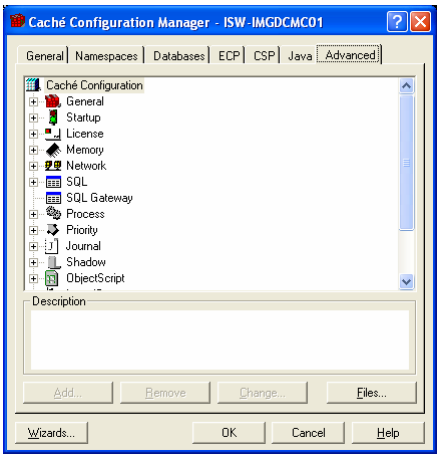
In Cache Version 5.0, these credentials are set up using Caché itself. In Caché version 5.1, these credentials are set up using the Windows Control Panel.

3.9.2.1 Credentials for Caché 5.0

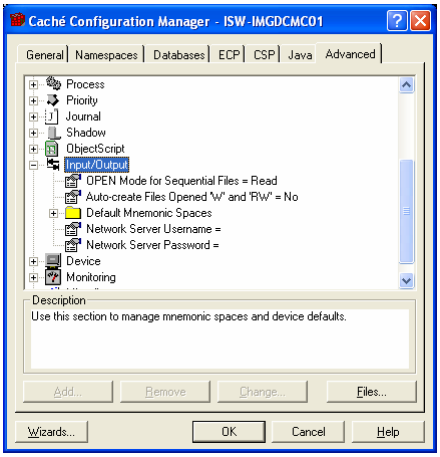
In order to set up credentials for "background" processes, right-click on the Caché Cube (either blue or grey). Select **Configuration Manager**.



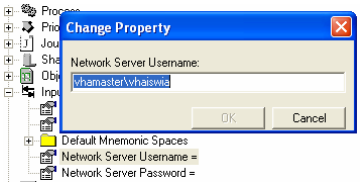
In the window that appears, select the tab labeled **Advanced** (the right-most tab).



In the window for Advanced Configuration Management, scroll down until the definition tree for **Input/Output** becomes visible. Left-click on the ⊞ icon, so that the tree will expand:



Double-click on the line for the **Network Server Username**. A new window will pop up:



Enter the username to be used for "background" processes. This username must be the fully qualified name for the Windows Operating System (not a VistA access code); most sites have set up a special user name like **XXXXXXXXXXXXXXXXXXXXXXX** (where **vv** is replaced with the VISN number and **xxx** is replaced with the three-letter abbreviation for the name of the site) for this purpose.

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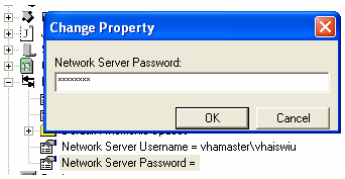
When the proper user-name is entered, left-click the **OK** button.

The edit-window will be closed.

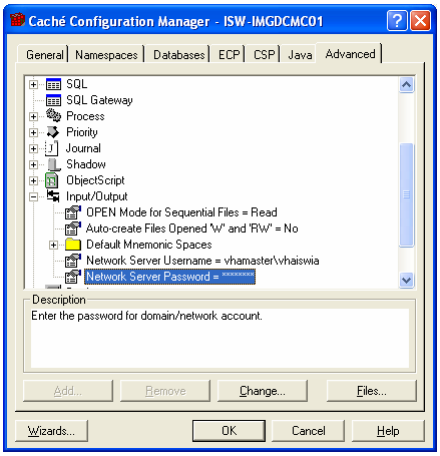
Next, double-click on the line for the **Network Server Password**. A new window will pop up:



Enter the password for the username entered above. Note that passwords are not echoed.

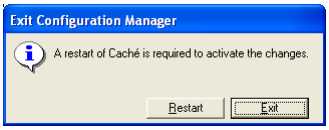
When the proper password is entered, left-click the **OK** button.

The edit-window will be closed.



Finally, left-click the **OK** button.

If Caché was up-and-running (blue cube) while this change was made, since this is a change that affects the complete Caché system operation, the Caché system will restart itself after this change has been made.



Left-click the **Restart** button to make this change effective.

Note: VA policy requires that end-user passwords are changed on a regular basis. Because of this, it is recommended to use the special user **XXXXXXXXXXX** for this purpose, since the password of this special user should be set up so that it does not expire. In either case, when the

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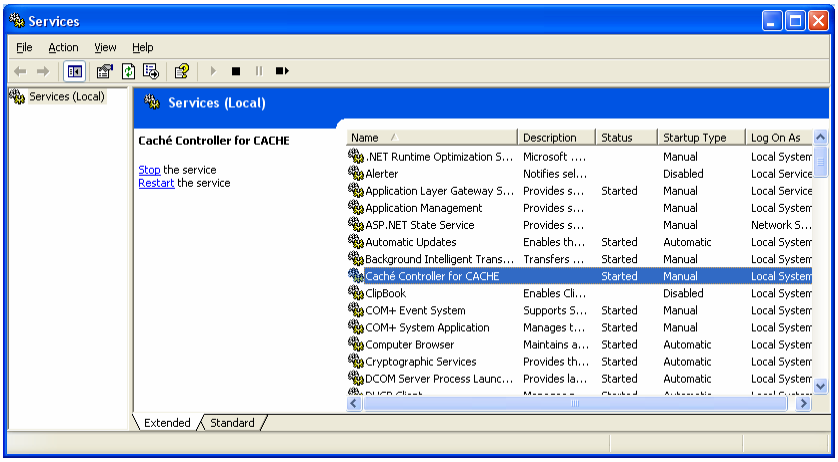
password of this user is changed, be sure to update this setting accordingly, otherwise "background" processes will no longer have access to networked disk shares.

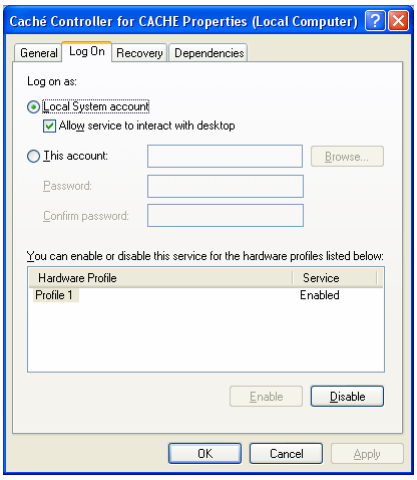
Next, it is important to verify that appropriate privileges are granted to the username that was selected above.

From the **Start Menu**, select **Control Panel → Administrative Tools → Services**.



Right-click on **Caché Controller for CACHE**, and select **Properties**.

Select the tab labeled Log On

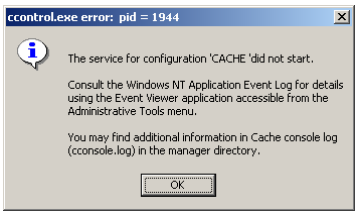


Make sure that the radio-button is selected for **Local System Account**, and make sure that the checkbox for **Allow service to interact with desktop** is checked.

Click the **OK** button and close the windows for **Services** and **Administrative Tools**.

3.9.2.2 More Privileges

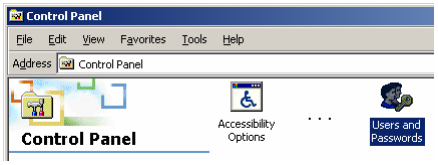
When Caché is restarted, it may happen that the following message appears:



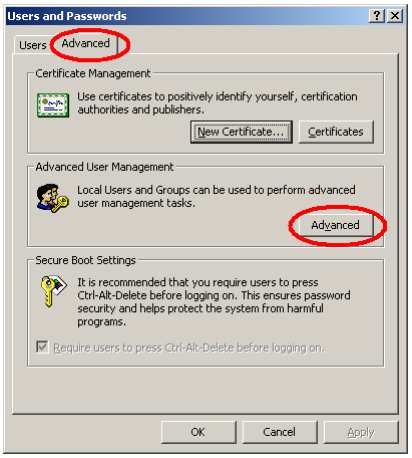
This message may appear in any version of Caché. This message usually means that the credentials that were entered in the previous step belong to a username that has no administrative privileges on the current computer.

If a different user should be selected, repeat the steps from the previous sections to enter the correct credentials.

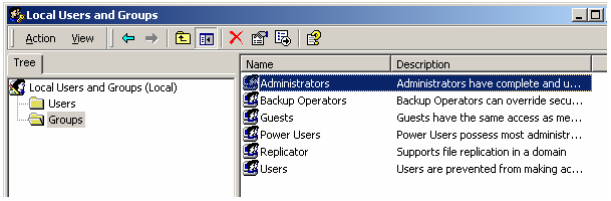
If the selected user should be an administrator on the current computer, go back to the Windows Control Panel, and double-click on Users and Passwords.



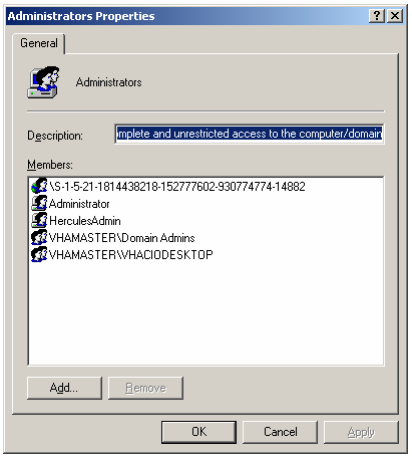
In the next dialog window, first select the tab labeled **Advanced**, and then click on the button labeled **Advanced**.



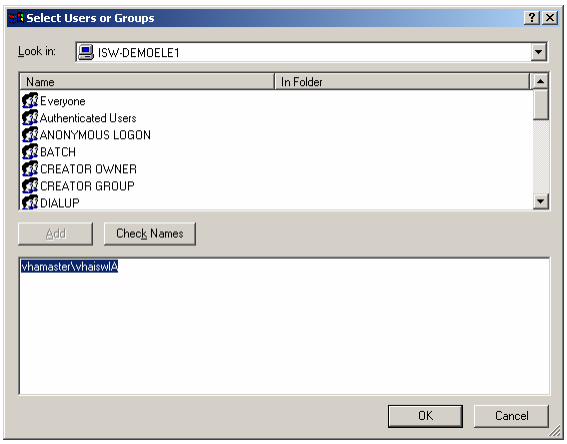
In the next window, click on Groups and then double-click on Administrators.



Subsequently, click on the button labeled Add



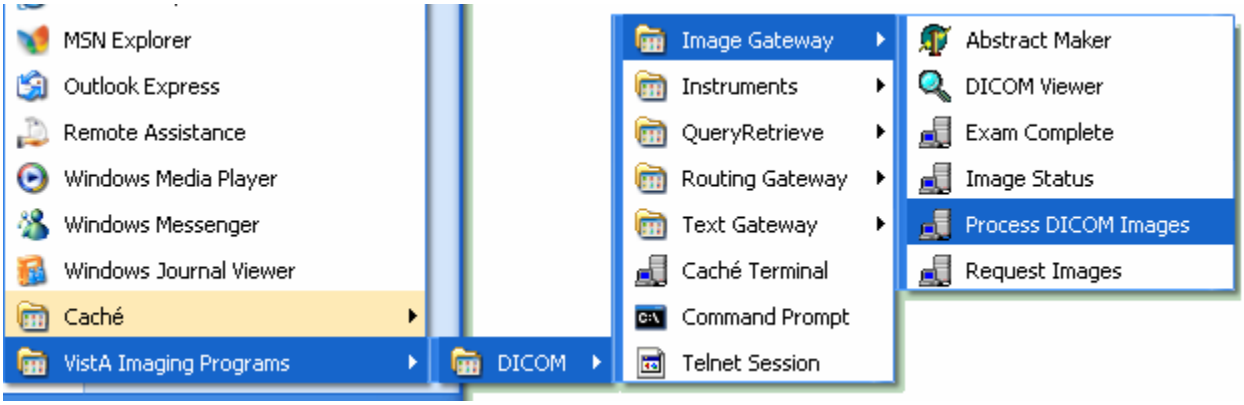
and add the name of the selected user in the dialog window that follows.



When the username is entered, click the **OK** button the appropriate number of times, and exit out of the remaining windows by clicking on the exit button ().

3.10 Starting Application Routines

The various programs that are part of the VistA Imaging DICOM Gateway can be started from the Microsoft Windows Start Menu:



In order to execute any of the programs, left-click on Start, navigate to **VistA Imaging Programs**, then to **DICOM**, then to the appropriate sub-system, and then to the appropriate application program.

See **Appendix A** for more information about this menu.

3.11 Installation Error Messages

Below follows a list of error messages that may occur during installation. Typically, each of these error messages will indicate a lack of privileges or a lack of resources:

An installation must be performed by a system manager who has appropriate privileges to install software within the operating system (i.e. must be a Windows Administrator).

If networked resources are used during an installation, the all systems must be connected using a stable network.

The target system must have sufficient disk-space to receive the software that is to be installed (at least 300MB of free disk space)

The messages itemized below may be produced during an installation. If any of these messages appears, contact Customer Support for assistance.

```
Unable to create batch file for (un)registering OCX files.
Could not close batch file (for processing OCX files).
Unable to process OCX files.
Unable to create batch file.
WriteLine to batch file failed (select ISS file).
Could not close batch file (select ISS file).
```

```
Unable to update ISS file.

Unable to run Caché Silent Install

Could not close file "xxx".

Could not perform Caché Silent Install: xxx

Unable to stop Caché.

Unable to create batch file to purge temporary files.

Unable to Purge Temporary Files for Caché Installation.

Unable to restart Caché.

Unable to create ZSTU routine file.

Unable to create batch file to load ZSTU routine.

Unable to import ZSTU routine.

Cannot import ZSTU routine

Cannot Read message in xxx

Unable to import ZSTU routine
xxx

Unable to create batch file to load DICOM application routines.

Unable to import DICOM application routines.

Cannot import DICOM application routines

Cannot Read message in xxx

Unable to import DICOM application routines
xxx

Unable to purge obsolete global variables.

Unable to create DICOM Global Variable Save file.

Unable to create batch file to load DICOM Global Variables.

Unable to import DICOM global variables.

Cannot import DICOM application routines

Unable to stop Caché.

Unable to create batch file to load DICOM Global Variables.

Unable (re)initialize Text Data Directories.

Unable to run Master File Update.

Unable to obtain status of Master File Update

Cannot locate notepad.exe.

Unable to display error log from Master File Update.

Unable to save DICOM_Look_Here in Registry.

Unable to save DICOM_Cache_Drive in Registry.

Unable to save DICOM_Text_Drive in Registry.

Unable to save DICOM_Image_Drive in Registry.
```

```
Unable to save DICOM_Dictionary_Drive in Registry.

Unable to save DICOM_Text_Drive in Registry.

Error in Set Up:
Destination for Text Data is invalid.
Selected destination is "x"
should be "xxx".
Destination for Image Data is invalid.
Selected destination is "xxx"
should be "xxx".
Destination for DICOM Dictionary Data is invalid.
Selected destination is "xxx"
should be "xxx".
Aborting installation...

Cannot Find Caché Configuration File
xxx

Cannot Create New Caché Configuration File
xxx

Cannot delete file "xxx"
Status code is nnn = xxx

Cannot Create New Host File
xxx

Cannot Create New Host File
xxx

Cannot copy shortcut for
xxx
nnn = xxx
```

3.12 End of First Phase of Installation

At this point, the express set-up of the software is complete. Continue with Chapter 4, which explains the definition of a number of site-specific parameters.

Chapter 4 Site-Specific Set-Up

This chapter describes how to build the Master File Dictionaries for the DICOM applications. All of the examples in this chapter assume that the master files are stored in the **\DICOM\Dict** directory on an Windows file server that is mounted as a networked drive and accessed using the letter **F:**.

The format and content of the master files is described in Appendix B.

4.1 Site-Specific parameters

The master files contain dictionary and configuration information that is used by the DICOM applications. Those master files that contain static dictionary information should not be modified (e.g. the DICOM Element Dictionary). Files containing site-specification configuration information must be customized before proceeding (e.g. list of instruments present at a site).

The master files are located in the directory **F:\DICOM\Dict** (If in section 3.8, a different drive letter was chosen, use that drive letter throughout this chapter). The local modifications to be made to these files are described in Appendix B. The files to be modified are:

- Instrument.DIC (see Appendix B.4.1)
- Modality.DIC (see Appendix B.4.2)
- Portlist.DIC (see Appendix B.4.3)
- SCU_list.DIC (see Appendix B.4.4)
- Worklist.DIC (see Appendix B.4.5)

4.2 Local Modifications

The contents of the master files **Instrument.DIC**, **Modality.DIC**, **PortList.DIC**, **Worklist.DIC** and **SCU_List.DIC** need to be modified to reflect the equipment that is present at the site. See Appendix B for details on the contents of these files.

Make any modifications that are needed to these files, and then continue with the steps below.

4.3 Configure the DICOM Gateway and load the DICOM Dictionaries

The following subsections describe the process of completely configuring a VistA Imaging DICOM Gateway including loading of all the dictionaries.

Note: Individual portions of the VistA Imaging DICOM Gateway can be selectively updated as well. This operation is described in the VistA Imaging DICOM Gateway User Manual.

Create a new session (click on the blue Caché cube, and select **Terminal**),then use the menu to start the program:

```
DICOM> Do ^MAGDLOGN <Enter>
```

```
*****************************************************************************
**  VistA DICOM Interface                                                  **
**                                                                         **
**  The Food and Drug Administration classifies this software as a medical **
**  device.  Modification of this software may result in an adulterated    **
**  medical device, the use of which is considered to be a violation of    **
**  US Federal Statutes.  Federal law restricts this device to use by or   **
**  on the order of either a licensed practitioner or persons lawfully     **
**  engaged in the manufacture, support, or distribution of the product.   **
**                                                                         **
**  The information in this system is further protected by the Privacy Act **
**  of 1974 (PL93-579).  Unauthorized access to or use of this system is a **
**  serious violation of Federal Law.  Violators will be prosecuted.       **
**                                                                         **
**                  Use of this software is monitored.                     **
*****************************************************************************

Login using M-to-M RPC Broker Server "10.2.29.246" on Port 4800

ACCESS CODE:     (use an access code that is valid on the VistA system)
VERIFY CODE:     (use a verify code that is valid on the VistA system)

                    ** WARNING**WARNING**WARNING**
"This U.S. Government computer system is for official use only.  The files
on this system include Federal records that contain sensitive information.
All activities on this system may be monitored to measure network
performance and resource utilization; to detect unauthorized access to or
misuse of the system or individual files and utilities on the system,
including personal use; and to protect the operational integrity of the
system.  Further use of this system constitutes your consent to such
monitoring.  Misuse of or unauthorized access to this system may result in
criminal prosecution and disciplinary, adverse, or other appropriate
action."
                  **WARNING** WARNING** WARNING**
  MISUSE OF THIS SYSTEM AND INFORMATION IN THIS SYSTEM IS A FEDERAL CRIME


============================================================================
                  ISW-IMGDEMO1
       Welcome to the VistA Imaging Demo System!

Press <Enter> to continue
```

From this point, proceed with menu option 4-2-2:

4 System Maintenance
→ **2** Gateway Configuration and DICOM Master Files
→ → **2** Update Gateway Configuration Parameters

4.3.1 Name of System

The system title is a short character string that appears on the top of the main DICOM application menu. Examples:

"Moscow DICOM Image Server System #3"
"New Orleans DICOM Text Gateway and Background Processor"

```
Please enter the system title: IMAGUSER's Workstation <Enter>
```

4.3.2 Location of DICOM Gateway

The configuration program will query the VistA system in order to obtain a list of the "locations" that are operational for the site. When a DICOM Gateway is part of a site that has only one

"location", the software will merely display the name of that location, and not ask the end-user for any input, e.g.:

```
This Gateway is located at COLUMBIA, MO (#543)
```

Otherwise, the end-user will be asked to identify the name of the "location" for which the DICOM Gateway in question will be operating.

4.3.3 DICOM Data Directories

The DICOM data directories are located on the local system, and are used to hold both the DICOM text and image files. D:\DICOM is typically the DICOM data directory. However, you may select another device letter (C:-Z:).

```
Please enter the device letter for
the DICOM text directory: d:// d <Enter>

Please enter the device letter for
the DICOM image directories: d:// d <Enter>
```

4.3.4 Percentage of Free Disk Space

The software will cease storing image files when the amount of free disk space drops below a certain threshold. The usual value for this threshold is **15%**.

```
Please enter the percentage of free disk space
required to allow storage of image files: 15%// 15 <Enter>
```

4.3.5 DICOM Dictionary Directory

The DICOM dictionary directory is usually on a networked system, and is used to hold DICOM master files. F:\DICOM is typically the DICOM dictionary directory. You may select any other device letter, however.

```
Enter the device letter for
the DICOM dictionary directory: c:// f <Enter>
```

4.3.6 Communication Channels

Communication channels are used to broadcast VistA event data. A separate channel is needed for each different destination. For instance, event data may be sent to both a commercial PACS and to one or more Modality Worklist service class providers (for example a Mitra Broker or a DeJarnette MediShare). Each destination must have its own event channel ***n*** and a dedicated c:\dicom\data***n*** subdirectory.

The number of communication channels must be between 1 and 9.

```
Please enter the number of communication channels  2// 2 <Enter>
```

4.3.7 Machine ID

Each computer that is used as a Text or Image DICOM Gateway needs a single unique identification letter. Use "**A**" for the first Image Gateway, "**B**" for the second Image Gateway,

"**C**" for the third Image Gateway (and so forth), and "**Z**" for the Text Gateway. The names of the DICOM image files acquired by this system will begin with this letter.

```
Please enter the machine ID:  A <Enter>
```

4.3.8 DICOM Image Gateway

If this system is to be configured as a VistA DICOM Image Gateway, the answer to this question must be "**Yes**". If this system is to be configured otherwise, answer "**No**".

Note: A VistA DICOM Gateway may be configured as a Text Gateway, an Image Gateway, a Routing Processor, or any combination thereof.

```
Will this system be a DICOM Image Gateway?  YES// y <Enter>
```

4.3.9 DICOM Text Gateway

If this system is to be configured as a VistA DICOM Text Gateway, to support the Modality Worklist and/or send event messages to a commercial **P**icture **A**rchiving and **C**ommunication **S**ystem (PACS), the answer to this question must be "**Yes**". If this system is to be configured otherwise, answer "**No**".

Note: A VistA DICOM Gateway may be configured as a Text Gateway, an Image Gateway, a Routing Processor, or any combination thereof.

```
Will this system be a DICOM Text Gateway?  YES// y <Enter>
```

4.3.10 DICOM Routing Processor

If this DICOM Gateway is to be configured as a VistA DICOM Routing Processor, the answer to this question must be "Yes". If this system is to be configured otherwise, answer "No".

Note: A VistA DICOM Gateway may be configured as a Text Gateway, an Image Gateway, a Routing Processor, or any combination thereof.

```
Will this system be a DICOM Routing Processor?  YES// y <Enter>
```

4.3.11 Auto-Routing Active

If one of the DICOM Gateways at this site is being used as a Routing Processor, the answer to this question must be "Yes". If no automated routing is to occur at this site, the answer to this question must be "No".

Note: When the answer to this question is set to "Yes", queue-entries will be created for automated routing. If no Routing Processor is active at the site, these queue entries will accumulate and never be processed or purged.

4.3.12 Radiology

If this DICOM Gateway is to be configured as a computer that processes Radiology exams, the answer to this question must be "Yes". If this system is to be configured otherwise, answer "No".

Note: A VistA DICOM Gateway may be configured as one that processes Radiology exams, one that handles Consults, or one that supports both.

4.3.13 Consults

If this DICOM Gateway is to be configured as a computer that processes Consults, the answer to this question must be "Yes". If this system is to be configured otherwise, answer "No".

Note: A VistA DICOM Gateway may be configured as one that processes Radiology exams, one that handles Consults, or one that supports both.

4.3.14 Send Text to commercial PACS

If this VistA DICOM Text Gateway is to be configured to send messages to either a commercial PACS or a Modality Worklist provider (for example, a Mitra Broker or a DeJarnette MediShare), the following question should be answered with "**Yes**". Otherwise, answer "**No**".

```
Send text to a commercial PACS, Mitra Broker, et cetera? n// n <Enter>
```

4.3.15 Receive EXAM COMPLETE Message from commercial PACS

The EXAM COMPLETE message is sent by some commercial PACS to signal that all the images for a study have been acquired and are ready to be sent to VistA. The EXAM COMPLETE message then serves as a trigger for VistA to pull the images from the commercial PACS. Other commercial PACS do not use the EXAM COMPLETE message, but autoroute their images to VistA.

If a commercial PACS is going to transmit EXAM COMPLETE messages to VistA that indicate all the images in a study are ready to be sent, answer "**Yes**" to this question. Otherwise, answer "**No**".

```
Is a PACS going to send Exam Complete messages to VistA?  NO// n <Enter>
```

4.3.16 Kind of PACS

If the previous question is answered with "Yes", an additional question will be asked:

```
Select the kind of commercial PACS at this site
-----------------------------------------------
    1 - GE Medical Systems PACS with Mitra PACS Broker
    2 - GE Medical Systems PACS with ACR-NEMA Text Gateway
    3 - eMed Technology Corporation PACS
    4 - Other commercial PACS

What kind of a PACS?
```

Enter the sequence number for the kind of PACS that is present at the site.

4.3.17 Modality Worklist Provider

If this Text Gateway is to be configured to provide the "Modality Worklist" capability, answer "**Yes**" to this question. Otherwise, answer "**No**".

```
Will this system be a Modality Worklist Provider?  y// <Enter> yes
```

4.3.18 Send CPT Modifiers

With Radiology Package patch RA*5*10, modifier codes are included when CPT codes are transmitted. These modifier codes` may be sent to PACSs and modalities via DICOM as a two-character suffix to a procedure code (*nnnn-**xx***). The usual configuration is to include the modifier suffix.

If the modifier suffices are to be included in messages, answer "**Yes**" to this question. If these suffixes are to be omitted, answer "**No**".

If the site is going to use VistARad, select "Yes". If it is going to use a commercial PACS, check with the vendor to see if it can support CPT-Modifiers.

```
Send CPT Modifiers? Yes // <Enter> Yes
```

4.3.19 Dashes in SSN sent to PACS

The DICOM Text Gateway can be configured to include or not include dashes in Social Security Numbers sent to a PACS. If the PACS can handle dashes in Social Security Numbers, enter "Yes". If it cannot handle them, enter "No".

```
Include DASHES in Social Security Numbers sent to PACS? YES// <Enter> YES
```

Note: Dashes can also be suppressed in Modality Worklist. See Section B.4.5.

4.3.20 TCP/IP Address for VistA

In order to connect to the VistA system using the MUMPS-to-MUMPS Kernel Broker, the DICOM Gateway must know the TCP/IP address of the VistA system. Enter the site-specific address.

```
Enter the network address for the main VistA HIS: 10.11.12.13//
```

The address may be entered as the numeric address (in those cases that the connection must be with a specific processor) or to the "human-readable" name that is set up in the domain name server.

DICOM Gateways running on MSM servers are limited in the sense that symbolic names may not be longer than 31 characters. DICOM Gateways running on Caché servers do not have such a limitation.

4.3.21 TCP/IP Port for MUMPS-to-MUMPS Broker

In order to connect to the VistA system using the MUMPS-to-MUMPS Kernel Broker, the DICOM Gateway must know the TCP/IP port number on which the Broker is listening on the VistA system. Enter the site-specific port-number.

```
Enter the network port number for the main VistA HIS: 4800//
```

4.3.22 Mail Group

When significant operational issues arise, the DICOM Gateway will send e-mail messages to a site-specific mail-group. Enter the e-mail address for the site-specific mail-group.

Note 1: A DICOM Gateway sends e-mail using the standard SMTP protocol, ***not*** through MailMan. If a mail-group within MailMan needs to receive these e-mail messages, the name of this mail-group cannot include any space characters.

Note 2: A site may or may not decide to include addresses in this mail-group that cause a pager to be activated.

```
Send emergency e-mail notices to: DICOM@site.med.va.gov//
```

4.3.23 Display Patient Name

A DICOM Image Gateway presents an activity log while it is processing images. This activity log includes information that contains patient identifiers. When this display is visible from a public area, it is necessary to suppress the privacy-sensitive details.

When these details are to be suppressed (i.e., displayed as a series of asterisks), the answer to this question must be “No”. If these details are allowed to be visible, the answer to this question can be “Yes”.

```
Display Patient Name/ID in Image Processing? NO//
```

4.3.24 Access Code for Modality Worklist

When an external entity sends a Modality Worklist request to a DICOM Gateway, the DICOM Gateway is usually able to respond to the request using information that is stored on the Gateway itself. In some cases, the DICOM Gateway will need to query the VistA system for details to report back to the requester. When the DICOM Gateway makes such a request to the VistA system, it will use the access code that is specified as the answer to this question.

Note: The response to this question is treated as a password, i.e. it is not displayed on the monitor of the end-user.

```
Access Code for Modality Worklist //
```

4.3.25 Verify Code for Modality Worklist

When an external entity sends a Modality Worklist request to a DICOM Gateway, the DICOM Gateway is usually able to respond to the request using information that is stored on the Gateway

itself. In some cases, the DICOM Gateway will need to query the VistA system for details to report back to the requester. When the DICOM Gateway makes such a request to the VistA system, it will use the access code that is specified as the answer to this question.

Note: The response to this question is treated as a password (i.e., it is not displayed on the monitor of the end-user).

```
Verify Code for Modality Worklist //
```

4.3.26 Modality Worklist Port Numbers

Normally, modality worklist requests are processed through TCP/IP port number 60010. Some sites have equipment that uses a different port number, and that cannot be configured to use any other port number. In order to support such equipment, it is possible to define additional port numbers for modality worklist processors.

```
Currently, there is a Modality WorkList processor for
the following port:
          60010

Change? [A/D/N] N// ? <Enter>
Enter one of the following:
  No                if no (additional) change is to be made
  Add <number>      to add a listener for a port
  Delete <number>   to remove a listener for a port
Note that valid port numbers are integers between 1 and 65535.
Note that the listener for port 60010 may not be removed.

Currently, there is a Modality WorkList processor for
the following port:
          60010

Change? [A/D/N] N// a 104 <Enter>

Currently, there are Modality WorkList processors for
the following ports:
          104
          60010

Change? [A/D/N] N// d 104 <Enter>

Currently, there is a Modality WorkList processor for
the following port:
          60010

Change? [A/D/N] N//
```

4.3.27 E-mail Post Office

The Department of Veterans Affairs has three virus-checking post-offices set up for nationwide e-mail. The post-office that should be selected for this setting should be the one to which the site has the best network-connection. There are six possible responses for this question:

- **0**: use the local VistA system (default)
- **1**: use the Virus-Checking Office in Silver Spring, MD at 10.2.27.92
- **2**: use the Virus-Checking Office in Hines, IL at 10.3.27.92
- **3**: use the Virus-Checking Office in San Francisco, CA at 10.6.27.92
- **4**: use VA-Forum at 10.2.29.131
- or enter the TCP/IP address of the system to be used.

```
Which post-office will this computer use? smtp.va.gov <Enter>
```

Note: VA policy on the usage of e-mail post offices has changed several times while this documentation was being prepared. At the time this documentation is written, the only value that is allowed to be entered for this parameter is "**smtp.va.gov**".

Consult with your ISO for the VA's current policy on this issue.

4.4 Loading the DICOM Dictionaries

The DICOM Dictionaries are constructed by populating a number of Fileman globals with data from the master files. Appendix B contains a detailed description of each master file. The format and contents of the resulting subtrees in global variable ^MAGDICOM(2006.5xx) are described in the (on-line) FileMan Data Dictionaries.

Sites should only make changes to the master files for the site-specific DICOM Dictionaries. The information in the global variable themselves should not be manually modified, as it will be overwritten the next time the master file is loaded.

In order to start loading the dictionaries, select menu option 4-2-8:

4 System Maintenance
→ **2** Gateway Configuration and DICOM Master Files
→ → **8** Reinitialize All the DICOM Master Files

```
Ready to build all of the DICOM Master Files?  y//  <Enter> yes
```

4.4.1 DICOM Data Element Dictionary

During this step, the contents of the file **ELEMENT.DIC** are loaded into global variable **^MAGDICOM(2006.51,…)**.

The contents of the master file **ELEMENT.DIC** may not be modified by the site.

```
Building the DICOM Element Dictionary -- ^MAGDICOM(2006.51)
Ready to read dictionary file "f:\DICOM\Dict\ELEMENT.DIC"?  y// y <Enter>
```

4.4.2 DICOM Message Template Dictionary

During this step, the contents of the file **TEMPLATE.DIC** are loaded into global variable **^MAGDICOM(2006.52,…)**.

The contents of the master file **TEMPLATE.DIC** may not be modified by the site.

```
Building the DICOM Message Template Dictionary -- ^MAGDICOM(2006.52)

Ready to read dictionary file "d:\DICOM\Dict\TEMPLATE.DIC"?  y// <Enter> yes

*** PASS 1 STARTED ***
*** PASS 2 STARTED ***
```

```
- DONE -
```

4.4.3 DICOM Unique Identifier Dictionary

During this step, the contents of the file **UID.DIC** are into global variable **^MAGDICOM(2006.53,…)**.

The contents of the master file **UID.DIC** may not be modified by the site.

```
Building the DICOM UID Dictionary -- ^MAGDICOM(2006.53)
Ready to read dictionary file "f:\DICOM\Dict\UID.DIC"?  y// y <Enter>
```

4.4.4 Extended SOP Negotiation Table

During this step, the Extended SOP (Service Object Pair) Negotiation Table is loaded into global variable **^MAGDICOM(2006.531,…)**.

```
Updating the extended SOP negotiation table... done!
```

4.4.5 DICOM PDU Types

During this step, the PDU (Protocol Data Unit) table is loaded into global variable **^MAGDICOM(2006.54,…)**.

```
Updating the PDU TYPE table... done!
```

4.4.6 Imaging Service Dictionary

During this step, the Imaging Service Dictionary is loaded into global variable **^MAGDICOM(2006.589,…)**.

```
Updating the Imaging Service table...
done!
```

4.4.7 DICOM HL7 Segment and Field Dictionary

During this step, the contents of the file **HL7.DIC** are loaded into global variable **^MAGDICOM(2006.57,…)**.

The site may not modify the contents of the master file **HL7.DIC**.

```
Building the DICOM HL7 dictionary in ^MAGDICOM(2006.57)
Ready to read dictionary file "f:\DICOM\Dict\HL7.dic"?  y// y <Enter>

done!
```

4.4.8 Instruments

During this step, the contents of the file **INSTRUMENT.DIC** are loaded into global variable **^MAGDICOM(2006.581,…)**.

The contents of the master file **INSTRUMENT.DIC** must be customized for the site.

```
Building the Instrument Dictionary -- ^MAGDICOM(2006.581)
Ready to read dictionary file "f:\DICOM\Dict\INSTRUMENT.DIC"?  y// y <Enter>
```

4.4.9 Modalities

During this step, the contents of the file **MODALITY.DIC** are loaded into global variable **^MAGDICOM(2006.582,…)**.

The contents of the master file **MODALITY.DIC** must be customized for the site.

```
Building the Modality Type Dictionary -- ^MAGDICOM(2006.582)
Ready to read dictionary file "f:\DICOM\Dict\MODALITY.DIC"?  y// y <Enter>
```

4.4.10 Modality Worklist

During this step, the contents of the file **WORKLIST.DIC** are loaded into global variable **^MAGDICOM(2006.583,…)**.

The contents of the master file **WORKLIST.DIC** must be customized for the site.

```
Building the Modality Worklist Dictionary -- ^MAGDICOM(2006.583)
Ready to read dictionary file "f:\DICOM\Dict\WORKLIST.DIC"?  y// y <Enter>
```

4.4.11 Port Numbers for Text Gateway sending messages to PACS

During this step, the contents of the file **PORTLIST.DIC** are loaded into global variable **^MAGDICOM(2006.584,…)**.

The contents of the master file **PORTLIST.DIC** must be customized for the site.

Note: There may be no entities in the file.

```
Building the TCP/IP Provider Port Dictionary -- ^MAGDICOM(2006.584)
Ready to read dictionary file "f:\DICOM\Dict\PORTLIST.DIC"?  y// y <Enter>
```

4.4.12 User Application Parameters

During this step, the contents of the file **SCU_LIST.DIC** are loaded into global variable **^MAGDICOM(2006.585,…)**.

The contents of the master file **SCU_LIST.DIC** must be customized for the site.

```
Building the User Application Dictionary -- ^MAGDICOM(2006.585)
Ready to read dictionary file "f:\DICOM\Dict\SCU_LIST.DIC"?  y// y <Enter>
```

4.4.13 Provider Application Dictionary

During this step, the contents of the file **SCP_LIST.DIC** are loaded into global variable **^MAGDICOM(2006.586,…)**.

The contents of the master file **SCP_LIST.DIC** may not be modified by the site.

```
Building the Provider Application Dictionary -- ^MAGDICOM(2006.586)
Ready to read dictionary file "f:\DICOM\Dict\SCP_LIST.DIC"?  y// y <Enter>
```

4.4.14 Data Transfer

The master file named **Modality.DIC** references several other dictionary files that contain lists of additional data elements to be displayed on a diagnostic workstation. These "data transfer" dictionaries are loaded during this step.

```
Ready to build the "Data Transfer" Dictionaries?  y// y <Enter>

-- DICOM Master File Build completed successfully --
```

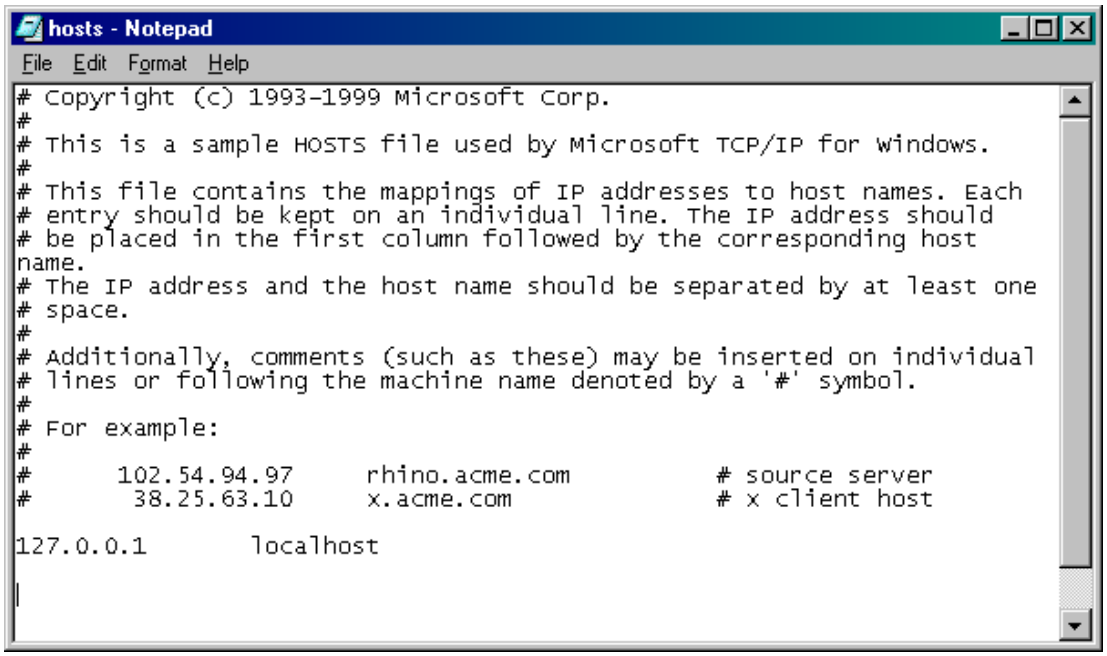
4.5 Automatically Generating Instrument Shortcut Icons

Menu option **4-2-9** (Create Shortcuts for Instruments) may be executed to generate instrument shortcut icons.

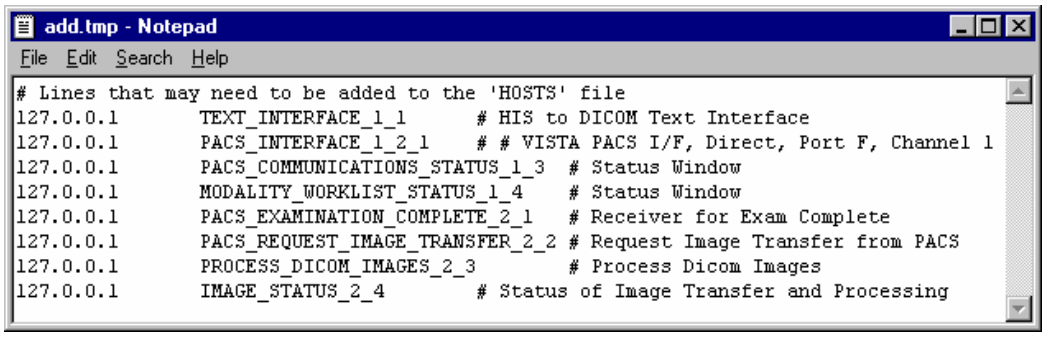
```
[DCM,DCM]>d ^MAGDMFIC <Enter>

Do you want to edit the 'HOSTS' file? Y// <Enter>
Done.
[DCM,DCM]>
```

The program first builds all "shortcuts" (in sub-directories of x:\DICOM\Icons\…) and then offers the installer the option to add a number of definitions to the "hosts" file. This file defines the "aliases" for the various TCP/IP addresses that may be needed for communication between the various pieces of equipment.

The program will open two Notepad™ windows, one for the file called "Hosts" and one for the file called "add.tmp". These are shown on the next two figures.



HOSTS



ADD.TMP

The user performing the installation can cut and paste lines with definitions from the window labeled "add.tmp" to the window labeled "hosts". When done editing, first close the window labeled "hosts", and then close the window labeled "add.tmp".

4.6 Adding DICOM Application Entities to the HOSTS file

When a DICOM Application Entity connects to a VistA Imaging DICOM Gateway, the gateway attempts to determine the network identity (i.e., the IP address) that is making the connection. It does this by invoking the operating system function `gethostbyaddr()`. This works most efficiently when the IP address of the instrument is registered in the VistA Imaging DICOM Gateway's "**HOSTS**" file (The full name of this file is typically **c:\WinNT\System32\ Drivers\etc\hosts**).

Each DICOM Application Entity needs to be added to the hosts file so that the gateway can quickly resolve names when TCP/IP connections are created. For each instrument (and each separate Modality Worklist service class user), add the IP address and mnemonic to the "**HOSTS**" file.

The following is an example from of a "HOSTS" file.

```
127.0.0.1       localhost

111.222.333.40    GECT1                          # GE High Speed CTI, Room F24
111.222.333.41    GEADW                          # GE Advantage Workstation F24
111.222.333.42    GEMR                           # GE Signal MRI, Room Mobile Trailer
#End of File
```

4.7 M Security – Programmer Access Code and Tied Terminal Table

As a final step, access to the login prompt will be restricted by making all access through telnet lines tied to the VistA DICOM login program.

Note 1: In the sample text below, the text "**password**" appears several times. For each instance, use a site-specific password that is appropriate. Passwords must be six or more characters in length and must consist of a combination of letters and numbers.

Note 2: When an end-user logs on using the password for "**Print/View Only**", the only menu options that will be available are those that cannot modify the database.

Note 3: Use different passwords for ACCESS code, VERIFY code, PROGRAMMER ACCESS code, PRINT/VIEW ONLY code, and SUPPORT code.

```
[DICOM>Do INIT^MAGDLOGN <Enter>


Enter new ACCESS code: password <Enter>
Re-enter ACCESS code (to make sure I got it right): password <Enter>

Enter new VERIFY code: password <Enter>
Re-enter VERIFY code (to make sure I got it right): password <Enter>

Enter new PROGRAMMER ACCESS code: password <Enter>
Re-enter PROGRAMMER ACCESS code (to make sure I got it right): password
<Enter>

Enter new PRINT/VIEW ONLY code: password <Enter>
Re-enter PRINT/VIEW ONLY code (to make sure I got it right): password <Enter>

Enter new SUPPORT code: password <Enter>
Re-enter SUPPORT code (to make sure I got it right): password <Enter>
[DICOM]>
```

4.8 Personal Preferences

Once the above setup procedures are completed, a few more steps may be taken to cosmetically adjust the appearance of the VistA Imaging DICOM Gateways.

Since the VistA Imaging DICOM Gateway software uses a lot of windows that will be simultaneously open, screen real estate on the monitor is at a premium. The current minimum resolution is 1280 by 1024 pixels, and, sometimes, that is still not enough. As a result, it is recommended to turn off all "frills" on directory windows: turn off all toolbars, all status bars, and don't use "web-view" (All of these are by themselves interesting additions, but for the purpose of a DICOM Gateway, they just take up a lot of display space, and don't offer any value in return). However, do leave the task bar that is usually at the bottom of the screen.

Note: Any customizations described in this section should be repeated for each VistA Imaging DICOM Gateway, so that all stations will present a similar appearance.

In order to make the final adjustments to the desktop, login with the user name that will be used to login into VistA from the current workstation (it is recommended that this name be

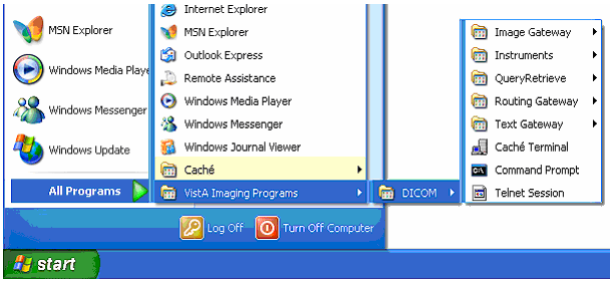
```
Content removed; FOIA exemption b2/high 2
```

Remove any icons that are left over from installation procedures, e.g. *Install Service Pack <nn>*, from all profiles (including the profile called "All Users").

At this point, all software and data is installed on the PC. This chapter describes a number of procedures that may be performed to validate that the installation software is correct and complete.

Please refer to **Appendix A** for detailed instructions for defining shortcuts.

The installation should have added a number of programs to the Windows Start menu.



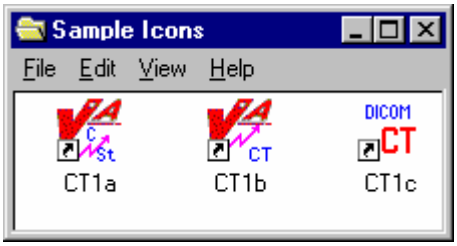
Follow the various menu trees to view all menu options that are made available.

Depending on the purpose of the gateway, one or more of these folders will be used for the day-to-day operation. See the VistA Imaging DICOM Gateway User Manual for further details on these icons and folders.

The installation procedure has created a folder named **\DICOM\Icons\Instruments** on the "text data disk. Some sites prefer to have the instruments separated out into multiple "folders" by gateway system, so that each folder contains only those instruments that are assigned to a specific gateway. Other sites prefer to turn off the "auto arrange" feature on the directory windows, and manually arrange the icons in the windows so that the selection for a specific machine can be made visible by scrolling and sizing the window.

If a site prefers to separate the folders for the various computers, a fairly straightforward way to achieve this separation is to create subfolders in **\DICOM\Icons\Instruments** where each reflects one of the gateways, e.g. **\DICOM\Icons\Instruments\DIG1** through **\DICOM\Icons\Instruments\DIG4** if there are four image gateways. The icons for the various instruments can then be moved easily into the directories for the assigned gateways.

The icons for the various instruments are initially all the same. The folders **\DICOM\Icons\Icons (Letters)** and **\DICOM\Icons\Icons (VA Logo)** contain additional icons that may be used to designate the various instruments in a more specific manner.



4.9 Recommended Icons

The installation process creates a number of icons for the benefit of the end-user. A typical site will only use a subset of these icons. It is recommended that a site customize the windows that are described above. Usage of the various icons will depend on the tasks that are run from the system. The table below shows which gateway tasks relate to which icons.

Icon	Text G/W	Text G/W with PACS	Image G/W	Image G/W with PACS	Combined Text and Image G/W	Combined Text and Image G/W with PACS
Command Prompt	X	X	X	X	X	X
Text Gateway	X	X	--	--	X	X
PACS Interface	X	X	--	--	X	X
PACS Communication Status	--	X	--	--	--	X
Modality Worklist Status	X	X	--	--	X	X
Examination Complete	--	--	--	X	--	X
Request Images	--	--	--	X	--	X
Process DICOM Images	--	--	X	X	X	X
Image Status	--	--	X	X	X	X
DICOM Viewer	--	--	X	X	X	X

Chapter 5 KIDS Package to Install in the VistA System

This chapter describes the installation of the "KIDS" package that is to be installed into a VistA system to support the VistA Imaging DICOM Gateway that will be running on satellite PCs. The complete KIDS installation is detailed in the VistA Imaging Installation Guide. Specific details pertinent to the DICOM Gateway are covered here.

The name of the KIDS package will be in the VistA Imaging namespace ("MAG"). Review the VistA Imaging Installation Guide for an example of the KIDS installation.

Installation of the KIDS package "VistA Imaging" is required to establish the files needed for DICOM image acquisition and for DICOM text Gateway. It establishes the global variable (^MAGDHL7) used for providing information to an outside PACS vendor and for providing a modality worklist to a radiology instrument. Data dictionaries and menu options are also created to assist in manual correction of images that failed to be processed during the initial image download for the Radiology and Medicine modalities.

The following sections describe those parts of the KIDS installation on the VistA system that pertains to the operation of the DICOM Gateway.

5.1 VistA -PACS Radiology Interface Setup Instructions

The following steps are required to establish the global variable (^MAGDHL7) used for providing radiology order information to an outside PACS vendor and for providing a modality worklist to radiology devices. These steps are performed on the VistA system using Fileman utility. Apply one step at a time to allow testing changes and tracking errors before applying all changes. It is imperative that you follow the instructions precisely -- especially if not in a test account.

5.1.1 Step 1

Use Fileman Enter/Edit to edit file 771 (HL7 APPLICATION PARAMETER) and update the FACILITY NAME field for the following entries RA-CLIENT-IMG, RA-SERVER-IMG and MAGD-CLIENT. Also, ensure that the ACTIVE\INACTIVE field is set to active for entries RA-SERVER-IMG and MAGD-CLIENT

5.1.2 Step 2

Enter the protocol **MAGD SEND ORM** in the SUBSCRIBERS (multiple field) for the protocol **RA REG**.

```
Select OPTION: EN <Enter>TER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS <Enter>
   EDIT WHICH SUBSCRIBERS SUB-FIELD: ALL//
THEN EDIT FIELD:
Select PROTOCOL NAME:  RA REG <Enter>
Select SUBSCRIBERS: MAGD SEND ORM <Enter>   ← Add this item.
```

Note: This protocol is exported in "VistA Imaging" KID file.

5.1.3 Step 3

Activate the triggering of HL7 messages during Radiology exam registration by entering RA-SERVER-IMG into the SENDING APPLICATION field of the RA REG protocol entry.

```
Select OPTION: EN <Enter>TER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE: ACCESSION// 101 <Enter>  PROTOCOL    (1710 entries)
EDIT WHICH FIELD: ALL// SENDING APPLICATION <Enter>
THEN EDIT FIELD:

Select PROTOCOL NAME: RA REG <Enter>       Rad/Nuc Med exam registered
SENDING APPLICATION: RA-SERVER-IMG <Enter>
```

Once this step is complete, entries should start populating file 772 and file 2006.5 (global variable ^MAGDHL7). You can test by using the Radiology options to register an exam. For each exam case registered, an entry will be set in file 2006.5.

Note: If errors start occurring, remove the **SENDING APPLICATION and SUBSCRIBERS** entries, process for above steps, from the RA REG protocol and contact the National Help Desk. A copy of the error trap should be included when reporting the error. *If an error is encountered do not proceed with the remaining steps until the National Help Desk assists*.

5.1.4 Step 4

Select the **EXAMINATION STATUS** for each Imaging type that should trigger the "examined" HL7 message. The HL7 will only be triggered once for an exam – when the exam has been upgraded to the status with the **GENERATE EXAMINED HL7 MESSAGE** field set to "**yes**". (Examination Status file #72).

Example:

```
>D P^DII <Enter>

VA FileMan 22.0

Select OPTION: ENT <Enter>ER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: PROTOCOL// 72 <Enter>  EXAMINATION STATUS
                                          (55 entries)
EDIT WHICH FIELD: ALL// 8 <Enter>  GENERATE EXAMINED HL7 MESSAGE
THEN EDIT FIELD: <Enter>

Select EXAMINATION STATUS: EXAMINED <Enter>
     1   EXAMINED          GENERAL RADIOLOGY
     2   EXAMINED          ULTRASOUND
     3   EXAMINED          MAGNETIC RESONANCE IMAGING
     4   EXAMINED          NUCLEAR MEDICINE
     5   EXAMINED          CARDIOLOGY STUDIES (NUC MED)
Press <RETURN> to see more, '^' to exit this list, OR
CHOOSE 1-5: 1 <Enter>  EXAMINED        GENERAL RADIOLOGY
GENERATE EXAMINED HL7 MESSAGE: YES// <Enter>
```

5.1.5 Step 5

Follow steps 2-3, and apply to protocol RA EXAMINED instead of RA REG.

```
Select OPTION: EN <Enter>TER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS <Enter>
   EDIT WHICH SUBSCRIBERS SUB-FIELD: ALL//
THEN EDIT FIELD: SENDING APPLICATION <Enter>

Select PROTOCOL NAME:  RA EXAMINED <Enter>
```

Select SUBSCRIBERS: **MAGD SEND ORM <Enter>** ← Add this item. This protocol is exported in the KIDS package for the released version of VistA Imaging.

```
SENDING APPLICATION:  RA-SERVER-IMG <Enter>
```

Once this step is complete, entries should start populating file 772 and file 2006.5 (MAGDHL7 global). You can test by using the Radiology options to edit an exam. For each exam case edited that is upgraded to the status with the GENERATE EXAMINED HL7 MESSAGE field set to yes, an entry will be set in file 2006.5 (Usually this for all cases that has been upgraded to examined).

Note: If errors start occurring, remove the SENDING APPLICATION and SUBSCRIBERS entries, process for above steps, from the RA EXAMINED protocol and contact the National Help Desk. *If an error is encountered do not proceed with the remaining steps until the National Help Desk assists.*

5.1.6 Step 6

Apply the steps outlined for steps 2-3 for the RA CANCEL protocol.

```
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS <Enter>
   EDIT WHICH SUBSCRIBERS SUB-FIELD: ALL//
THEN EDIT FIELD: SENDING APPLICATION

Select PROTOCOL NAME:  RA CANCEL <Enter>
```

Select SUBSCRIBERS: **MAGD SEND ORM <Enter>** ← Add this item. This protocol is exported in the KIDS package for the released version of VistA Imaging.

```
SENDING APPLICATION:  RA-SERVER-IMG <Enter>
```

Use the Radiology option to cancel a radiology case. An entry for each canceled case should be entered into files 772 & 2006.5.

5.1.7 Step 7

Apply step 2 for the **RA RPT** protocol except use the **MAGD SEND ORU** protocol and apply step 3.

```
INPUT TO WHAT FILE:  101 <Enter>  PROTOCOL
EDIT WHICH FIELD: ALL// SUBSCRIBERS
   EDIT WHICH ITEM SUB-FIELD: ALL//
THEN EDIT FIELD: SENDING APPLICATION <Enter>

Select PROTOCOL NAME:  RA RPT <Enter>
```

Select SUBSCRIBERS: **MAGD SEND ORU <Enter>** ← Add this item. This protocol is exported in the KIDS package for the released version of VistA Imaging.

```
SENDING APPLICATION:  RA-SERVER-IMG <Enter>
```

Use the Radiology option to produce a verified report. Only verified reports will create entries in files 772 and 2006.5.

Reminder: If any errors occur, the DHCP-PACS Radiology interface can be stopped by…

1. Removing the SENDING APPLICATION and SUBSCRIBERS entries from the protocol causing the error.
2. Removing the MAGD SEND ORM or MAGD SEND ORU from the SUBSCRIBERS field on the protocol causing the error.
3. Send a copy of the error trap to the **National Help Desk**. *If an error is encountered do not proceed with the remaining steps until the National Help Desk assists.*

5.2 VistA -PACS ADT Interface Setup Instructions

Note: Disregard this section if not interfacing to a Commercial PACS system.

The following are the instructions to establish the interface to provide a mechanism for notifying the PACS system regarding changes in ADT events.

5.2.1 Step 1

Use FileMan to set the field PACS INTERFACE SWITCH to ON in the IMAGING SITE PARAMETERS file (#2006.1).

```
> Do P^DII <Enter>

VA FileMan 22.0

Select OPTION: EN <Enter> TER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: IMAGING SITE PARAMETERS// 2006.1 <Enter>
          IMAGING SITE PARAMETER   (1 entry)
EDIT WHICH FIELD: ALL// PACS INTERFACE SWITCH <Enter>
THEN EDIT FIELD: <Enter>

Select IMAGING SITE PARAMETERS NAME: your site name <Enter>
PACS INTERFACE SWITCH: 1 <Enter>        ON PACS INTERFACE

Select IMAGING SITE PARAMETERS NAME: <Enter>

Select OPTION: <Enter>
>
```

5.2.2 Step 2

Routine ^MAGDHLE invokes INIT^HLTRANS which checks for the existence of "PACS GATEWAY" entry in the NON-DHCP APPLICATION PARAMETER file (#770).

First, the following entry needs to be established in the HL7 APPLICATION PARAMETER file (#771):

NAME**: PAC GATEWAY**
ACTIVE/INACTIVE: **ACTIVE**

Then the following entry must be created in the NON-DHCP APPLICATION PARAMETER file (#770):

NAME**: PACS GATEWAY**
NON-DHCP FACILITY NAME: *your facility name*
DHCP STATION NUMBER: *your facility number*
DHCP APPLICATION: **PAC GATEWAY** <<Pointer to file 771.

And then the entry for PAC GATEWAY entry in file 771 can be renamed to PACS GATEWAY.

Use FileMan to perform this set-up:

```
> Do P^DII <Enter>

VA FileMan 22.0

Select OPTION: en <Enter> TER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: 771 <Enter>   HL7 APPLICATION PARAMETER (139 entries)
EDIT WHICH FIELD: ALL//  <Enter>

Select HL7 APPLICATION PARAMETER NAME: PAC GATEWAY <Enter>
  Are you adding 'PAC GATEWAY' as
    a new HL7 APPLICATION PARAMETER (the 140TH)? No// Y <Enter>   (Yes)
ACTIVE/INACTIVE: AC <Enter>   ACTIVE
FACILITY NAME: ^ <Enter>

Select HL7 APPLICATION PARAMETER NAME:  <Enter>

Select OPTION: en <Enter> TER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: HL7 APPLICATION PARAMETER// 770 <Enter>
                        HL7 NON-DHCP APPLICATION PARAMETER (2 entries)
EDIT WHICH FIELD: ALL//  <Enter>

Select HL7 NON-DHCP APPLICATION PARAMETER NAME: PACS GATEWAY <Enter>
  Are you adding 'PACS GATEWAY' as
    a new HL7 NON-DHCP APPLICATION PARAMETER (the 3RD)? No// Y <Enter>   (Yes)
   HL7 NON-DHCP APPLICATION PARAMETER DHCP STATION NUMBER: <your station number> <Enter>
   HL7 NON-DHCP APPLICATION PARAMETER NON-DHCP FACILITY NAME: <your facility name> <Enter>
   HL7 NON-DHCP APPLICATION PARAMETER DHCP APPLICATION: PAC GATEWAY <Enter>   ACTIVE
DHCP STATION NUMBER: <your facility number> //  <Enter>
NON-DHCP FACILITY NAME: <your facility name> //  <Enter>
MAXIMUM BLOCK SIZE: ^ <Enter>

Select HL7 NON-DHCP APPLICATION PARAMETER NAME:  <Enter>

Select OPTION: en <Enter> TER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: HL7 NON-DHCP APPLICATION PARAMETER// 771 <Enter>
                                HL7 APPLICATION PARAMETER (140 entries)
EDIT WHICH FIELD: ALL// .01 <Enter>   NAME
THEN EDIT FIELD:  <Enter>

Select HL7 APPLICATION PARAMETER NAME: PAC GATEWAY <Enter>        ACTIVE
```

```
NAME: PAC GATEWAY// PACS GATEWAY <Enter>

Select HL7 APPLICATION PARAMETER NAME:  <Enter>

Select OPTION:  <Enter>
```

5.2.3 Step 3

The ADT changes are trigged by a protocol running off the MAS Event driver. You must add the MAGD DHCP-PACS ADT EVENTS protocol to the DGPM Movements Events protocol.

```
> Do P^DII <Enter>

VA Fileman 22.0

Select OPTION: en <Enter> TER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: IMAGING WORKSTATIONS//  101 <Enter>      PROTOCOL
EDIT WHICH FIELD: ALL// ITEM <Enter>
     1   ITEM       (multiple)
     2   ITEM TEXT
CHOOSE 1-2: 1 <Enter>
   EDIT WHICH ITEM SUB-FIELD: ALL// <Enter>
THEN EDIT FIELD: <Enter>

Select PROTOCOL NAME: DGPM MOVEMENT EVENTS <Enter>

Select ITEM: IB CATEGORY C BILLING// MAGD DHCP-PACS ADT EVENTS <Enter>
     NOTIFICATION DHCP-PACS ADT EVENT
  MNEMONIC: ^ <Enter>

Select PROTOCOL NAME: <Enter>

Select OPTION: <Enter>

>
```

This completes the creation of the items necessary for the PACS ADT interface. Use the PIMMS option to Admit, Transfer and Discharge a patient to test the cross-reference setting. During the update processing, on any of these three transactions, the system will spawn off a background task that will execute the cross-reference routine and display the following on the screen:

```
*** HL7 TASK FOR PACS ***
```

If successful, the HL7 messages for the events will be recorded in the PACS MESSAGES file (#2006.5).

5.3 Service Account

Content removed; FOIA exemption b2/high 2

```
Content removed; FOIA exemption b2/high 2
```

Appendix A Creating “Short-Cuts”

A.1 Short-Cuts

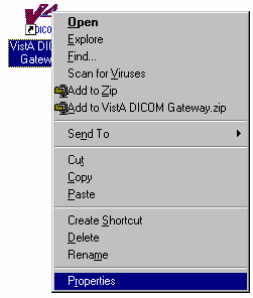
In the Microsoft Windows™ operating systems the end-user may communicate with the operating system in a number of ways. One of the methods of starting a program is to double-click on an icon that is “linked” to the program. Such icons are also called “short-cuts”, “links” or “aliases”. As a part of the installation procedure, the VistA Imaging DICOM Gateway Installation program will define a number of short-cuts that give access to the various programs that are used by the VistA Imaging DICOM Gateway.

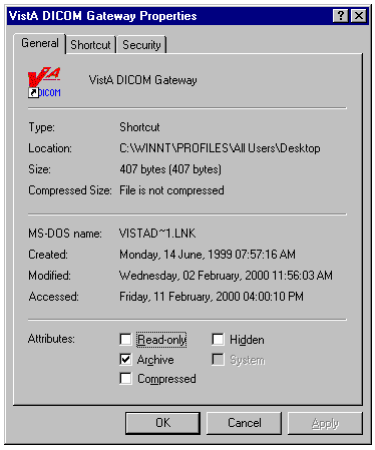
The installation program will create a number of icons in the Windows “Start” menu.

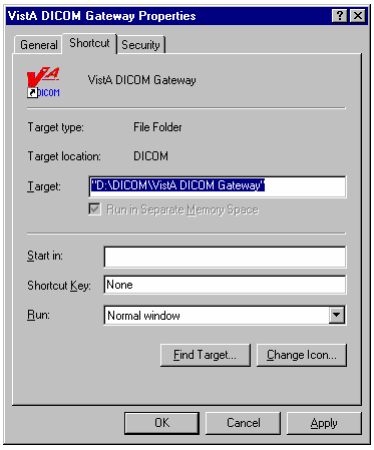
A.2 Defining a Short-Cut

A short-cut has a number of parameters. These parameters can be defined and modified by right-clicking on the icon. When the mouse is clicked, a menu will appear, and one of the options on this menu is “Properties”.

Once the menu option “**Properties**” is selected, a new window will pop up. In this window, select the tab labeled “Shortcut” to gain access to the next window. The subsequent window can be used to modify any of the parameters about the “short-cut”.



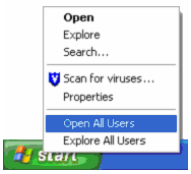




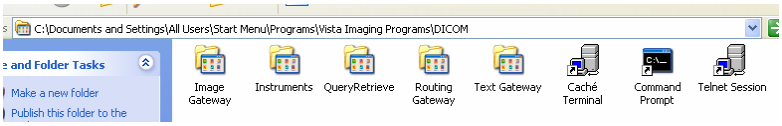
A.3 Short-Cuts for the VistA Imaging DICOM Gateway

The short-cuts for the VistA Imaging DICOM Gateway may be accessed by right-clicking on the 

button in the Windows menu bar. When this button is activated in this way, a menu window will pop up. On this menu, select the option labeled **Open All Users**.



This option causes a directory window to be opened. In this window, navigate to the subdirectory that holds the short-cuts for the VistA Imaging DICOM Gateway:



(First double click on the directory icon for **Programs**, then on the one for **VistA Imaging Programs** and then on the one for **DICOM**).

A.4 Directory Tree containing Short-Cuts

The installation program will define the following tree of short-cuts for easy access to the software. In this diagram, a number of abbreviations are used:

%SystemRoot% = The path-prefix for the directory that holds the Microsoft Windows™ operating system, typically “**c:\winnt**\” or “**c:\Windows**\”.

d_1 = The drive on which the data is installed, typically “**c**”.
d_2 = The drive on which the common software is installed, typically “**c**”.
d_3 = The drive on which the Caché database is installed, typically “**c**”.
d_4 = The drive on which the text data is being stored, typically “**c**”.
d_5 = The drive on which the image data is being stored, typically “**c**”.

```
|
+---Telnet Session
|   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|
+---Caché Terminal
|   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   Parameters: 127.0.0.1
|
+---Command Prompt
|   Points to: %SystemRoot%\System32\cmd.exe
|   Working Directory: %temp%
|
+---DICOM Text Gateway
|   |
|   +---Process Text Messages
|   |   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   |   Parameters: TEXT_GATEWAY_1_1
|   |
|   +---PACS Status
|   |   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   |   Parameters: PACS_COMMUNICATIONS_STATUS_1_3
|   |
|   +---Modality Worklist Status
|       Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|       Parameters: MODALITY_WORKLIST_STATUS_1_4
|
+---DICOM Image Gateway
|   |
|   +---Exam Complete
|   |   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   |   Parameters: PACS_EXAM_COMPLETE_2_1
|   |
|   +---Request Images
|   |   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   |   Parameters: PACS_REQUEST_IMAGE_TRANSFER_2_2
|   |
|   +---Process DICOM Images
|   |   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   |   Parameters: PROCESS_DICOM_IMAGES_2_3
|   |
|   +---Image Status
|   |   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   |   Parameters: IMAGE_STATUS_2_5
|   |
|   +---DICOM Viewer
|       Points to: d2:\Program Files\VistA\Imaging\DCMView\MAG_DCMView.exe
|       Working Directory: d5:\DICOM
|       Icon: d2:\Program Files\VistA\Imaging\DCMView\Viewer1.ico
|
```

```
+---DICOM Routing Gateway
|   |
|   +---Start Transmitter
|   |   Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|   |   Parameters: START_TRANSMITTER_3_1
|   |
|   +---Start Rule Evaluator
|       Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_Telnet.exe
|       Parameters: START_EVALUATOR_3_3
|
+---DICOM Instruments
|   |
|   +---Default
|       Points to: d2:\Program Files\VistA\Imaging\DICOM\MAG_CStore.exe
|       Working Directory: d2:\Program Files\VistA\Imaging\DICOM
|       Parameters: localhost 60000 default
|       Icon: d1:\DICOM\Icons\MAG_CStore.ico, image # 0
|
+---Query/Retrieve
    |
    +---Install RunTime License
    |   Points to: d2:\C:\Program Files\VistA\Imaging\DICOM\install_dcf_license.exe
    |
    +---Start QueryRetrieve Listener
        Points to: d2:\Program Files\VistA\Imaging\DICOM\QR.BAT
```

Appendix B Master Files

B.1 Overview

The VistA Imaging DICOM Gateway uses a number of tables to drive certain parameterized procedures within the VistA Imaging DICOM Gateway software. These tables are populated from the data in a set of ASCII text files. In the context of the VistA Imaging DICOM Gateway, these text files are called "master files".

Common usage within the Department of Veterans Affairs is to use the term "file" for a subtree of a global variable in MUMPS. The master files that are described in this chapter, however, are files in the more traditional sense: entities that live in directories within an operating system. In order to minimize confusion about the meaning of the term "file", this chapter will reserve the term "file" for entities outside of MUMPS, and the term "table" for databases within a MUMPS environment.

B.2 Master Files

The VistA Imaging DICOM Gateway uses a number of FileMan tables to drive the VistA Imaging DICOM Gateway software. These FileMan tables are populated from ASCII text data stored in master files located in a directory named **F:\DICOM\Dict**, (in this document the drive-letter **F:** is used, see sections 3.3 and 3.5). The actual name for this directory is stored by the VistA Imaging DICOM Gateway software as data in **^MAGDICOM(2006.563,1,"DICT PATH")**.

B.2.1 Master File Menu Options

The menu of the VistA Imaging DICOM Gateway has a number of options that each import one, some or all of the master files. These menu options are:

4. System Maintenance
→ 2. Gateway Configuration and DICOM Master Files
→ → 1. Display Gateway Configuration Parameters
→ → 2. Update Gateway Configuration
→ → 3. Update Instrument.DIC
→ → 4. Update Modality.DIC and Data*.DIC
→ → 5. Update PortList.DIC
→ → 6. Update SCU_List.DIC
→ → 7. Update WorkList.DIC
→ → 8. Reinitialize All the DICOM Master Files

There are two groups of master files, static ones that are the same for all sites, and site-configurable ones that must be edited at each site.

B.2.2 General Formatting Issues

- In all master files, lines that start with a number sign ("#") are comment lines.
- Text lines that do not start with a number sign contain dictionary data.
- While updating master files, blank lines and comment lines will be ignored.

Note: The final line in any master file must be followed by an "end-of-line" control sequence (carriage return and line feed). If the final "end-of-line" control sequence is missing, the line will be invisible to the software that updates the master files. In order to prevent this problem, all distributed versions of the master files end with the following comment line:

```
# End of File<CR><LF>
```

B.3 Static Master Files

This section describes the format and contents of the static master files, which are part of the release distribution of the VistA Imaging.

Static master files in this category contain data that is the same for all sites. These files may not be modified by the sites (reference VA directive and FDA warning).

The following files are included in the release:

File Name	FileMan Table	MUMPS Routine	Comment
DataGECT.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
Data_CR.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
DataMisc.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
Data_MRI.DIC	2006.511 sub 2006.5112	^MAGDIR4	Contains list of data-items to be shown on diagnostic workstation displays.
Element.DIC	2006.51	^MAGDMFB2	Contains DICOM Standard data elements.

File Name	FileMan Table	MUMPS Routine	Comment
HL7.DIC	2006.57	^MAGDMFB7	Contains list of HL7 message templates.
SCP_List.DIC	2006.586	^MAGDMFB9	Contains lists of parameters for Provider Applications
Template.DIC	2006.52	^MAGDMFB3 ^MAGDMFB4	Contains templates for DICOM messages.
UID.DIC	2006.53	^MAGDMFB5	Contains list of unique DICOM identifiers.

B.3.1 Element.DIC

The file **F:\DICOM\Dict\Element.DIC** contains the DICOM data dictionary. As part of the installation process, this file is read by routine **^MAGDMB2** and is used to construct the FileMan table **DICOM Data Element Dictionary** (File 2006.51, stored in **^MAGDICOM(2006.51,…)**).

In a DICOM data stream, every data element is identified by a four-byte binary "tag" consisting of a two-byte group field and a two-byte element field. The tag value is usually represented by two groups of four hexadecimal digits, separated by a comma (group, element, e.g. 0010,21B0 for Additional Patient History). Odd-numbered groups denote private elements and are accompanied by an explicit owner identification code.

The file **F:\DICOM\Dict\Element.DIC** contains three kinds of records:

The first is the "group" record, which for odd-numbered groups defines the owner identification code for private elements. Following the group record are one or more "element" records that define each element and its set of attributes. Some of the element records are followed by optional "value" records, which define the legal set of enumerated values or defined terms for the element.

The values of an element are "enumerated values" when the value of that element may be one of an explicitly specified set of standard values, which shall not be extended by implementers.

The values of an element are "defined terms" when the value of that element may be one of an explicitly specified set of standard values, which may be extended by implementers.

The formats for the different record types are as follows:

- Group Record: <group> | <group owner> | <group title>
- Element Record: <tag> | <element name> | <value representation> | <multiplicity> | <value flag> | <retired flag>
- Value Record: <tag> | <permitted value>

The different fields are defined below:

<group>	The group identifier, expressed in four hexadecimal digits.
<group owner>	Blank for groups that are defined in the DICOM standard, and otherwise contains the name of or a mnemonic for the owner of the group.
<group title>	A name for the group for documentation purposes.
<tag>	Identifies the group and element(s), the value may contain hexadecimal digits and several wildcard characters.
<element name>	The name of the element (case-sensitive).
<value representation>	The 2-letter data type mnemonic.
<multiplicity>	Identifies the (maximum) number of values that may be passed at a time.
<retired flag>	An identifier that denotes that the element is no longer current.
<permitted value>	The enumerated value or defined term, along with its meaning.

Example:

```
0010||Patient Information
0010,0000|Group Length|UL|1||
0010,0010|Patient's Name|PN|1||
0010,0020|Patient ID|LO|1||
0010,0021|Issuer of Patient ID|LO|1||
0010,0030|Patient's Birth Date|DA|1||
0010,0032|Patient's Birth Time|TM|1||
0010,0040|Patient's Sex|CS|1|E|
0010,0040|M=male
0010,0040|F=female
0010,0040|O=other
0039|VA DHCP|Admission, Discharge, and Transfer Information Shadow
0039,0000|Group Length|UL|1||
0039,0010:1:00FF|Owner of Group|LO|1||
0039,xx10|Current Patient Location Sequence|SQ|1||
0039,xx20|Patient's Institutional Residence Sequence|SQ|1||
```

When a <tag> contains an “x”, this means that it is a private element and the same definition applies to all tags that have any hexadecimal digit in the position of that “x”.

When a tag contains a value of the format <start>:<step>:<end>, this means that the same definition applies to all values covered by that range definition.

The information in Element.DIC is extracted directly from the DICOM standard (element definitions are specified in **Part 6: Data Dictionary (PS 3.6)**; lists of permitted values are specified in **Part 3: Information Object Definitions (PS 3.3)**).

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.51,d0,0) = group , element [ , owner ] ^ name ^ VR ^ mult ^ flag
^MAGDICOM(2006.51,d0,1,d1,0) = value ^ meaning
^MAGDICOM(2006.51,“B”, group element [owner], d0) = “”
^MAGDICOM(2006.51,d0,1,“B”,value,d1) = “”
```

B.3.2 HL7.DIC

The file **F:\DICOM\Dict\HL7.DIC** contains the definitions of the recognized HL7 messages. As part of the installation process, this file is read by routine **^MAGDMB7** and is used to construct the FileMan table **DICOM HL7 SEGMENT** (File 2006.57, stored in **^MAGDICOM(HL7,…)**).

The routine **^MAGDHRP** uses the values in this table to produce a formatted HL7 message listing. Each record consists of two parts. The first part is either the HL7 segment identifier (if it is alphanumeric), or it contains the HL7 segment field number (if it is numeric). The second piece is text that defines either the name of the segment or the name of the field.

Example of an HL7 segment with its fields:

```
PID|Patient Identification Segment
1|Set ID - Patient ID
2|Patient ID (External ID)
3|Patient ID (Internal ID)
4|Alternate Patient ID
5|Patient Name
6|Mother's Maiden Name
7|Date of Birth
8|Sex
9|Patient Alias
10|Race
11|Patient Address
12|Country Code
13|Phone Number - Home
14|Phone Number - Business
15|Language - Patient
16|Marital Status
17|Religion
18|Patient Account Number
19|SSN Number - Patient
20|Driver's Lic Num - Patient
21|Mother's Identifier
22|Ethnic Group
```

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM("HL7",d0,0) = segment ^ name of segment
^MAGDICOM("HL7",d0,1,d1,0) = name of element
^MAGDICOM("HL7","B",segment,d0) = ""
```

B.3.3 SCP_List.DIC

The file **F:\DICOM\Dict\SCP_List.DIC** contains the definitions of the applications that are supported by the VistA Imaging DICOM Gateway operating in the role of a **S**ervice **C**lass **P**rovider (SCP). As part of the installation process, this file is read by routine **^MAGDMB9** and is used to construct the FileMan table **Provider Application List** (File 2006.586, stored in **^MAGDICOM(2006.586,…)**).

There are three kinds of records in the file **F:\DICOM\Dict\SCP_List.DIC**. The first is the "application" record, which identifies the name of the VistA service class provider. Following the application record are one or more "service" records defining the services that may be utilized. Following a "service" record, there is at least one "transfer syntax" record, defining how information may be exchanged.

- Application Record: <called AE title> | <application name>
- Service Record: | <SOP Class>
- Transfer Syntax Record: | | <syntax>

The different fields are defined below:

<called AE title>	The title of the called VistA provider (SCP) application entity.
<application name>	The name that VistA uses to refer to the DICOM application.
<SOP Class>	The name of the DICOM service object pair (SOP).
<syntax>	is the name of a supported transfer syntax

Currently, there are three possible transfer syntax's:

1. Implicit VR, Little Endian
2. Explicit VR, Little Endian
3. JPEG Baseline (Process 1):Default Lossy JPEG 8 Bit Compression

Example of entries in SCP_LIST.DIC:

```
# VistA Service Class Providers
# <VistA Application Entity Title> | <application name>
# | <supported SOP class>
#
VISTA_WORKLIST|VistA Modality Worklist
|Verification SOP Class
||Implicit VR Little Endian
|Modality Worklist Information Model – FIND
||Implicit VR Little Endian
#
VISTA_STORAGE|VistA Storage
|Verification SOP Class
||Explicit VR Little Endian
||Implicit VR Little Endian
|Computed Radiography Image Storage
||Explicit VR Little Endian
||Implicit VR Little Endian
|CT Image Storage
||Explicit VR Little Endian
||Implicit VR Little Endian
|Ultrasound Multi-frame Image Storage (retired)
||Explicit VR Little Endian
||Implicit VR Little Endian
```

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.586,d0,0) = AE Title ^ Application name
^MAGDICOM(2006.586,d0,1,d1,0) = SOP Class UID ^ SOP Class Name
^MAGDICOM(2006.586,d0,1,d1,1,d2,0)
                                = Transfer Syntax UID ^ Transfer Syntax Name
^MAGDICOM(2006.586,“B”,AE Title,d0) = “”
^MAGDICOM(2006.586,d0,1,“B”,SOP Class UID,d1) = “”
^MAGDICOM(2006.586,d0,1,d1,1,“B”,Transfer Syntax UID,d2) = “”
```

B.3.4 Template.DIC

The file **F:\DICOM\Dict\Template.DIC** contains model definitions of the messages that are supported by the VistA Imaging DICOM Gateway. As part of the installation process, this file is read by routines **^MAGDMB3** and **^MAGDMFB4** and is used to construct the file **F:\DICOM\Dict\Template.TMP** and the FileMan table **DICOM Message Template Dictionary** (File 2006.52, stored in **^MAGDICOM(2006.52,…)**).

DICOM data elements are the attributes of the Service Classes and the Information Object Definitions. The service classes and information object definitions are joined together to form the Service-Object Pair (SOP) classes. The SOP classes are the high-level communications message protocol units of DICOM.

The file **F:\DICOM\Dict\Template.DIC** defines the way that the DICOM data elements are combined to make up the SOP Classes. The file **F:\DICOM\Dict\Template.DIC** contains attributes of the service classes, the information object definition modules, and the SOP classes. Because the same set of attributes is often repeated in several different SOP classes, the gateway master file update software uses a “macro” facility so that the attributes can be defined once and used multiple times. The file **F:\DICOM\Dict\Template.DIC** is “expanded” by the macro

facility (routine ^**MAGDMFM4**) to create the file **F:\DICOM\Dict\Template.TMP**, which contains the model of each DICOM message. The routine ^**MAGDMFB3** routine invokes ^**MAGDMFM4** to expand the macros, and then reads the resulting file **F:\DICOM\Dict\Template.TMP** to populate the FileMan table in global variable ^MAGDICOM(2006.52).

The format for the macro definitions is as follows:

```
{$define <name of macro>}
    <body of macro>
{$end <name of macro>}
```

The macro facility performs simple text replacement. When a macro is invoked, the invocation is replaced by the macro text. The format for a macro invocation is {<name of macro>}. The macro invocation is replaced with <body of macro> in the expanded text. Macros may be nested.

The <body of macro> (i.e., the macro text) consists of a sequence of DICOM Element Records and (optional) Macro Invocation Records. The formats for these two types of records are as follows:

• Element Record:	<element name> | <tag> | <group owner> | <SCP/SCU Type> |<default value>
• Macro Invocation:	{<name of macro>}

The different fields are defined below:

<element name>	The case-sensitive name of the element.
<tag>	The group and element numbers, in (gggg,eeee) hexadecimal format.
<group owner>	The name/mnemonic for the owner of the group.
<SCP/SCU Type>	The SCP and SCU DICOM Type (1, 1C, 2, 3, etc.).
<default value>	The default value of the element in the message.

Example of a macro definition:

```
{$define N-EVENT-REPORT-RQ}
Affected SOP Class UID|(0000,0002)||1/1|
Command Field|(0000,0100)||1/1|0100H
Message ID|(0000,0110)||1/1|
Priority|(0000,0700)||1/1|
Data Set Type|(0000,0800)||1/1|0003H
Affected SOP Instance UID|(0000,1000)||1/1|
Event Type ID|(0000,1002)||1/1|
{$end N-EVENT-REPORT-RQ}
```

Macros are used for building model message templates.

A message template consists of four different types of records. The "template" record identifies the beginning of the message template. The "SOP" record defines the SOP class for the template. The "element" and "macro invocation" records define the element attributes of the template. The different fields for the "template" and "sop" records are defined below:

- Template Record: $TEMPLATE | <message name> | <DIMSE> | <typename> | <typeid>
- SOP Record: $SOP | <SOP class name>
- Element Record: <element name> | <tag> | <group owner> | <SCP/SCU Type> | <default value>
- Macro Invocation: {<name of macro>}

The different fields for the "template" and "sop" records are defined below:

<message name>	The name of the template.
<DIMSE>	The DICOM Message Service Element.
<typename>	The DICOM Event Type Name.
<typeid>	The DICOM Event Type Id.
<SOP class name>	The case-sensitive name of the SOP class defined in the UID.DIC file.

Note: Refer to the **DICOM standard, Part 4 Service Class Specifications (PS 3.4)** for the definition of the DICOM terms.

Example of a template definition:

```
$TEMPLATE|PATIENT DEMOGRAPHIC CHANGE|N-EVENT-REPORT|Patient Updated|3|
$SOP|VA Detached Patient Management SOP Class
{N-EVENT-REPORT-RQ}
Instance Creation Date|(0008,0012)||-/2|
Instance Creation Time|(0008,0013)||-/2|
Instance Creator UID|(0008,0014)||-/2|
{Patient Data}
{Message Handle}
```

The element information in the file **F:\DICOM\Dict\Template.DIC** is extracted directly from the DICOM standard, **Part 6: Data Dictionary (PS 3.6)** and **Part 7:Message Exchange (PS 3.7)**. The list of attributes comes from **Part 3: Information Object Definitions (PS 3.3)** and **Part 7:Message Exchange (PS 3.7)**.

See http://medical.nema.org/dicom/ for more information about the DICOM standard.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.52,d0,0) = Title ^ DIMSE ^ SOP Class ^ Type Name ^ Type ID
^MAGDICOM(2006.52,d0,1,d2,0) = tag ^ name ^ SCP type / SCU type ^ Value ^ Pointer
^MAGDICOM(2006.52,“B”,Title,d0) = “”
```

B.3.5 UID.DIC

The file **F:\DICOM\Dict\UID.DIC** contains the definitions of the unique identifiers for SOP classes, transfer syntax’s and class instances for the DICOM standard. As part of the installation process, this file is read by routine **^MAGDMB5** and is used to construct the FileMan table **DICOM UID Dictionary** (File 2006.53, stored in **^MAGDICOM(2006.53,…)**).

DICOM uses a unique object identification scheme based upon ISO-9834-3. This standard uses numeric fields separated by periods that are assigned in a left-to-right hierarchical fashion in order to allow uniqueness. All DICOM standard UIDs have the root **1.2.840.10008**, and UIDs generated by the VA have the root **1.2.840.113754**.

The file **F:\DICOM\Dict\UID.DIC** contains all the pre-defined UID values that are used by the VistA DICOM applications.

The file UID.DIC contains two types of records:

• UID Record:	<UID Value> | <UID Name> | <UID Type> | <Reference> | <Function>
• Meta Record	| <UID Value> | <UID Name>

When a UID identifies a Meta SOP Class, the record for the Meta SOP Class will be followed by one or more Meta records. In such a case, each Meta record defines one UID that identifies a SOP class that is a member of the Meta SOP class.

The different fields are defined below:

<UID Value>	The unique period delimited numeric string that represents the value of the UID
<UID Name>	The text name for the UID; 1:1 mapping between <UID Value> and <UID NAME>.
<UID Type>	Indicates the usage for the UID.
<Reference>	Documents where the UID is officially defined.
<Function>	Identifies which UIDs are supported by VistA Storage (for example, S for Storage).

Example of some UID definitions:

```
1.2.840.10008.1.1|Verification SOP Class|SOP Class|Part 4|*
1.2.840.10008.3.1.2.1.4|Detached Patient Management Meta SOP Class
                                                  |Meta SOP Class|Part 4|
|1.2.840.10008.3.1.2.1.1|Detached Patient Management SOP Class
|1.2.840.10008.3.1.2.2.1|Detached Visit Management SOP Class
1.2.840.113754.3.1.2.1.4|VA Detached Patient Management Meta SOP Class
                                                  |Meta SOP Class|Part 4|S
|1.2.840.113754.3.1.2.1.1|VA Detached Patient Management SOP Class
|1.2.840.113754.3.1.2.2.1|VA Detached Visit Management SOP Class
```

The UID information in the file **F:\DICOM\Dict\UID.DIC** is extracted directly from the DICOM Standard, **Part 6: Data Dictionary (PS 3.6)** and material supplied by the Imaging Project.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.53,d0,0) = Name ^ UID Code ^ Type ^ Reference
^MAGDICOM(2006.53,d0,1,d1,0) = Name ^ UID Code
^MAGDICOM(2006.53,“B”,Name,d0)= “”
^MAGDICOM(2006.53,“C”,UID Code,d0) = “”
^MAGDICOM(2006.53,d0,1,“B”,Name,d1) = “”
^MAGDICOM(2006.53,d0,1,“C”,UID Code,d1) = “”
```

B.3.6 Additional Data

Certain DICOM elements are extracted from the DICOM image header and copied into the “about image” text file when an image is processed. These data items are then displayed on the diagnostic workstation with the image.

Different items may be selected and displayed for different modalities. Currently, the following files with lists of additional data-items are available:

- DataGECT.DIC (specific for CT equipment from General Electric and others)
- Data_CR.DIC (specific for CR equipment)
- DataMisc.DIC (general for any other equipment)
- Data_MRI.DIC (specific for MRI equipment)

In these files, each line that defines a data-item consists of two parts: the first part identifies an attribute tag and the second part specifies an attribute name, e.g.:

```
0008,0070|Manufacturer
```

The data from these files is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.511,d0,0) = filename
^MAGDICOM(2006.511,d0,1,d1,0)=tag ^ name
^MAGDICOM(2006.511,“B”,filename,d0) = “”
```

B.3.6.1 DataMisc.DIC

The file DataMisc.DIC contains a list of general-purpose elements to be displayed. These data-items are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,5100|Patient Position
0020,0010|Study ID
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

Note: In the following lists, the highlighted lines are additional fields.

B.3.6.2 DataGECT.DIC

The data-items for CTs from General Electric (and other manufacturers) are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,0050|Slice Thickness
0018,0060|KVP
0018,1100|Reconstruction Diameter
0018,1120|Gantry/Detector Tilt
0018,1150|Exposure Time
0018,1151|X-ray Tube Current
0018,1190|Focal Spot(s)
0018,1210|Convolution Kernel
0018,5100|Patient Position
0020,0010|Study ID
```

```
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0020,0060|Laterality
0020,1040|Position Reference Indicator
0020,1041|Slice Location
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

B.3.6.3 Data_CR.DIC

The data-items for CRs are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,1004|Plate ID
0018,1400|Acquisition Device Processing Description
0018,1405|Relative X-ray Exposure
0018,5100|Patient Position
0018,6000|Sensitivity
0020,0010|Study ID
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

B.3.6.4 Data_MRI.DIC

The data items for MRIs are:

```
0008,0008|Image Type
0008,0023|Image Date
0008,0033|Image Time
```

```
0008,0060|Modality
0008,0070|Manufacturer
0008,0080|Institution Name
0008,1010|Station Name
0008,1090|Manufacturer's Model Name
0018,0010|Contrast/Bolus Agent
0018,0015|Body Part Examined
0018,0020|Scanning Sequence
0018,0080|Repetition Time
0018,0081|Echo Time
0018,0083|Number of Averages
0018,0091|Echo Train Length
0018,1310|Acquisition Matrix
0018,5100|Patient Position
0020,0010|Study ID
0020,0011|Series Number
0020,0012|Acquisition Number
0020,0013|Image Number
0020,0032|Image Position (Patient)
0028,0004|Photometric Interpretation
0028,0010|Rows
0028,0011|Columns
0028,0030|Pixel Spacing
0028,0101|Bits Stored
0028,0102|High Bit
0028,0103|Pixel Representation
0028,1052|Rescale Intercept
0028,1053|Rescale Slope
```

B.4. Site-Specific Master Files

This section describes the format and contents of the site-specific master files.

Currently, the following files exist:

File Name	FileMan Table	Comment
Instrument.DIC	2006.581	Contains list of operational instruments.
Modality.DIC	2006.582	Contains list of parameters for handling modalities.
Portlist.DIC	2006.584	Contains list of port numbers for handling instruments.
SCU_List.DIC	2006.585	Contains lists of parameters for User Applications.
Worklist.DIC	2006.583	Contains list of parameter for Modality Worklist handling.
DICOM HEALTHCARE PROVIDER SERVICE	2006.5831	Contains mapping of Request Services (^GMR(123.5)) to Image Index For Specialty/Subspecialty (^MAG(2005.84))

The contents of the files in this section need to be customized to reflect the actual attributes used at the site.

Note: These changes should be made to the text file dictionaries in **F:\DICOM\Dict** only. The software will load this information from these dictionary files into the global variables, overwriting any previously saved information.

Note: in the .dic files, leading and trailing spaces are ignored when the data is imported into the database. This makes it possible to align information for easier reading:

```
#
RADIOLOGY     ||RAD| RAD    |LONG|Local Vista Modality Worklist provider
DENTAL        ||CON| DENT   |LONG|Local dental worklist provider
OPHTHALMOLOGY ||CON| OPHTH  |LONG|Local eye care worklist provider
OPTOMETRY     ||CON| OPTOM  |LONG|Local optometry worklist provider
CARDIOLOGY    ||CON| CARDIO |LONG|Local cardiology worklist provider
#
```

B.4.1 Instrument.DIC

The file **F:\DICOM\Dict\Instrument.DIC** contains the definitions of the various image acquisition devices that are being used at the site. This file is read by routine **^MAGDMB8** to (re)construct the FileMan table **Instrument Dictionary** (File 2006.581, stored in **^MAGDICOM (2006.581,…)**). This is done as part of the installation process, and whenever operational information has changed at the site.

Use the VistA Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance
→ 2. Gateway Configuration and DICOM Master Files
→ → 2. Update Instrument.DIC

Each image producing instrument must send its images to a VistA storage provider. In the VistA DICOM Image Gateway, there is a separate storage provider process running on a dedicated network port for each instrument that produces images. The file **F:\DICOM\Dict\ Instrument.DIC** lists each image producing instrument and its dedicated communications port, along with its corresponding imaging service.

An entry in the file **F:\DICOM\Dict\Instrument.DIC** is formatted as follows:

<mnemonic> | <description> | <institution name> | <imaging service> | <port> [| <machine]

The different fields are defined below:

<mnemonic>	is a short code for the instrument created by the site (it must be unique). Typically abbreviations like **CR1**, **CT2**, **NM, GI-FLUORO**, and so forth.
<description>	is free text describing the instrument and its location.
<institution name>	The name of the institution (as defined in `Piece(^DIC(4,ien,0),"^",1)`. It also may be the site id or left null (default is the site of the gateway).
<imaging service>	indicates where the orders and reports are placed on the hospital information system ("RAD" or "CON" – see below)
<port>	is the network communications port number (this must be unique, see Appendix E)
<machine>	identifies the Image Gateway computer that will receive image files from this instrument (optional parameter, free text)

Example of a portion of the INSTRUMENT.DIC file:

```
# Computed Radiography
CR1|Fuji AC3 CR, Room 2156|Wilmington, DE|RAD|60050|A
CR2|Fuji AC3 CR, Room 2160 (Chest)|Wilmington, DE|RAD|60051|C
CR3|Fuji AC3 CR, Cubby, 2145 Hallway|Wilmington, DE|RAD|60052
```

```
#
# Computed Tomography
CT1|GE High Speed Advantage, Room 2142|Wilmington, DE|RAD|60060|A
#
```

In the previous example, please observe that there are **four** different instruments and **two** different modalities.

The site must create an entry in the file **F:\DICOM\Dict\Instrument.DIC** for each piece of equipment that is going to produce images and send them to VistA. Otherwise, images cannot be acquired from the equipment.

Please note that the port numbers must be unique. This is true even in the situation where several different VistA DICOM Image Gateways are used. By making the port numbers unique, it is possible to redirect the output of any image producing instrument to a different VistA DICOM Image Gateway by adding a second IP address to the gateway. The recommended port number scheme is included in Appendix E.

Names of institutions must be spelled exactly as in the Institution File (File number 4, stored in `^DIC(4,...)`). These names are processed in a case-insensitive fashion. Only the part of the name before the first comma needs to match the value in the institution file. Any other punctuation characters that occur in that part of the "official" name must appear in the value that is entered here.

If no name is specified for the name of an institution, the default value from the Gateway Site will be used.

Names of imaging services must be either "**RAD"**, for radiology, or "**CON"**, for Healthcare Providers (consults).

Note: These names must be spelled in all upper-case characters.

The optional 6th parameter identifies the Image Gateway to which the instrument will transmit its image files. Such identifiers are single character codes.

A sample file **F:\DICOM\Dict\Instrument.Sample** is supplied with the VistA Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\Instrument.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be manually transferred to the operational master file at the discretion of the site.

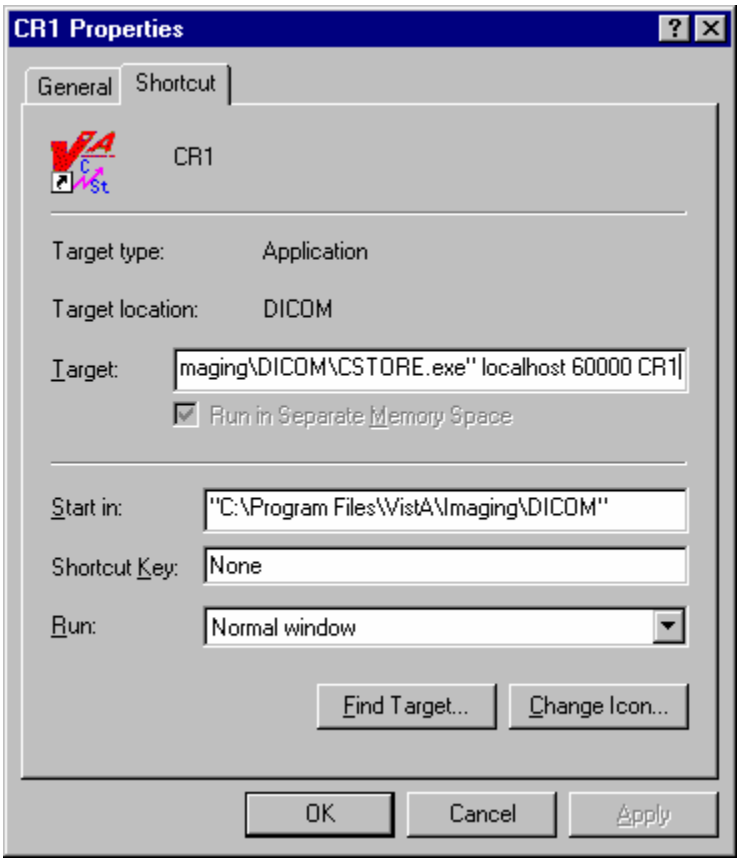
The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.581,d0,0) = Nickname ^ Description ^ Service ^ Port ^ Site ^
Machine
^MAGDICOM(2006.581,"B",Nickname,d0) = ""
```

B.4.1.1 Icons for Instruments

Normally, icons will be generated for all instruments at the end of an installation when the program `^MAGDMFIC` is run. The Site Manager can then adjust the icons in the window to show only those storage providers that are actually being used on the current PC.

When set-up parameters need to be modified for one of these icons, it is important to know the values that should be entered. The typical values for each of these icons are shown below.



In the example above, the complete value for "target" would be:

```
"C:\Program Files\VistA\Imaging\DICOM\MAG_CSTORE.exe" localhost 60000 CR1
```

Note: The quotes around the path-name for the C-Store program are required.

The entry for "Target" should link the icon to the "C-Store" program, and specify the parameters:

- IP-address is always "**localhost**" (never modify this value).
- Port number is always **60000** (never modify this value).
- Instrument name is the abbreviation for the instrument, e.g. "**CR1**" (only modify this value to reflect changes made in the master file **F:\DICOM\Dict\Instrument.DIC**).

The icon can be changed to be more descriptive for the type of instrument. For CRs, the distributed system provides two sample icons:

The end-user may select any other icon that would be more descriptive of the instrument.

B.4.2 Modality.DIC

The file **F:\DICOM\Dict\Modality.DIC** contains the definitions of the parameters that are needed to process image files, store them on the file server, and associate them with the patient record. This file is read by routine **^MAGDMB8** to (re)construct the FileMan table **Modality Type Dictionary** (File 2006.582, stored in **^MAGDICOM(2006.582,…)**). This is done as part of the installation process, and whenever operational information has changed at the site.

Use the VistA Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance
→ 2. Gateway Configuration and DICOM Master Files
→ → 3. Update Modality.DIC and Data*.DIC

B.4.2.1 Image Processing Overview

After images have been acquired, they have to be processed and incorporated into the patient medical record. The rules for processing the images produced by each different kind of modality are stored in the file **F:\DICOM\Dict\Modality.DIC**.

Each time an image is processed, the following steps will be taken:

1. The patient and study information is extracted from the image header.
2. The study is looked up on VistA using the patient and study information from the image header.
3. The image is converted into TARGA™ (*.TGA) format and the image abstract (also known as thumbnail or icon) is created.
4. Some image information is saved in a text (*.TXT) file for display purposes.
5. All image attributes from the header are saved in a text (*.TXT) file for later regeneration of files in DICOM format (*.DCM).

B.4.2.2 Assigning Field Values for the Modality Dictionary

The details of these steps are controlled through the various fields in the file **F:\DICOM\Dict\ Modality.DIC**. There must be one entry in that file for each different image producing modality. There may be multiple entries for an instrument, if it produces more than one type of image. The lookup in this dictionary file uses a composite key consisting of the triplet {manufacturer, model, modality}.

Note: These values may be set to asterisk (i.e., "*") if the instrument does not supply their values in the headers of the image files.

Modality Record: <mfgr> | <model> | <modality> | <image processing rules> | <accession number code> | <text data code> | <text data file> | <imaging service>

The different fields are defined below:

<mfgr>	The manufacturer of the equipment producing the images; element (0008,0070).
<model>	The manufacturer's model name for the equipment; element (0008,1090).
<modality>	The official DICOM defined term for the modality; element (0008,0060).
<image processing rules>	Control the conversion of the image from DICOM to Targa file format.
<accession number code>	M routine name used to extract the accession number from image header.
<text data code>	M routine for outputting text data (*.TXT) for diagnostic workstation.
<text data file>	Lists DICOM attributes to output as text (*.TXT) for diagnostic workstation (see Appendix B.3.6 for a description of the format of a text data file).
<imaging service>	indicates where the orders and reports are placed on the hospital information system ("RAD" or "CON" – see below)

Note: The above fields require exact matches.

Also note that Imaging Service has been added to MODALITY.DIC as the eighth field. This field contains either **RAD** for radiology or **CON** for consult, and is used to select imaging service-specific processing.

The MODALITY.DIC entry for the image acquisition device must specify "**<DICOM>**" in the <image processing rules> field, and typically "**CORRECT^MAGDIR3**" in the <accession number code> field. The "RoadRunner" example below illustrates this:

```
#manufacturer|model|modality|dcmtotga.exe parameters|case# lookup code|data extraction
code|data extraction file|imaging service
#
# Examples:
#
# ACME CT Company|BETA|CT|b12 f0|GECT^MAGDIR3|GECTHISA^MAGDIR4A|datagect.dic|RAD
#
# RoadRunner, INC|Beep-Beep|OT|<DICOM>|CORRECT^MAGDIR3||datamisc.dic|CON
#
# end of file
```

B.4.2.2.1 Image Processing Rules – Setup

Images are converted from the DICOM format to the Targa™ format by the program MAG_DCMTOTGA.EXE program. The image processing rules are parameters to MAG_DCMTOTGA, and control the conversion process. They are listed below (*nnn* represents an unsigned integer number):

A*nnn* Add *nnn* to each pixel (before the minimum/maximum check is performed).

B*nnn** Specifies the number of bits in the original pixel.

C*nnn* Ceiling (maximum) pixel value; any value > *nnn* is replaced by *nnn.*

F*nnn* Floor (minimum) pixel value; any value < *nnn* is replaced by *nnn.*

I Invert each pixel.

O*nnn** Byte offset in the DICOM file to the image.

R1 Reduce the size of the image file by outputting the low-order byte of a two-byte pixel.

R2 Reduce the size of the image file two by shifting two-byte pixels into one-byte pixels.

R4 Reduce the size of the image by four by combining four pixels into one two-byte pixel.

R8 Reduce the size of the image by eight by combining four pixels into one one-byte pixel.

R16 Reduce the size of the image by sixteen by combining sixteen pixels into one two-byte pixel.

R32 Reduce the size of the image by thirty-two by combining sixteen pixels into one one-byte pixel.

S*nnn* Subtract *nnn* from each pixel (unsigned arithmetic, executed before add is performed).

X*nnn** X-dimension of the image (horizontal width or the number of columns).

Y*nnn** Y-dimension of the image (vertical height or the number of rows).

The parameters designated with an asterisk ("*") are required; all the others are optional. The rule letters are not case sensitive. Two sets of rules, separated by a slash ("/"), can be placed in the <image processing rules> field of the modality record. The first set of rules is used for the production of the Targa™ file, and the second set (optional) is used for the production of the "Big" file, which is used by the diagnostic workstation (This is optional and is only done for Computed Radiography, Digital Radiography, and digitized film).

Parameters for this program are specified in the "master file" named Modality.dic. When images are stored in VistA in DICOM format, the value "**<DICOM>**" is used instead of any of these parameters to indicate that MAG_DCMTOTGA is not being used.

B.4.2.2.1.1 Typical Values for Image Conversion Parameters

Parameter Value	Equipment
<DICOM>	Images stored in VistA in DICOM format, exactly as they were received from the instrument.
b8	Acuson, Sequoia, US
b12 f0 c4095	ADAC, *, NM
b12 f0 c4095	ADAC, Solus, NM
b12 f0 c4095	ADAC, Vertex, NM
B12 F0 C4095 R8	AGFA, ADC 5145, CR
b8	Aspect Electronics, Inc., Access Acquisition Module, US and OT
b8 f0	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US

Parameter Value	Equipment
b10 f0 c1023 R8/b10 f0 c1023	DeJarnette Research Systems, ImageShare CR, CR
b10 f0 c1023 R8/b10 f0 c1023	DeJarnette Research Systems, Imageshare Fuji CR Acquisition Station, CR
b8	Diasonics, *, US
b10	GE Medical Systems, DLX, XA
b8	GE Medical Systems, DRS, RF
b12 f0	GE Medical Systems, Genesis CT9800 QHL, CT
b12 f0	GE Medical Systems, Genesis HiSpeed RP, CT
b12 f0	GE Medical Systems, Genesis Jupiter, CT
b12 f0	GE Medical Systems, Genesis Signa, MR
b12 f0	GE Medical Systems, HiSpeed CT/i, CT
b12 f0	GE Medical Systems, HiSpeed RP, CT
a1000 b12 f0 c4095	GE Medical Systems, ProSpeed, CT
b12 f0	GE Medical Systems, Rhapsode, CT
b12 f0 c4095 R8	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
b12 f0 c4095 R8	Lumisys, LS75, CR, CT, MR, MRI, NM, OT, RAD, SC and US
b12 f0 c4095	Picker International, Inc., AX000, MR
b12 f0 c4095	Picker International, Inc., Edge 1.5T, MR
b16 a1000 f0 c4095	Picker International, Inc., Polaris, CT
b12 a1000 f0 c4095	Picker International, Inc., PQ2000, CT
b12 a1000 f0 c4095	Picker International, Inc., PQ2000, SC

Parameter Value	Equipment
b12 a1000 f0 c4095	Picker International, Inc., PQ5000, CT
b12 a1000 f0 c4095	Picker International, Inc., PQ5000, SC
b12 a1000 f0 c4095	Picker International, Inc., PQ6000, CT
b12 a1000 f0 c4095	Picker International, Inc., PQS, CT
b12 a1000 f0 c4095	Picker International, Inc., PQS, SC
b12 a1000 f0 c4095	Picker International, Inc., VOXEL, CT
b12 a1000 f0 c4095	Picker International, Inc., VOXELQ, CT
B8	VAMC Image Acquisition Corporation, VA Image Camera, OT

The parameter value for the Fuji CR (labeled above as "DeJarnette Research Systems Imageshare") consists of two parts. The first part is used to create the clinician's down-sampled image file and the second is used to create the full diagnostic resolution image file, which is referred to as the .BIG file.

B.4.2.2.2 Accession Number Extraction Subroutines

The names of the MUMPS routines for extracting the accession number from the image header, and for outputting formatted text for display on the diagnostic workstation, are defined by the VistA Imaging Project.

Possible names of subroutines that extract Accession Numbers are:

Line Tag^Routine	Description
`CORRECT^MAGDIR3`	DICOM for Consults and Procedures (native DICOM format)
`IGNORE^MAGDIR3`	Ignore Image
`STUDYUID^MAGDIR3`	Get from a VistA -generated Study Instance UID
`GEMSPACS^MAGDIR3`	GE Medical Systems PACS
`PQ2000^MAGDIR3`	Picker PQ 2000 CT

Line Tag^Routine	Description
GECTHISA^MAGDIR3	GE High Speed Advantage CT
GEDRS^MAGDIR3	GE Digital Radiography System
LONGCASE^MAGDIR3	Long Case Number
PIDCASE^MAGDIR3	PID after SSN
PIDCASE2^MAGDIR3	PID after //
STUDYID^MAGDIR3	Study ID with Long Case Number
ADACNM^MAGDIR3	ADAC Nuclear Medicine
SERDESC^MAGDIR3	ADAC Nuclear Medicine, Solus
PNAME^MAGDIR3	After Patient Name
MEDCASE^MAGDIR3	Medicine Capture

B.4.2.2.2.1 Typical Values for Accession Number Subroutine

Parameter Value	Equipment
PNAME^MAGDIR3	Accuson, Sequoia, US
LONGCASE^MAGDIR3	ADAC, *, NM
LONGCASE^MAGDIR3	ADAC, Solus, NM
LONGCASE^MAGDIR3	ADAC, Vertex, NM
LONGCASE^MAGDIR3	AGFA, ADC 5145, CR
PIDCASE^MAGDIR3	Aspect Electronics, Inc., Access Acquisition Module, US and OT
LONGCASE^MAGDIR3	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US
LONGCASE^MAGDIR3	DeJarnette Research Systems, ImageShare CR, CR
LONGCASE^MAGDIR3	DeJarnette Research Systems, Imageshare Fuji CR

Parameter Value	Equipment
	Acquisition Station, CR
PNAME^MAGDIR3	Diasonics, *, US
STUDYID^MAGDIR3	GE Medical Systems, DLX, XA
GEDRS^MAGDIR3	GE Medical Systems, DRS, RF
LONGCASE^MAGDIR3	GE Medical Systems, Genesis CT9800 QHL, CT
GECTHISA^MAGDIR3	GE Medical Systems, Genesis HiSpeed RP, CT
GECT^MAGDIR3	GE Medical Systems, Genesis Jupiter, CT
LONGCASE^MAGDIR3	GE Medical Systems, Genesis Signa, MR
LONGCASE^MAGDIR3	GE Medical Systems, HiSpeed CT/i, CT
GECTHISA^MAGDIR3	GE Medical Systems, HiSpeed RP, CT
LONGCASE^MAGDIR3	GE Medical Systems, ProSpeed, CT
LONGCASE^MAGDIR3	GE Medical Systems, Rhapsode, CT
LONGCASE^MAGDIR3	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
LONGCASE^MAGDIR3	Lumisys, LS75, CR, CT, MR, MRI, NM, OT, RAD, SC and US
PQ2000^MAGDIR3	Picker International, Inc., AX000, MR
PQ2000^MAGDIR3	Picker International, Inc., Edge 1.5T, MR
PQ2000^MAGDIR3	Picker International, Inc., Polaris, CT
PQ2000^MAGDIR3	Picker International, Inc., PQ2000, CT
PQ2000^MAGDIR3	Picker International, Inc., PQ2000, SC
LONGCASE^MAGDIR3	Picker International, Inc., PQ5000, CT
PQ2000^MAGDIR3	Picker International, Inc., PQ5000, CT
LONGCASE^MAGDIR3	Picker International, Inc., PQ5000, SC
PQ2000^MAGDIR3	Picker International, Inc., PQ5000, SC

Parameter Value	Equipment
PQ2000^MAGDIR3	Picker International, Inc., PQ6000, CT
PQ2000^MAGDIR3	Picker International, Inc., PQS, CT
PQ2000^MAGDIR3	Picker International, Inc., PQS, SC
PQ2000^MAGDIR3	Picker International, Inc., VOXEL, CT
PQ2000^MAGDIR3	Picker International, Inc., VOXELQ, CT
IGNORE^MADGIR3	(skip this image)

Note: There are multiple possibilities for the same modality, depending upon whether the image was sent directly or via a commercial PACS.

B.4.2.2.3 Text Data Subroutines - Setup

Possible names of subroutines that generate extra text data are:

Line Tag^Name	Description
GECT^MAGDIR4A	General Electric CTs
PICKERCT^MAGDIR4A	Picker CTs
PHILIPCT^MAGDIR4A	Philips CTs
GELCA^MAGDIR4A	General Electric LCA DLX

B.4.2.2.3.1 Typical Values for Data Extraction Subroutine

Parameter Value	Equipment
(none)	Accuson, Sequoia, US
(none)	ADAC, *, NM
(none)	ADAC, Solus, NM
(none)	ADAC, Vertex, NM
(none)	AGFA, ADC 5145, CR

Parameter Value	Equipment
(none)	Aspect Electronics, Inc., Access Acquisition Module, US and OT
(none)	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US
(none)	DeJarnette Research Systems, ImageShare CR, CR
(none)	DeJarnette Research Systems, Imageshare Fuji CR Acquisition Station, CR
(none)	Diasonics, *, US
GELCA^MAGDIR4A	GE Medical Systems, DLX, XA and RF
GECT^MAGDIR4A	GE Medical Systems, Genesis CT9800 QHL, CT
GECT^MAGDIR4A	GE Medical Systems, Genesis HiSpeed RP, CT
GECT^MAGDIR4A	GE Medical Systems, Genesis Jupiter, CT
GECT^MAGDIR4A	GE Medical Systems, Genesis Signa, MR
GECT^MAGDIR4A	GE Medical Systems, HiSpeed CT/i, CT
GECT^MAGDIR4A	GE Medical Systems, HiSpeed RP, CT
GECT1000^MAGDIR4A	GE Medical Systems, ProSpeed, CT
GECT^MAGDIR4A	GE Medical Systems, Rhapsode, CT
(none)	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
(none)	Lumisys, LS75, CR, CT, MR, MRI, NM, OT, RAD, SC and US
(none)	Picker International, Inc., AX000, MR
(none)	Picker International, Inc., Edge 1.5T, MR
PickerCT^MAGDIR4A	Picker International, Inc., Polaris, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQ2000, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQ2000, SC

Parameter Value	Equipment
PickerCT^MAGDIR4A	Picker International, Inc., PQ5000, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQ5000, SC
PickerCT^MAGDIR4A	Picker International, Inc., PQ6000, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQS, CT
PickerCT^MAGDIR4A	Picker International, Inc., PQS, SC
PickerCT^MAGDIR4A	Picker International, Inc., VOXEL, CT
PickerCT^MAGDIR4A	Picker International, Inc., VOXELQ, CT

B.4.2.2.4 Text Data File – Setup

Possible names of files with DICOM elements to be output as text data are:

Name	Description
`DataGECT.dic`	General Electric CTs
`Data_CR.dic`	CR Units
`DataMisc.dic`	Miscellaneous
`Data_MRI.dic`	MRI Units

B.4.2.2.4.1 Typical Values for Text Data Extraction Element List

Parameter Value	Equipment
datamisc.dic	Accuson, Sequoia, US
datamisc.dic	ADAC, *, NM
datamisc.dic	ADAC, Solus, NM
datamisc.dic	ADAC, Vertex, NM
datamisc.dic	AGFA, ADC 5145, CR

Parameter Value	Equipment
datamisc.dic	Aspect Electronics, Inc., Access Acquisition Module, US and OT
datamisc.dic	ATL, 8500-0030-01 (HDI 3000, Pegasus Level 8), US
datamisc.dic	DeJarnette Research Systems, ImageShare CR, CR
datamisc.dic	DeJarnette Research Systems, Imageshare Fuji CR Acquisition Station, CR
datamisc.dic	Diasonics, *, US
datamisc.dic	GE Medical Systems, DLX, XA and RF
datagect.dic	GE Medical Systems, Genesis CT9800 QHL, CT
datagect.dic	GE Medical Systems, Genesis HiSpeed RP, CT
datagect.dic	GE Medical Systems, Genesis Jupiter, CT
datagect.dic	GE Medical Systems, Genesis Signa, MR
datagect.dic	GE Medical Systems, HiSpeed CT/i, CT
datagect.dic	GE Medical Systems, HiSpeed RP, CT
datagect.dic	GE Medical Systems, ProSpeed, CT
datagect.dic	GE Medical Systems, Rhapsode, CT
datamisc.dic	Lumisys, *, CR, CT, NM, OT, RAD, SC and US
datamisc.dic	Lumisys, LS75, CR, CT, MR, MRI. NM, OT, RAD, SC and US
datamisc.dic	Picker International, Inc., AX000, MR
datamisc.dic	Picker International, Inc., Edge 1.5T, MR
datagect.dic	Picker International, Inc., Polaris, CT
datagect.dic	Picker International, Inc., PQ2000, CT
datagect.dic	Picker International, Inc., PQ2000, SC

Parameter Value	Equipment
datagect.dic	Picker International, Inc., PQ5000, CT
datagect.dic	Picker International, Inc., PQ5000, SC
datagect.dic	Picker International, Inc., PQ6000, CT
datagect.dic	Picker International, Inc., PQS, CT
datagect.dic	Picker International, Inc., PQS, SC
datagect.dic	Picker International, Inc., VOXEL, CT
datagect.dic	Picker International, Inc., VOXELQ, CT

B.4.2.3 Example of a MODALITY.DIC File

An example of a portion of a MODALITY.DIC file is show below:

```
GE MEDICAL SYSTEMS|DLX|XA|b10

…|STUDYID^MAGDIR3|GELCA^MAGDIR4A|datamisc.dic

Picker International, Inc.|PQ2000|CT|b12 a1000 f0 c4095
…|PQ2000^MAGDIR3|PICKERCT^MAGDIR4A|datagect.dic

Picker International, Inc.|PQ2000|SC|b12 a1000 f0 c4095
…|PQ2000^MAGDIR3|PICKERCT^MAGDIR4A|datagect.dic

DeJarnette Research Systems|Imageshare Fuji CR Acquisition Station|CR|
…|b10 f0 c1023 R8/b10 f0 c1023|LONGCASE^MAGDIR3||datamisc.dic

LUMISYS|*|CR|b12 f0 c4095 R8|LONGCASE^MAGDIR3||datamisc.dic

EyeCamera|ACME|RoadRunner|VL|<DICOM>|CORRECT^MAGDIR3||datamisc.dic
```

Note 1: There are two entries for the Picker CT. Each image from the unit is processed as an individual file. The first entry in the file **F:\DICOM\Dict\Modality.DIC** is for processing the CT images themselves. The second entry is for the processing of the reference or scout image, which is identified as being a secondary capture (SC) modality image.

Note 2: The Fuji CR has two sets of image processing rules, the first for the reference quality image (reduce 8:1 by combining four 10-bit pixels into one 8-bit pixel), and the second for the full-resolution diagnostic quality image.

Note 3: The headers of the files produced by the LUMISYS film scanner do not contain a model field.

A sample file **F:\DICOM\Dict\Modality.Sample** is supplied with the VistA Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\Modality.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be transferred to the operational master file at the discretion of the site.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.582,d0,0) = Manufacturer ^ Model ^ Modality
                        ^ DCMTOTGA [ / DCMTOTGA ] ^ Accession Number Subroutine
                                    ^ Text Data Subroutine ^ Text Data Filename
^MAGDICOM(2006.582,"B",Manufacturer,Model,Modality,d0) = ""
```

B.4.3 Portlist.DIC

The file **F:\DICOM\Dict\PortList.DIC** contains the port numbers of commercial PACS (typically Mitra Brokers) that receive messages from the DICOM Text Gateway. This file is read by routine **^MAGDMB8** to (re)construct the FileMan table **Radiology TCP/IP Provider Port** (File 2006.584, stored in **^MAGDICOM(2006.584,…)**). This should be done manually as part of the installation process, and whenever operational information has changed at the site.

Use the VistA Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance
→ 2. Gateway Configuration and DICOM Master Files
→ → 4. Update PortList.DIC

The VistA DICOM Text Gateway has the ability to send (push) data to multiple destinations. These destinations may be commercial PACSs or commercial providers of the DICOM Modality Worklist service. The file **F:\DICOM\Dict\PortList.DIC** is used to specify the communication ports for each of the different applications receiving VistA text transactions.

Portlist Record: <menu-option> | <AE title> | <port number> | <file mode> | <channel>

The various fields are defined below:

<menu-option> The text for the communications menu of the VistA DICOM Text Gateway.

<AE title> The application entity title of the service.

<port number> The the network communications port number.

<file mode> Specifies that the service will use fifo queue file buffering.

<channel> Is 1:n, for the DICOM\DATA1 to DICOM\DATAn directory.

An example of the file **F:\DICOM\Dict\PortList.DIC** is shown below:

```
#Menu-option|AE Title|Port|File Mode (FIFO QUEUE or DIRECT)|CHANNEL
```

```
PACS Interface|VistA PACS I/F|60041|FIFO QUEUE|1
#MITRA Broker Interface|VistA PACS I/F|60042|FIFO QUEUE|2
#DeJarnette Medishare Interface|VistA PACS I/F|60043|FIFO QUEUE|2
```

A sample file **F:\DICOM\Dict\PortList.Sample** is supplied with the VistA Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\PortList.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be transferred to the operational master file at the discretion of the site.

The port number for this dictionary should be on the range 60040:60049 – see Appendix E.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.584,d0,0) = Destination ^ Name ^ Port ^ Mode ^ Channel
^MAGDICOM(2006.584,"B",Destination,d0) = ""
```

B.4.4 SCU_List.DIC

The file **F:\DICOM\Dict\SCU_List.DIC** defines the DICOM applications that VistA can invoke as a **S**ervice **C**lass **U**ser (SCU). All the information needed by VistA to initiate the association is included in this file. This file is read by routine **^MAGDMB9** to (re)construct the FileMan table **User Application** (File 2006.585, stored in **^MAGDICOM (2006.585,…)**). This should be done as part of the installation process, and whenever operational information has changed at the site.

Use the VistA Imaging DICOM Gateway menu to update this master file as follows:

4. System Maintenance
→ 2. Gateway Configuration and DICOM Master Files
→ → 5. Update SCU_List.DIC

There are three kinds of records in the file **F:\DICOM\Dict\SCU_List.DIC**. The first is the "provider" record, which identifies the service class provider (SCP) of a DICOM application. Following the provider record are one or more "service" records defining the services to be utilized. "Service" records may be followed by optional "transfer syntax" records.

- Provider Record: <application name> | <called AE title> | <calling AE title> | <destination IP address> | <destination port number> [| <PACS-type>]
- Service Record: <presentation context name> | <transfer syntax name>
- Transfer Syntax Record: | | <transfer syntax name>

The different fields are defined below:

<application name>	The name that VistA uses to refer to the DICOM application.
<called AE title>	The title of the called provider (SCP) application entity.
<calling AE title>	The name of the VistA user (SCU) application entity.
<destination IP address>	The network IP address of the provider (SCP) application entity.
<destination port number>	The network port number for the provider (SCP application entity.
<PACS-type>	A code for the type of PACS being used (optional parameter, default value is "GE")
<presentation context name>	The name of the DICOM service object pair (SOP).
<transfer syntax name>	The name of the DICOM transfer syntax

Editing the file **F:\DICOM\Dict\SCU_List.DIC** implies changing the <destination IP address> and <destination port number> fields in the provider record. These values come from the commercial equipment providers.

When an entry in this file describes a remote PACS, an additional parameter is needed to indicate the type of PACS being used. Currently, the values "GE" (default) and "KODAK" are supported.

The following is an example of entries in the file **F:\DICOM\Dict\SCU_List.DIC**:

```
# User Application List
# Format:
# line 1:App Name|Called AE|Calling AE|Destination IP Address|Socket|Type
# line 2:|Presentation Context Name|Transfer Syntax Name
# line 3:||Transfer Syntax Name (if there are more than one)
#
EMED Query/Retrieve|EMED_SCP_LAND|VA VISTA|111.222.33.44|104
|Verification SOP Class|Implicit VR Little Endian
|Study Root Query/Retrieve Information Model - MOVE|Implicit VR Little
Endian
#
```

A sample file **F:\DICOM\Dict\SCU_List.Sample** is supplied with the VistA Imaging DICOM Gateway distribution, and may be edited by adding and/or deleting the pound signs ("#"). During an initial installation, this sample file is renamed to **F:\DICOM\Dict\SCU_List.DIC**. When performing an upgrade, the existing copy of this file will remain unaffected. Information from the sample file may be transferred to the operational master file at the discretion of the site.

The data from this file is stored in MUMPS in the following structure:

```
^MAGDICOM(2006.585,d0,0) = Service name
^MAGDICOM(2006.585,d0,1,d1,0) = SOP Class
^MAGDICOM(2006.585,d0,1,d1,1,d2,0) = Transfer Syntax
^MAGDICOM(2006.585,"B",Service name,d0) = ""
^MAGDICOM(2006.585,d0,1,"B",SOP Class,d1) = ""
^MAGDICOM(2006.585,d0,1,d1,1,"B",Transfer Syntax,d2) = ""
```

One of the purposes of including entries in this file is so that images can be transmitted to

DICOM Destinations. For the details of using entries as Routing Destinations, see the VistA Imaging Routing User Guide.

B.4.5 Worklist.DIC

The file **F:\DICOM\Dict\WorkList.DIC** contains the definitions of the various parameters that are needed for Modality Worklist processing by the instruments that are being used at the site. This file is read by routine **MAGDMBW** and to (re)construct the FileMan table **Modality Worklist Dictionary** (File 2006.583, stored in **^MAGDICOM(2006.583,…)**). This is done manually as part of the installation process, and whenever operational information has changed at the site.

After editing, use the VistA Imaging DICOM Gateway menu option to update this master file as follows:

4. System Maintenance
→ 2. Gateway Configuration and DICOM Master Files
→ → 6. Update WorkList.DIC

The file **F:\DICOM\Dict\WorkList.DIC** is used in conjunction with the VistA Modality Worklist Service Class Provider. It maps the modality issuing the request to the corresponding site of image acquisition, image service, and image type. The record defining the modality is defined below:

```
<calling AE Title> | <location name> | <imaging service> | <imaging type> |
<accession number/SSN format> | <description>
```

The different fields are defined below:

<calling AE Title>	The AE title of the modality; different units should use different AE titles.
<location name>	The name of the institution (as defined in `Piece(^DIC(4,ien,0),"^",1)`. It also may be the site id or left null (default is the site of the gateway).
<imaging service>	The name of the imaging service (as defined in FileMan File 2006.589, **Imaging Service Dictionary**, stored in `^MAGDICOM(2006.589,…)`).
<imaging type>	The abbreviation for the Imaging Type. For radiology this is defined in FileMan File 79.2, **Imaging Type**, stored in `^RA(79.2,…)`. For Healthcare Providers Software, this is defined in File 2005.84, **Image Index For Specialty/Subspecialty**, stored in `^MAG(2005.84,…)`.

<accession number/SSN format>	Specifies the accession number format: short(case number nnnnn) or long format(mmddyy-nnnnn). The SSN format is with DASH or without (NODASH), DASH being the default.
<description>	A description that describes the equipment and typically also its location.

An example of the WORKLIST.DIC file is shown below:

```
#Station AE Title|Location Code|Imaging Service|Imaging Type|Short or
Long Accession Number
SCANNER1|Baltimore, MD|RAD|RAD|LONG|North Clinic
PICKER_CT_TONY|Baltimore, MD|RAD|RAD|LONG|Second Floor, Room E16a
HUMPHRY_ZEISS|660|CON|EYE|LONG/DASH|Eye Clinic
```

The file WORKLIST.DIC has to be edited for every new instrument using the VistA modality worklist service.

- Names of locations must be spelled as in the **Institution** File (File number 4, stored in `^DIC(4,...)`). These names are processed in a case-insensitive fashion. Only the part of the name before the first comma needs to match the value in the institution file. Any other punctuation characters that occur in that part of the "official" name must appear in the value that is entered here.

  If no name is specified for the name of a location, the default value from the Gateway Site Parameter will be used.

- Names of imaging services must be either "**RAD**", for radiology, or "**CON**" for Healthcare Providers (consults). These names must be spelled in all upper-case characters.

Names of imaging types depend on the Imaging Service.

B.4.6 Populating the DICOM Healthcare Providers Service File

The DICOM Healthcare Providers Service file ^MAG(2006.5831) is a pointer to file ^GMR(123.5) that will support the DICOM interface. Each Consult Service that will use the DICOM interface must be included in this file in order to create modality worklist entries.

These are the fields for the DICOM HEALTHCARE PROVIDERS SERVICE:

.01	REQUESTED SERVICE (pointer to file 123.5)
2	SERVICE GROUP (pointer to file 2005.84)
3	SERVICE DIVISION (pointer file 4- Institution File)

For each Consult Service that you will enter into the DICOM Healthcare Providers Service file, you will need to specify the following data values:

a) The REQUESTED SERVICE field is a pointer to file 123.5 (REQUEST SERVICES). Some sites may have one or two consult service defined in file 123. The site needs to decide whether to keep this consult(s) to be used for the DICOM interface. If a site decides to keep the existing consult service for the DICOM interface this means that all orders placed for this consult service will show up on the DICOM work list. If you want to only show consult orders with images, the site might want to create a new consult service just for the DICOM use. An example might be Dental Image or Ophthalmology Image. This Dental Image consult request service will only be used by the Dental Department.

b) The SERVICE GROUP field is a pointer to file 2005.84 (IMAGE INDEX FOR SPECIALTY / SUBSPECIALTY). This entry defines all the consult & procedure requests from the different related Healthcare Providers that are to appear together on the same DICOM modality worklist. Use the following guidelines:

- If ophthalmology and optometry are to be together on the same worklist, use "EYE CARE" for all the services. "EYE" will be used as the Image Type in modality worklist.
- If they are to be on separate worklists, use "OPHTHALMOLOGY" and "OPTOMETRY" instead. This case, "OPHTH" and "OPTOM" will be the two Image Types for the modality worklist.

Note: Ophthalmology and Optometry are both subspecialties of Eye Care. That means that if the Eye Care specialty is selected in Image Display, images tagged with Eye Care, Ophthalmology or Optometry will be returned. So, the users can map to any of the three and take advantage of the flexibility built into the system. We would recommend that they map to Ophthalmology or Optometry depending on the device/service. They could then enter either Ophthalmology or Optometry for specific views of eye images, or Eye Care for general views.

For the dental services, because of eligibility restrictions, it is advisable to create a new "Dental Image" service and map only it to the "DENTAL" entry. Dental personnel will verify eligibility and order specific procedures for this service so that they appear on modality worklist. Since the other dental services are not mapped, the ineligible consult and procedure requests will not appear on the modality worklist.

For GI Endoscopy, use "GASTROENTEROLOGY". The Image Type in modality worklist will be "GI".

c) The SERVICE DIVISION field is a pointer to file 4 (Institution) to identify the actual division where the service exits. If you have a service that sees patients at more than one location and want to keep each set of patients separate on the worklist, you will need to create an individual service for each location.

Here is a sample FM dialog for populating 2006.5831, DICOM Healthcare Providers Service file:

```
Select OPTION: ENTER OR EDIT FILE ENTRIES
INPUT TO WHAT FILE: 2006.5831  DICOM HEALTHCARE PROVIDERS SERVICE
```

```
EDIT WHICH FIELD: ALL//

Select DICOM HEALTHCARE PROVIDERS SERVICE REQUESTED SERVICE: DENTAL OUTPATIENT
  Are you adding 'DENTAL OUTPATIENT' as
    a new DICOM HEALTHCARE PROVIDERS SERVICE (the 5TH)? No// Y  (Yes)
SERVICE GROUP:DENTAL
SERVICE DIVISION: SALT LAKE CITY                        660

Global examples:
Global ^MAG(2006.5831
        MAG(2006.5831
^MAG(2006.5831,0) = DICOM HEALTHCARE PROVIDERS SERVICE^2006.5831P^46^3
^MAG(2006.5831,44,0) = 44^17^543
^MAG(2006.5831,45,0) = 45^17^589
^MAG(2006.5831,46,0) = 46^53^660
```

B.4.7 Populating the Related Hospital Location file

In VistA, consult and procedure requests are assigned to Request Services (#123.5) while appointments are scheduled to Clinics. In order to determine which appointments should be associated with which requests, it is necessary to map the Clinics to the Services. This is accomplished by specifying the corresponding Clinics of each Healthcare Providers Service in the Service's Requested Hospital Location file.

In this example, the request is to be performed by the Eye Photographer service (#45). Cross checking the Related Hospital Location field indicates that this service can be performed in the Eye Photography Clinic (#67). This means that an appointment for the Eye Photography Clinic can be associated with a consult or procedure request for the Eye Photographer Service.

```
Global ^GMR(123.5,45,123.4 -- NOTE: translation in effect
^GMR(123.5,45,123.4,0)=^123.56P^1^1
^GMR(123.5,45,123.4,1,0)=67
^GMR(123.5,45,123.4,"B",67,1)=
```

Here is the FM dialog for 123.5, field related hospital locations:

```
Select OPTION: ENTER OR EDIT FILE ENTRIES

INPUT TO WHAT FILE: REQUEST SERVICES//
EDIT WHICH FIELD: ALL// RELATED HOSPITAL LOCATION    (multiple)
   EDIT WHICH RELATED HOSPITAL LOCATION SUB-FIELD: ALL//
THEN EDIT FIELD:

Select REQUEST SERVICES SERVICE NAME: OPH
     1   OPHTHALMOLOGY
     2   OPHTHALMOLOGY-PHOTOGRAPHY
CHOOSE 1-2: 1  OPHTHALMOLOGY
Select RELATED HOSPITAL LOCATION: OPHT
     1   OPHTHALMOLOGY
     2   OPHTHALMOLOGY-BELKIN
     3   OPHTHALMOLOGY-EYEPHOTOGRAPHY
     4   OPHTHALMOLOGY-KUZMAK
CHOOSE 1-4: 1  OPHTHALMOLOGY
  Are you adding 'OPHTHALMOLOGY' as
    a new RELATED HOSPITAL LOCATION (the 1ST for this REQUEST SERVICES)? No// Y
  (Yes)
Select RELATED HOSPITAL LOCATION:
```

Appendix C Networking Fundamentals

C.1 Overview

TCP/IP inter-process (i.e., computer-to-computer) communications are performed between operating system endpoints called sockets. A socket is assigned a unique numeric port value (1-65535) when it is placed into use. Server applications allocate sockets and assign well-known port numbers when they start up. Client applications allocate sockets and access the server applications via the well-known port numbers.

Internet convention reserves port numbers 1-1023 for the system. The telnet server application, for example, uses port number 23. Port numbers 1024-5000 are automatically assigned by the system, as needed, for things like handling telnet client sessions. Port numbers above 5000 are available for user-developed services[2] (e.g., VA Kernel Broker uses 9200).

DICOM applications require well-known port numbers. The port numbers for the VistA Imaging DICOM Gateway are assigned in a consistent dedicated fashion so that each application always uses the same port number, and different applications are always assigned different port numbers.

This allows applications to be moved between machines for redundancy and load balancing, without requiring the port numbers to be reconfigured. The VistA Imaging DICOM Gateway applications use port numbers in the range of 60000-61000 (see Appendix A).

C.2 IP Addresses and Subnet Masks

Internet Protocol (IP) addresses are defined for network interfaces. More than one address may be defined for an individual network interface, and a machine may have more than one network interface. If a machine has more than one network interface, the IP address for each of the interfaces must be assigned in different subnets.

IP addresses are 32 bits long and are represented in the format *aaa.bbb.ccc.ddd*, where *aaa*, *bbb*, *ccc*, and *ddd* are the first, second, third, and fourth octets (bytes) respectively.

Large organizations sub-divide their network namespace into logically independent *subnets*. With the TCP/IP protocol suite, two machines can directly communicate with one another *only if they have IP addresses that are in the same subnet*. Otherwise, routers must be used to provide inter-subnet store and forward communications.

The *subnet mask* is used to partition the network namespace IP addresses into the different subnets. The subnet mask is also 32 bits long and has the same *aaa.bbb.ccc.ddd* format as the IP address. By definition, the subnet mask consists of a string of high-order ONE bits followed by a string of low-order ZERO bits. The bits in the *aaa* octet of the subnet mask are usually set to ONE. The *bbb*, *ccc*, and *ddd* octets have a specific number of high-order ONE bits and low-order ZERO bits.

[2] UNIX® Network Programming, W. Richard Stephens, Prentice Hall, 1990, page 304.

The sequence of the ONE bits in the subnet mask define the subnet of the IP address. In a very frequently used combination in the VA, the *ccc* and *ddd* octets may have a string of nine high-order ONE bits followed by seven low-order ZERO bits. The resulting decimal sequence 255.255.255.128 (i.e., 11111111.11111111.11111111.10000000 in binary) is commonly referred to as a nine-bit subnet mask.

The selection of the subnet mask is a crucial configuration factor governing performance in the imaging network.

Two IP addresses are in the same subnet if two conditions are met:
- They have the same subnet mask.
- The logical AND of the subnet mask and each IP address are the same.

Routing imposes a network bottleneck for high-volume LAN applications like imaging. It is highly desirable, for performance reasons, to avoid routing imaging traffic, whenever possible. One way to accomplish this is to use a switched network topology and place all of the components (workstations, servers, etc.) in the same subnet. Another way is to have separate subnets, but to assign multiple IP addresses to the servers, one for each subnet.

C.2.1 Example 1 – Original Configuration – Nine-bit Subnet Mask

Assume that machines A, B, C, and D are all on the same switched network. Machines A and B are file servers containing images, and machines C and D are imaging workstations.

Subnet Mask	255.255.255.128	(nine-bit subnet mask)
IP Address A	111.222.34.30	
IP Address B	111.222.34.31	
IP Address C	111.222.34.130	
IP Address D	111.222.34.131	

Note: In all the examples in this document, dummy IP addresses starting with 111.222 are used (Please ignore the fact that 111.xxx.yyy.zzz is a Class A network address, while 152.xxx.yyy.zzz is a Class B one).

The subnet mask specifies that the upper three octets and the high order bit of the low order octet must be the same. The seven low order bits may be different.

There are 128 (2^7) different IP address combinations in this subnet, of which 126 may be used (The lowest and highest address in the range are reserved).

In Example 1, there are two different subnets: 111.222.34.0 to 111.222.34.127 and 111.222.34.128 to 111.222.34.255. IP Addresses A and B are in one subnet (see Figure 10.1), while IP addresses C and D are in another subnet (see Figure 10.2).

IP Address "A" Logically ANDed with Subnet Mask

	Decimal Notation	Binary Notation
IP Address "A"	111.222.34.30	01101111.11011110.00100010.00011110
Subnet Mask	255.255.255.128	11111111.11111111.11111111.10000000
Logical AND	111.222.34.0	01101111.11011110.00100010.00000000

Figure 10.1

IP Address "C" Logically ANDed with Subnet Mask

	Decimal Notation	Binary Notation
IP Address "C"	111.222.34.130	01101111.11011110.00100010.10000010
Subnet Mask	255.255.255.128	11111111.11111111.11111111.10000000
Logical AND	111.222.34.128	01101111.11011110.00100010.10000000

Figure 10.2

Machines A and B can communicate directly with each other, as can machines C and D, but machines A and B can not directly communicate with machines C and D. A router is required in order for machines A & B to communicate with machines C & D.

Rather poor image retrieval performance is obtained in the Example 1 configuration because every byte of data transferred from the file servers (A & B) to the workstations (C & D) must pass through the router. As Example 2 will show, merely by changing the subnet mask by one bit can dramatically improve image transfer times.

C.2.2 Example 2 – Change to Eight-bit Subnet Mask

Assume that machines A, B, C, and D are all on the same switched network. Machines A and B are file servers containing images, and machines C and D are imaging workstations.

Subnet Mask	255.255.255.0	(eight-bit subnet mask)
IP Address A	111.222.34.30	
IP Address B	111.222.34.31	
IP Address C	111.222.34.130	
IP Address D	111.222.34.131	

In Example 2, there is only one subnet: 111.222.34.0 to 111.222.34.255 with 254 usable IP addresses. Machines A, B, C, and D can directly communicate with each other without requiring a router.

There is a significant gain in performance for the imaging application between the first and the second configuration. The second configuration is much faster than the first because the images can be retrieved from the file servers directly, without having to be passed through a router.

C.2.3 Example 3 – Keep Nine-bit Subnet Mask and Add Secondary IP Address to Servers

Another option is to keep the original nine-bit subnet masks and add secondary IP addresses to the servers.

Assume that machines A, B, C, and D are all on the same switched network. Machines A and B are file servers containing images, and machines C and D are imaging workstations.

Subnet Mask	255.255.255.128 (nine-bit subnet mask)
IP Address A	111.222.34.30, 111.222.34.250
IP Address B	111.222.34.31, 111.222.34.251
IP Address C	111.222.34.130
IP Address D	111.222.34.131

In Example 3, there are the two original subnets: 111.222.34.0 to 111.222.34.127 and 111.222.34.128 to 111.222.34.255. IP Addresses C and D are in one subnet, but IP addresses A and B are in both subnets. Machines A, B, C, and D can directly communicate with each other without requiring a router. Like Example 2, there is a similar significant gain in performance for the imaging application with this configuration.

For several years, the nine-bit subnet mask 255.255.255.128 was the recommended for the VA when the network topology consisted of several subnets connected by routers. With the new switched network topology consisting (ideally) of a single subnet containing several segments connected together by switches, other subnet mask values will be used.

The Telecommunications Support Office recommends using Variable Length Subnet Masks with a switched network topology in order to minimize the router load and maximize throughput. This means using different size subnet masks for different parts of the network IP address space.

In order to achieve optimal performance in a switched network topology, partition the IP address space and assign subnet masks to provide the largest possible subnets and minimize routing.

C.2.4 Example 4 – Use Multiple Subnets

A VAMC has been assigned the 111.222.29.1 to 111.222.32.126 range of IP addresses. All addresses outside this range are assigned to other facilities. The entire VAMC is wired with a 100 Base TX switched network infrastructure. What subnet masks should be used to provide the largest possible subnets?

The best solution is to use three subnets as follows:

Name	IP Address Range	Subnet Mask	Number of Addresses
Subnet A	111.222.29.1 - 111.222.29.254	255.255.255.0 eight-bit subnet mask	254
Subnet B	111.222.30.1 - 111.222.31.254	255.255.254.0 seven-bit subnet mask	510
Subnet C	111.222.32.1 - 111.222.32.126	255.255.255.128 nine-bit subnet mask	126

Note how the values of the IP addresses affect the way that the subnets can be constructed. The high-order bits of the IP address ANDed with the subnet mask must be the same for the entire subnet. IP addresses 111.222.30.* and 111.222.31.* can be placed into the same subnet using the seven-bit mask because the value of the ANDs are both 111.222.30.0. Note, however, that IP addresses 111.222.29.* and 111.222.30.* cannot be placed into the same subnet using the seven-bit mask, because the value for the ANDs are different, 111.222.28.0 and 111.222.30.0 respectively. Subnet A can accommodate the imaging application with up to 250 workstations with no need for routing. An application with more workstations (like office automation) might be placed in Subnet B. Miscellaneous applications can be placed in Subnet C.

If the nine-bit subnet mask were used instead of the variable length subnet mask scheme, there would be seven subnets with 126 addresses in each. The image file servers could then have multiple IP addresses, one in each subnet to avoid much of the routing. Otherwise, considerably more routing would be required.

Another site has used subnet mask 255.255.128.0 (allowing 32,766 addresses) so that all the devices in the facility are on the same subnet. It is also possible to use a VISN-wide Class A private network address scheme with a subnet mask 255.0.0.0 and IP addresses like 10.130.xxx.yyy.

Note: The site then may need to provide an IP address conversion capability so that Silver Spring can access the gateway using pcAnywhere.

Warning: Changes to the subnets need to be reflected in the routers and the other systems on the network.

For further information, contact your CIO Network Group and the network vendor specialists.

C.3 Default Gateways

A Default Gateway is typically a port on a router that is used to transfer traffic between subnets. The default gateway port IP address must be in the same subnet as the IP address of the network interface. Typically, the bottom or top address in a subnet is used as the IP address for the default gateway. In this example, the default gateway IP address might be 111.222.34.1 or 111.222.34.126 for IP addresses A and B, and 111.222.34.129 or 111.222.34.254 for IP addresses C and D.

It is possible to set the default gateway IP address incorrectly and still get routing to occur. Some routers have an "automatic address resolution option" which, if enabled, will automatically resolve IP addresses and perform routing, in spite of the fact that the default gateway IP address may be incorrect. This "feature" may tend to "hide" IP address problems and may promote bad networking practices.

The IP addresses on a Windows workstation are set by mouse clicking on Start, picking Settings, and selecting Control Panel. Clicking on the Network icon on the Control Panel window brings up the Network window. Selecting the Protocols tab brings up a list of the installed network protocols. Selecting the TCP/IP Protocol and the Properties button brings up the Microsoft TCP/IP Properties window. Select the adapter and enter the IP address, subnet mask, and default gateway. The system may have to be rebooted afterwards.

The Advanced button brings up the Advanced IP Addressing window that allows the entry of the additional IP addresses. The IP addresses can been in either the same subnet or in different subnets. This is very useful for connecting servers to multiple subnets. It is also useful in the event of a system failure for redirecting communications to an operational VistA DICOM machine.

For imaging workstations, the IP address, subnet mask, default gateway, and other parameters, such as WINS and DNS addresses, can be left blank and be assigned at run time using the Dynamic Host Configuration Protocol (DHCP). This should not be used for VistA Imaging DICOM Gateways, however, as permanent (i.e., "hard coded") IP addresses are usually required for communications by the commercial DICOM equipment.

C.4 HOSTS File

The HOSTS file maps IP addresses to aliases. Aliases are mnemonics, memory aids that can serve multiple purposes. It is very useful to place entries for all the commercial DICOM equipment into the HOSTS file of the VistA Imaging DICOM Gateway.

Using aliases makes it much easier to access the other systems. The aliases can be used in commands in place of the numeric IP addresses. If it is necessary to change the IP address of the commercial DICOM equipment, it can be changed in the HOSTS file while keeping the same familiar alias.

Service providers can use the information in the HOSTS file in a reverse fashion, to lookup incoming client IP addresses and display the corresponding alias.

Example of HOSTS file:

```
# VAMC DICOM Image Producing Modalities
111.222.35.30 CT1              # Picker CT PQ-2000 #1
111.222.35.31 CT2              # Picker CT PQ-2000 #2
111.222.35.32 CT3              # GEMS High Speed Advantax CT
```

The HOSTS file is not limited to IP addresses of other systems, however. Aliases can also point to the current system (using the IP address 127.0.0.1) and form a local loopback.

The VistA DICOM application makes use of this capability by defining aliases to identify different telnet processes running on the current system. The telnet windows for the different processes are started with the different aliases. Each telnet window displays the alias in its title bar while it is running, identifying the process.

Note: The alias can also contain the menu prompt numbers, making it easier to start the process).

Example of HOSTS file:

```
# local host telnet connections for the VistA DICOM PACS Interface
# VistA DICOM Text Gateway
127.0.0.1   TEXT_INTERFACE_1_1       # HIS to DICOM Test Interface
127.0.0.1   EMED_PACS_1_2_1          # EMED PACS Communications
127.0.0.1   MITRA_BROKER_1_2_2       # MITRA / FUJI Communications
```

The command “telnet EMED_PACS_1_2_1” will display “Telnet – EMED_PACS_1_2_1” in the title bar at the top of the window.

Appendix D Diagnostic Networking Tools

D.1 HOSTDIR.BAT

The full path to the HOSTS file is several directories deep and is system dependent (e.g., `c:\WINNT\system32\drivers\etc\hosts`). Rather than trying to remember which path to use for which system and typing in the whole thing every time, use the following script:

```
cd %SystemRoot%\system32\drivers\etc
```

This takes you to the directory containing the HOSTS file. The script is stored in the file **`c:\Program Files\VistA\Imaging\DICOM\hostdir.bat`**. The installation procedure ensures that this directory will be included in the "path", so that this command file can be started by simply typing "`hostdir`".

D.2 IPCONFIG

The current system's IP address, subnet masks, and default gateways can be conveniently displayed with the IPCONFIG command, as shown below:

```
c:\>ipconfig

Windows IP Configuration

Ethernet adapter DC21X42:

    IP Address. . . . . . . . . . : 222.111.36.138
    Subnet Mask . . . . . . . . . : 255.255.255.192
    Default Gateway . . . . . . . : 222.111.36.190

Ethernet adapter DC21X41:

    IP Address. . . . . . . . . . : 111.222.36.39
    Subnet Mask . . . . . . . . . : 255.255.255.128
    IP Address. . . . . . . . . . : 111.222.36.40
    Subnet Mask . . . . . . . . . : 255.255.255.128
    Default Gateway . . . . . . . : 111.222.36.122
```

Note that the second network interface has two different IP addresses assigned to it. This illustrates how one VistA Imaging DICOM Gateway can be configured to subsume the tasks of another, in the event of a system failure. In this example, the system with IP address 111.222.36.40 was taken out of service and all of its tasks were given to the system with IP address 111.222.36.39. The DICOM applications that had run on the old system now run on the new system without any changes to the commercial DICOM system's configuration files.

Multiple IP addresses can also be used in a switched network to span multiple subnets. These additional IP address can be defined by selecting the Advanced button of the Microsoft TCP/IP Properties window (see Section C.2.3 above).

D.3 PING

Probably the most useful command for network troubleshooting is PING which, like the navy destroyers of old, listens for an echo response from its target destination. The pinging of Forum, the VA email system, is shown below:

```
c:\>ping forum

Pinging FORUM [111.222.38.25] with 32 bytes of data:

Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
Reply from 111.222.38.25: bytes=32 time<10ms TTL=254
```

or

```
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

The above example shows the results of a successful and an unsuccessful PING. The PING protocol uses "impc" request and response packets. Four "impc requests" were issued by PING and four (or zero) "impc responses" were received.

A system should always be able to ping its default gateway. A good initial test for physical network integrity is to try to ping the system's default gateway.

Note: While most DICOM devices support PING in both directions, at least one commercial DICOM image acquisition device (the GE Digital Radiofluoro DRS 3.1) simulates a phony PING function by attempting to establish an FTP session with the destination system. This does not work with the VistA DICOM system, since Windows Professional™ workstation does not normally provide an FTP server.

D.4 TRACERT

In addition to PING, Windows Professional™ supports TRACERT (trace route) to explicitly display the full route that is used to communicate with the target system. This tool presents many more diagnostic details. The route to Forum is shown below:

```
c:\>tracert forum

Tracing route to FORUM [111.222.38.25]
over a maximum of 30 hops:

  1   <10 ms   <10 ms   <10 ms  111.222.38.122
  2   <10 ms   <10 ms   <10 ms  FORUM [111.222.38.25]

Trace complete.
```

In the above example, the host system 111.222.38.39 used its default gateway 111.222.38.122 to hop first to the gateway 111.222.38.122 and then to FORUM 111.222.38.25.

D.5 NETSTAT

NETSTAT displays protocol statistics and current TCP/IP network connections. The telnet, NetBIOS, and DICOM sessions are displayed by NETSTAT, as shown in the following example:

```
C:\>netstat

Active Connections

  Proto  Local Address      Foreign Address        State
  TCP    isw-xxx:60000      localhost:1091         ESTABLISHED
  TCP    isw-xxx:60120      localhost:1096         ESTABLISHED
  TCP    isw-xxx:1091       localhost:60000        ESTABLISHED
  TCP    isw-xxx:1095       localhost:telnet       TIME_WAIT
  TCP    isw-xxx:1096       localhost:60120        ESTABLISHED
  TCP    isw-xxx:1070       VHAISWXX2:nbsession    ESTABLISHED
  TCP    isw-xxx:1073       VHAISWXX1:nbsession    ESTABLISHED
```

In this example, ports 1070 and 1073 are used for NetBIOS sessions, port 1095 is used for a telnet client (to the telnet server port 23), and the other ports were used for DICOM. Port 60000 and 60120 were used for the VistA DICOM application, while ports 1091 and 1096 were assigned by the system for DICOM clients.

D.6 DICOM_Echo

Note: The DICOM_Echo utility is part of our normal distribution, and is located in the **c:\Program Files\VistA\Imaging\DICOM** directory.

C-ECHO is a DICOM service that is used to verify communications to a remote DICOM application entity (AE). A Verification SOP Class user can send a C-ECHO request to another DICOM AE. If the remote AE is a Verification SOP Class provider, it will return a C-ECHO response back to the original requesting AE. This function is analogous to a DICOM application-level PING.

DICOM_Echo is a public domain utility written by the Mallinckrodt Institute of Radiology that sends a C-ECHO request to a remote DICOM AE, and then waits for a response.

To View HELP:

```
C:\User>dicom_echo
dicom_echo [-a title] [-d] [-c title] [-m mode] [-n num] [-p] [-r repeat] [-s
sleeptime] [-v] [-x] node port

    a     Application title of this application
    c     Called AP title to use during Association setup
    d     Drop Association after echo requests
    m     Mode for SCU/SCP negotiation (SCU, SCP, SCUSCP)
    n     Number of network connections
    p     Dump service parameters after Association Request
    r     Number of times to repeat echo request
    s     Time to sleep after each echo request
    v     Verbose mode for DUL/SRV facilities
    x     Do not release Associations when finished with echo
```

```
    node  Node name of server
    port  Port number of server
```

Actual Usage:

```
C:\User>dicom_echo 111.222.36.38 60120
Echo context: Context
Verification Response
  Message ID Responded to:    1
  Verification Status:     0000
Echo Response
Message ID Responded To: 1
Data Set Type:           0101
Status:                  0000  Status Information:-
        Successful operation
Class UID:               1.2.840.10008.1.1
```

D.7 Send_Image

Note: The Send_Image utility is part of our normal distribution, and is located in the **c:\Program Files\VistA\Imaging\DICOM** directory.

C-STORE is the DICOM service that is used to transfer an image (i.e., a composite object) to a remote DICOM application entity. A Storage SOP Class user can send a C-STORE request to another DICOM AE. If the remote AE is a corresponding Storage SOP Class provider, it will accept the association and await image transfer. The Storage SOP Class user can then transfer one or more images to the Storage SOP Class provider. After the images are sent, it closes the association.

Send_Image is a public domain utility written by the Mallinckrodt Institute of Radiology to issue a C-STORE request and send one or more images to a remote DICOM Storage SOP Class provider.

To View HELP:

```
C:\User>send_image
send_image [-a application] [-c called] [-m maxPDU] [-p] [-q] [-r] [-s
SOPName][-t] [-x FAC] [-v] node port image [image...]

    -a    Set application title of this (calling) application
    -c    Set called AE title to title in Association RQ
    -m    Set maximum PDU in Association RQ to maxPDU
    -p    Alter image by sending minimal pixel data
    -q    Quiet mode.  Suppresses some messages to stdout
    -r    Make program sensitive to response status.  If not success, stop
    -s    Force an initial Association using one SOP Class based on SOPName
          (CR, CT, MR, NM, SC, US)
    -t    Time the image transfer.  Print elapsed time and transfer rate.
    -v    Place DUL and SRV facilities in verbose mode
    -x    Place one facility(DCM, DUL, SRV) in verbose mode

    node  Node name for network connection
    port  TCP / IP port number of server application
    image A list of one or more images to send
```

Actual Usage:

```
C:\User>send_image -q cemax30 104 a0000001.dcm a0000002.dcm a0000003.dcm
Store Response
Message ID Resp:1
Data Set Type:  0101
Status:         0000  Status Information:-
        Successful operation
Class UID:      1.2.840.10008.5.1.4.1.1.2
Instance UID:   1.2.840.113619.2.1.11101.786458237.2.11.858271581
Store Response
Message ID Resp:2
Data Set Type:  0101
Status:         0000  Status Information:-
        Successful operation
Class UID:      1.2.840.10008.5.1.4.1.1.2
Instance UID:   1.2.840.113619.2.1.11101.786458237.2.11.858271582
Store Response
Message ID Resp:3
Data Set Type:  0101
Status:         0000  Status Information:-
        Successful operation
Class UID:      1.2.840.10008.5.1.4.1.1.2
```

Appendix E Port Numbers for VistA Imaging DICOM Gateway Applications

Attention: For inter-process communications, DICOM applications require well-known port numbers[3].

The VistA Imaging DICOM Gateway uses port numbers in the 60000-61000 range, in order to avoid conflicting with those used by other applications.

Note: 104 is commonly used as the default port number for DICOM.

The following table contains suggested port numbers for the VistA DICOM Applications.

VistA Imaging DICOM Gateway Application	Port Number
Image acquisition MUMPS storage controller	60000
Modality Worklist SCP	60010
Performed Procedure Step SCP	60020
Storage Commitment SCP	60030
Commercial PACS Text Interface	60040
Commercial Modality Worklist SCP #1	60041
Commercial Modality Worklist SCP #2	60042
Query Retrieve SCP	60050
CR Modality – Image Storage	60100 – 60109
Digital Radiography – Image Storage	60110 – 60119
CT Modality – Image Storage	60120 – 60129
MR Modality – Image Storage	60130 – 60139

[3] DICOM applications require "hard coded" IP addresses and cannot use those assigned by the **D**ynamic **H**ost **C**onfiguration **P**rotocol (DHCP).

VistA Imaging DICOM Gateway Application	Port Number
Digital Radio Fluoro – Image Storage	60140 – 60149
Digital Angiography – Image Storage	60150 – 60159
Ultrasound – Image Storage	60160 – 60169
Nuclear Medicine – Image Storage	60170 – 60179
Visible Light – Image Storage	60180 – 60189
Film Digitizer – Image Storage	60190 – 60199
Dental – Image Storage	60200 – 60299
Ophthalmogy – Image Storage	60300 – 60399
Default – Image Storage	104

Appendix F VistA Imaging DICOM Gateway Application Entity (AE) Titles

DICOM requires the calling application entity to supply both its AE title and the called AE title when the association request is made. The AE titles for the VistA Gateway processes are listed in the following table (These values are defined in the master file named `F:\DICOM\Dict\scp_list.dic`).

VistA Imaging DICOM Gateway Process	Application Entity Title
PACS Text Interface	VISTA_PACS_IF
Query/Retrieve Provider	VISTA_QR_SCP
Query/Retrieve User	VISTA_QR_SCU
Modality Worklist	VISTA_WORKLIST
Image Storage	VISTA_STORAGE

Appendix G Setting Up the MUMPS-to-MUMPS Broker

The installation and set-up of the MUMPS-to-MUMPS Kernel Broker is described in the documentation that comes with the patches for the Kernel software (XU*8*28, XU*8*41 and XU*8*34).

Content removed; FOIA exemption b2/high 2

```
Content removed; FOIA exemption b2/high 2
```

```
Content removed; FOIA exemption b2/high 2
```

```
Content removed; FOIA exemption b2/high 2
```

```
Content removed; FOIA exemption b2/high 2
```

Appendix H TCP/IP Settings

In some systems, the communication across TCP/IP can be extremely slow (e.g. it would take up to 90 seconds to transmit an image across the local area network, while this should be possible in less than 3 seconds).

There is a combination of Registry settings and Network Interface Card settings that has shown to resolve this issue:

H.1 Registry Settings

The following settings need to be applied to the Registry:

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters]

GlobalMaxTcpWindowSize
 REG_DWORD
 value=65535 (decimal)

TcpWindowSize
 REG_DWORD
 value=65535 (decimal)

Tcp1323Opts
 REG_DWORD
 value=1
```

Possible values for `Tcp1323Opts` are:
0 (disable RFC 1323 options)
1 (window scale enabled only)
2 (timestamps enabled only)
3 (both options enabled)

Setting it to "1" essentially removes timestamps (or 12 bytes of header information).

H.2 Network Interface Card Settings

The NIC Speed and Duplex must be set to the same settings as the network switch between the DICOM Gateway and the Image fileserver. Most often, this setting is 100MBit and full duplex. In some cases, explicitly setting the NIC on the DICOM Gateway to 100/Full will be the optimal setting for the card. In some cases, setting the card to Auto Sense will be the optimal setting for the card. Sites should use the following test to see which setting works for them.

1. Download MagImage.exe (22 MB compressed) from the VistA Imaging FTP site (ftp://ftp.imaging.med.va.gov/Software/Released_Software) and put it on the DICOM Gateway desktop
2. Map a drive to an Imaging fileserver share

3. Copy the file from the Gateway desktop to the fileserver share and time how long it takes to copy

If it takes more than 3 seconds to copy, there's a mix of half and full duplex somewhere in the network between the DICOM Gateway and the file server. Toggle the NIC Speed and Duplex setting and re-test.

Note: Sometimes a card will perform well with an explicit setting for a period of time and then begin to fail. Most often when this happens, toggling the setting will solve the issue. Use the test above to verify that the DICOM gateway is performing optimally.