

## Conquest DICOM Server 1.4.12c documentation / MicroPACS CONFORMANCE STATEMENT

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Revision 1; 19961103	As taken from the 'developers cut' distribution of MicroPACS
Revision 2; 19980703	Conquest additions; pre-release 1.3.1.
Revision 3; 19980713	Conquest additions; release 1.3.1
Revision 4; 19990415	Updated according to latest software revisions (mainly for RT), release 1.3.2
Revision 5; 19990527	Small software updates, birthday, sex, bolus, release 1.3.3
Revision 6; 20000131	NKI specific sops updated, new compression mode, mirroring, release 1.3.4
Revision 7; 20000316	Added operation as NT service, pre-release 1.3.5
Revision 8; 20000403	Unlimited servers/services, auto-login, self-test, sop choices, fixes for GE Hi-Speed, improved display, fixed hang concurrent C- ECHO's, final release 1.3.5
Revision 9; 20000701	Improved browser menu, other ODBC drivers, release 1.3.6
Revision 10; 20001129	Multithread and UNC path fixes, edit ID, send to, edit database, release 1.3.7
Revision 11; 20010318	Hostname fix, optionally runs 4 services, show incoming, release 1.3.8
Revision 12; 20010502	GUI additions database fixing; faster compression; fixed leaks, release 1.3.9
Revision 13; 20011109	better forward/export, extended DB/sop, zip logs, drag and drop, release 1.3.10
Revision 14; 20020508	reliability and error handling fixes, UID configurable, dbrev 6
Revision 15; 20020613	Implemented StudyModality, db rev 7, find local missing pats, release 1.3.11
Revision 16; 20020822	FilenameSyntax options for DICOM-Works; printing, release 1.3.12
Revision 17; 20021215	Various fixes. Non-ODBC driver; read-ahead thread; <b>release 1.4.0</b>
Revision 18; 20030303	Bug fix release 1.4.1
Revision 19; 20030710	Release 1.4.2, flexible compression and transfer fixes, db rev 11
Revision 20; 20030922	Prepare release 1.4.3, registry / administrator bug/doc; long filenames
Revision 21; 20040406	Release 1.4.4, mysql fix / large disks / db rev 13 / jpeg fixes / GUI uses MAG0..9 / system DSN
Revision 22; 20040426	Release 1.4.4a, mysql fix broke MS-access and SQL server, added DoubleBackSlashToDB (see 4.1.3)
Revision 23; 20040615	Release 1.4.5, built-in DbaseIII driver now suitable for huge archives; better deletion tools; auto-move
Revision 24; 20040722	Release 1.4.6, Added FixKodak; Added "nj" compression; FixPhilips/FixKodak defaults 0 (!)
Revision 25; 20040805	Release 1.4.6a, Fix in move for single image
Revision 29; 20041129	Release 1.4.7, JPEG fix, bugreport button; split/merge, 'k' compress, uid list matching, AE with ~xx
Revision 30; 20050131	Release 1.4.8, Fixed delete, nightlymove, 4-server; hold failed forwards/copies; distribution compiles, initial linux release and initial web interface
Revision 31; 20050912	Release 1.4.9, Fixes in web and Linux, modality worklist
Revision 32; 20051024	Release 1.4.9a, Fix crashes due to no patch in controls.pas
Revision 33; 20060103	Release 1.4.10, VirtualServerFor, fixes leaks, linux, postgres
Revision 34; 20060328	Release 1.4.11, K-Pacs viewer, native MySQL, worklist fix, virtualserver fix, flexible filenamesyntax, WEBReadOnly, Fix forwarder retry logic

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Revision 35; 20060708	Release 1.4.12alpha: bug fixes, db performance improved, and appendix 5-7
Revision 36; 20061222	Release 1.4.12: bug fixes in dbaseIII driver and in deleting, forwarding and grabbing, resizeable GUI
Revision 37; 20070127	Release 1.4.12b: importconverters, converter scripting, fixes in dbaseIII driver and web access, no nki compression in .dcm
Revision 38; 20070201	Release 1.4.12c: "storage" importconverter, fix ExportFilter and problem in most GUI commands

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Server core based upon:

Copyright (c) 1995 Regents of the University of California. All rights reserved. Developed by: Mark Oskin, mhoskin@ucdavis.edu; University of California, Davis Medical Center; Department of Radiology with a Solaris port done and maintained by: Terry Rosenbaum; Michigan State University; Department of Radiology.

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## SECTION 1. INTRODUCTION

The MicroPACS is a Windows or Linux (preliminary) based PACS system that has, at its core, the UCDMC DICOM Network Transport libraries. This system has been combined with a complete user interface (Windows only), which also acts as installation program (written in Borland Delphi) to form the Conquest DICOM server. The Information Definition is designed to be field/run-time programmable. Below the DICOM interface is a database connectivity class that uses a stable built-in DBASEIII driver, talks to ODBC compatible data sources (Windows only), or MySQL (Windows only - sofar). This combination permits a PACS system with the following features:

- Complete DICOM Interface. Including SCP's for run-time programmable storage IOD's, and SCP for DICOM Queries and Retrieves.
- Programmable SQL Database tables. This user-programmable feature allows the MicroPACS to be custom tailored to a particular Clinical/Research area. For instance, in a CR setting, the PACS system can be programmed to allow users to query on kvp and ma or in a CT setting, the PACS can be programmed to allow queries on slice-distance.
- The communication to the database is done via a built-in dbaseIII driver (default and advised for small archives of up to 100.000 images), ODBC (Windows only), or native MySQL (Windows only, use version 5.0.22). This allows a de-coupling of PACS and SQL technology. ODBC has been tested with (Windows only):
  - Microsoft Access
  - SQL server (most reliable and advised for serious use)
  - Some users have reported successful operation using Interbase and Oracle. Versions 1.4.5 and up have a small fix to work with MySQL – which seems suitable for up to 100.000 images (see the DoubleBackSlashToDB setting in dicom.ini). Oracle requires simple manual editing of the DICOM.SQL file, where the names of fields 'rows' and 'columns' are changed to, e.g., 'qrows' and 'qcolumns'.

See appendix 6 for tests of the various database options.

**Note:** The built-in dBaseIII driver (Conquest addition) is not a full SQL server and poses limitations on query keys: only queries like 'key' = exact match; 'key\*' = value starts with key; and '\*key\*' = value contains key, are supported, as well as date-range queries and multiple UID matching queries (since 1.4.7). Only common hierarchical queries are supported with fields that are listed in the single de-normalized table for the selected query level (see file DICOM.SQL). Regular queries passing PatientID, StudyUID, and/or SeriesUID will be (very) fast, even for huge archives. Other (image) queries in large archives (>1000.000 images) may be very slow. Server startup time for huge archives may be long due to in-memory index creation (about 1 minute per 1000.000 images). During indexing the server is read-only and only shows indexed images. For Linux, the built-in driver is advised, however, a Postgres version is included.

- (Conquest addition) Fast and safe (CRC checked) error free compression (>2x) of image data on disk. Do not use this option if you want to read the image files directly from disk yourselves using third party software.
- (Conquest addition) Easy installation of many servers on a single PC. Servers may run as service(s).
- (Conquest addition) A database browser and slice viewer (Windows only) integrated in the PACS system with options for: viewing the DICOM information in a slice, creating BMP files (ideal for slides), sending selected images, printing, and database fix tools such as changing patient IDs, and deleting and anonymizing studies and series. Also tools to merge or split series. Drag and drop to load DICOM or HL7 files or directories.
- (Conquest addition) A simple query/move user interface (Windows only) for diagnostic purposes, to improve your knowledge of DICOM, and to grab missing data from another server.
- (Conquest addition) Fully integrated functionality in one user interface.
- (Conquest addition) Simple print server (Windows) - to default printer.
- (Conquest addition) Log files, which are daily zipped (Windows only). We use the TZipMaster VCL by Chris Vleghert and Eric W. Engler.
- (Conquest addition) Correct display of JPEG and RLE compressed images in browser (Windows only).
- (Conquest addition) Flexible configuration of JPEG and NKI private compression with optional (de)compression of incoming, dropped, transmitted and archived files. The actual JPEG (de)compression is done using executables from the OFFIS DICOM toolkit (DCMTK version 3.5.3), developed by Kuratorium OFFIS e.V.. Since version 1.4.7, also a built-in decompression engine is included (Windows only) using the International JPEG group code, and JPEG compression had some fixes.
- (More conquest additions) Highly improved performance (e.g., using a read-ahead thread), and simple image forwarding/action capability.
- The archive is well suited as DICOM server for the DICOMWORKS viewer by Phillippe Puech.
- If the BDE is not installed, we use the MiTeC DBFTable component by MichaL MutL. For other data sources ADO is used (Windows only). Alternatively libmysql.dll may be used to access mysql directly (copy it from mysql server version 5.0.22 to the dicom server directory).
- The server core of version 1.4.8 up runs and compiles on Linux and has a preliminary WEB interface.
- Version 1.4.9 up has preliminary DICOM Worklist query functionality with HL7 import and translation to DICOM worklist.
- Version 1.4.10 up has preliminary virtual server functionality: queries and retrieves can be forwarded to up to 10 other servers. (see appendix 7).

- Version 1.4.12 can use a native MySQL driver (based on Rangel Gustavo Reale's TMySQLDataset and Matthias Fichtner's mysql.pas) and includes a preliminary advanced series viewer based on EZDicom / K-Pacs (many thanks to Chris Rorden and Andreas Knopke). Fixes: strip group 2 information of any files sent, retry logic, worklist query.
- Version 1.4.12 improves database performance, has some important bug fixes (rare crashes, incomplete deletion and grabbing, and rare database corruption on dbaseIII). Further it has the possibility to forward multiple images on a single association, and improved documentation (appendix 5-7).
- Version 1.4.12b and c add importconverters and bug fixes in dbaseIII driver and web access and does not allow .dcm with nki compression

## SECTION A(2). CONFORMANCE STATEMENT

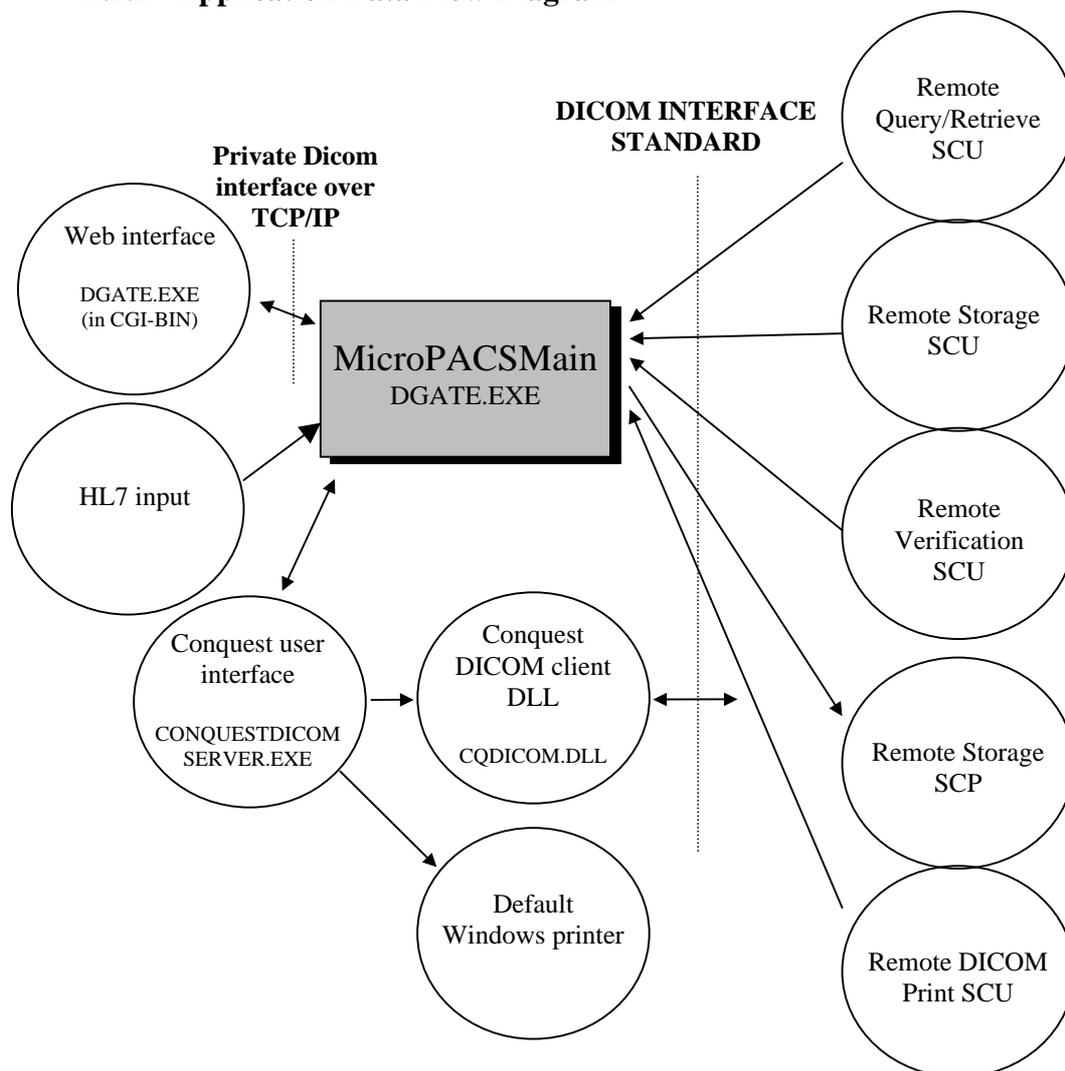
### A.0 INTRODUCTION

This conformance statement (CS) details the MicroPACS compliance to DICOM v3.0. It covers all DICOM Service Class roles in this product:

- Various Storage Service Class (SCP) Roles
- Morphing Storage Service Class (SCU) Roles
- Patient Root Query & Retrieve (SCP) Roles
- Study Root Query & Retrieve (SCP) Roles
- Patient/Study Root Query & Retrieve (SCP) Roles
- Verification Service Class (SCP) Role
- Print Management (SCP) Role
- Worklist Query (SCP) Role

### A.1 IMPLEMENTATION MODEL

#### A.1.1 Application Data Flow Diagram



#### A.1.2 Functional Definition of AE's

## Application Entity 1, MicroPACSMain

Supports the following functions:

- Has access to patient demographics and pixel data in the local database.
- Responds to DICOM associations containing image and worklist query requests using the information in the local database.
- Moves IOD modules to any configured DICOM AE when requested to do so by a remote DICOM AE.
- Responds to DICOM associations containing storage requests and places the IOD in the local database.
- Responds to DICOM associations containing verification requests.
- Responds to DICOM associations containing print requests and prints items on the default local Windows printer.
- Responds to private DICOM associations to support the WEB interface.

**NOTE:** The Conquest Applications (not part of the server release) or other DICOM network viewers (e.g., KPacs) will use separate AE's which **MUST** be configured in ACRNEMA.MAP (use the “**Known DICOM providers**” page) to allow access of images from the DICOM server.

### A.1.3 Sequencing of Real - World Activities

Image Store:

- The remote AE will initiate a DICOM association.
- The MicroPACSMain AE will select the appropriate Abstract and Transfer Syntax's from those proposed by the remote AE.
- The remote AE will initiate a C-Store to send the IOD.
- The MicroPACSMain AE will respond with a C-Store-RSP upon receipt of the IOD.
- The following processing occurs using the WorkList database (can be enabled/disabled using 'WorkListMode' in DICOM.INI):
  - WorkListMode=0: no processing occurs.
  - WorkListMode=1: The AccessionNumber is looked up in the local WorkList database, if it is found, any element in the DICOM object that is also present (and non-NULL) in the WorkList database, will be replaced by the value from the WorkList database. These changes are made both in the database and in the image that is stored on disk.
  - WorkListMode=2: As mode 1, but the image will be refused if the AccessionNumber is not found.
  - Note: there is no DICOM method of filling the worklist database (see the description of WorkListMode).
- The following processing (can be enabled/disabled by defining 'FixPhilips = 0/1' in DICOM.INI) of the patient ID occurs to conform patient ID's generated by a Philips scanner with NKI policy:

- From a patient ID of 10 digits (i.e., only exactly 10 digits) and a numeric value larger than 0001000000, starting with at least 2 zeros, the first 2 or 3 leading zeros are stripped. I.e., '0123456789' is not changed, '0020101234' is replaced by '20101234', '0009901234' is replaced by '9901234', and '0000012345' is replaced by 0012345. The result is that a 10 digit ID from Philips that consists of a valid NKI patient ID with extra leading zeros is converted to a valid NKI patient ID. These changes are made both in the database and in the image that is stored on disk.
- The following processing (can be enabled/disabled by defining 'FixKodak = 0/1' in DICOM.INI) of the patient ID occurs to conform patient ID's generated by a Kodak RIS worklist with NKI policy:
  - From a patient ID of 8 digits (i.e., only exactly 8 digits) and a numeric value larger than 01000000, starting with at least 1 zero, the leading zero is stripped. I.e., '0123456789' is not changed, '09901234' is replaced by '9901234', and '00012345' is replaced by 0012345. The result is that a 8 digit ID from Kodak RIS that consists of a valid NKI patient ID of before 2000 with a superfluous leading zero, is converted to a valid NKI patient ID. These changes are made both in the database and in the image that is stored on disk.
- Trailing space are discarded from the patient ID.
- ImportConverters are called as scripts or rules to modify, delete or log images or VR's in them.
- The pixel data is NKI or JPEG compressed if this option is enabled.
- The image is stored and disk and image header data is (re-)entered in the database at all four levels (patient, study, series, and image). The following consistency checking is performed on the data entered in the database (without changing the image information that is stored):
  - Inconsistent link information (e.g., two images of the same series belong to different patients), lead to a reject to store the new image with reported failure to the sending client.
  - Filled items will not be overwritten by empty items.
  - Known sex (M or F) in the patient database will not be overwritten with any other value than M or F.
  - A known date of birth in the database will not be overwritten with an empty date or with a date on the 1st of January (which has a high probability to be wrong). When the original date of birth is empty, any value will be accepted.
  - In case of any other inconsistency, the newer values will be written in the database, and the change will be logged as a warning in serverstatus.log. Inconsistencies in the birthdate are also logged in PacsTrouble.log.
  - The (series) Modality field is appended to the Study Modality field in the database if it does not already contain this Modality.
  - The PatientName, PatientBirthDate and PatientSex items are duplicated in the study table (database rev8 and up), to allow detection of patient ID mix-ups.

- Optionally the image is processed or forwarded (compressed or uncompressed) if Modality and StationName match with values specified in dicom.ini and the optional ExportFilter test is passed (see appendix 7).
- Some logging of activity occurs.

#### Query/Retrieve:

- The remote AE will initiate a DICOM association.
- The MicroPACSMain AE will select the appropriate Abstract and Transfer Syntax's from those proposed by the remote AE.
- Queries can be forwarded to up to 10 VirtualServerFor entries. The received data will be merged with the data from the server's database and cleaned of duplicates (see appendix 7).
- Upon receipt of a C-Move request, the MicroPACSMain AE will initiate an SSC/SCU association morphing to the stored IOD SOP Class to the specified and configured DICOM AE. Compressed pixel data will be decompressed or recompressed prior to transmission. A C-Move response message will be generated synchronously with the associated C-Store.
- Retrieval of data stored on one or more of the VirtualServerFor entries and not on the local server will initiate automatic transfer from the listed servers in the VirtualServerFor table to the local server, followed by a transfer to the C-MOVE destination. After the retrieval data can be optionally deleted again (see appendix 7).
- Some logging of activity occurs.

#### Worklist Query:

- The remote AE will initiate a DICOM association.
- The MicroPACSMain AE will select the appropriate Abstract and Transfer Syntax's from those proposed by the remote AE.
- The MicroPACSMain AE will query the Worklist database and respond with zero or more modality worklist items.
- Some logging of activity occurs.
- Note: there is no DICOM method of filling the worklist database. It can be filled through the web interface, by drag and dropping hl7 files or programmatically (see the description of WorkListMode).

#### Verification:

- The remote AE will initiate a DICOM association.
- The remote AE will initiate a C-ECHO.
- The MicroPACSMain AE will respond with a C-ECHO-RSP.
- Some logging of activity occurs.

#### DICOM Print:

- The remote AE will initiate a DICOM association.
- The remote AE will create a basic film session using N-CREATE.
- The MicroPACSMain AE will ignore the information but will respond with a N-CREATE-RSP.
- The remote AE will create a basic film box using N-CREATE.

- The MicroPACSMain AE extracts the Image Display Format (only “STANDARD\#rows,#cols” is accepted), and the film orientation (LANDSCAPE or PORTRAIT) and passes this information to the CONQUEST user interface. All other information is ignored.
- The MicroPACSMain AE creates the correct amount of Basic Grayscale or Color Image Box objects for the film page and transmits their UIDs to the remote AE in the N-CREATE-RSP. The UIDs contain information about the page number, number of rows and columns, and the image location on the page that will be used by the CONQUEST user assemble the printed page.
- The remote AE will use N-SET to fill each Image Box object.
- The MicroPACSMain AE will store each incoming Image Box onto disk (in directory “printer\_files” on device MAG0) and responds with N-SET-RSP. The name (UID) of the files is passed to the CONQUEST user interface.
- The CONQUEST user interface (Windows only) will queue incoming images and will asynchronously convert each DICOM file into a BMP file, load it in memory and assemble the pictures to be printed on a page. Processed DICOM files and BMP files are deleted. *Note: the basic print support in the CONQUEST user interface will not handle multiple simultaneous print requests correctly!*
- The remote AE will request printing of each film or of the complete session using an N-ACTION command for a basic film session or a basic film box.
- The MicroPACSMain AE passes these requests onto the CONQUEST user interface and responds with an N-ACTION-RSP.
- The CONQUEST user interface (Windows only) prints the pages on the default Windows printer. The only way to configure this printer is to change its default document settings in Windows. Printing progress is shown using a simple progress bar on the server status page.
- The remote AE may query the printer status with a N-GET request on the printer object.
- The MicroPACSMain AE will always respond with a N-GET-RSP with a “NORMAL” status and the name of the printer, which is pre-set to “Conquest dicom printer”.
- Other N-DELETE, N-SET, and N-EVENTREPORT requests are acknowledged with an adequate RSP and ignored.
- Some logging of activity occurs.

## A.2 AE SPECIFICATIONS

### A.2.1 AE1 Specification

This Application Entity provides Standard Conformance to the following DICOM v3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Verification (Echo)	1.2.840.10008.1.1
* Unknown IOD Storage	* See note

**NOTE:** This MicroPACS will initiate outgoing DICOM C-STORE requests masquerading as any stored IOD module. The behavior of this outgoing association link will be like the DICOM defined SCU role: Storage Service Class.

This Application Entity provides Standard Conformance to the following DICOM v3.0 SOP Classes as SCP:

SOP Class Name	SOP Class UID
Verification (Echo)	1.2.840.10008.1.1
Patient Root Query/Retrieve Info. Model -FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Info. Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Info. Model -FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Info. Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient Study Only Query/Retrieve Info. Model -FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient Study Only Query/Retrieve Info. Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18
Modality WorkList Query	1.2.840.10008.5.1.4.31
* Unknown IOD Storage	* See note

**NOTE:** This MicroPACS will accept any incoming DICOM C-STORE request sent using the DICOM defined SCP role: Storage Service Class. The d Gatesop.lst file (see configuration section and dicom.ini file) can be used to selectively restrict this ability.

#### A.2.1.1 Association Establishment Policies

##### A.2.1.1.1 General

The DICOM Application Context Name (ACN) that is always proposed is:

<b>Application Context Name</b>	<b>1.2.840.10008.3.1.1</b>
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The Maximum Length PDU negotiation is included in all association establishment requests. The maximum length PDU for an association initiated by the NetMain AE is:

<b>Maximum Length PDU</b>	<b>16Kbytes</b>
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The SOP class Extended Negotiation is not supported and ignored.

There is no limit on the maximum number of Presentation Contexts Items that will be proposed. In this implementation, each Abstract syntax will be proposed with either a single Transfer Syntax, or with a few JPEG transfer syntaxes, depending on the configuration in *acrnema.map*.

The user info items sent by this product are:

- Maximum PDU Length
- Implementation UID
- Implementation Version

**Note:** Max PDU length is not configurable at run time.

#### **A.2.1.1.2 Number of Associations**

MicroPACSMMain AE will initiate one DICOM association to perform image store for each concurrently incoming C-MOVE request.

There is no artificial maximum placed on the number of simultaneous DICOM associations open at one time. It should be noted that system response time will be degraded, and this could possibly adversely effect a time-out period on other remote AE's.

The Print Management function will correctly handle multiple simultaneous associations, but the elementary print support in the CONQUEST user interface will not correctly print (i.e., images on the pages will be mixed up) when multiple print jobs are sent simultaneously.

#### **A.2.1.1.3 Asynchronous Nature**

Asynchronous mode is not supported. All operations will be performed synchronously.

#### **A.2.1.1.4 Implementation Identifying Information**

The Implementation UID allows unique identification of a set of products that share the same implementation.

The Implementation UID for this ID/Net v3.0 Implementation is:

<b>Storage &amp; Q/R UID</b>	<b>1.2.826.0.1.3680043.2.135.1066.101</b>
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## A.2.1.2 Association Initiation by Real-World Activity

### A.2.1.2.1.2 Proposed Presentation Contexts

Presentation Context Table – Proposed					
Abstract Syntax & configuration		Transfer Syntax		Role	Expanded Negotiation
*Unknown	un,as,n1..n4	Little Endian	1.2.840.10008.1.2	SCU	None
*Unknown	j3..j6	JPEGBaseLine1	1.2.840.10008.1.2.4.50	SCU	None
*Unknown	j3..j6	JPEGExtended2and4	1.2.840.10008.1.2.4.51	SCU	None
*Unknown	j5	JPEGSpectralNH6and8	1.2.840.10008.1.2.4.53	SCU	None
*Unknown	j6	JPEGFullNH10and12	1.2.840.10008.1.2.4.55	SCU	None
*Unknown	j2	JPEGLosslessNH14	1.2.840.10008.1.2.4.57	SCU	None
*Unknown	j1, j2	JPEGLossless	1.2.840.10008.1.2.4.70	SCU	None

**Note:** Due to the morphing nature of the outgoing SSC-SCU engine, the specific Abstract Syntax that is proposed depends upon the nature of the stored image. The actual proposed Transfer Syntaxes depend on the configuration in *acrnama.map* and are the same for each class of stored images.

#### A.2.1.2.1.2.1 SOP Specific Conformance Statement for Image Storage SOP Class

This implementation can perform multiple C-STORE operations over a single association.

Upon receiving a C-STORE confirmation containing a successful status, this implementation will perform the next C-STORE operation. The association will be maintained.

Upon receiving a C-STORE confirmation containing an Error, Refused or Warning status, this implementation will fail the specific IOD in question. If more images need to be sent, they will be sent in the same association.

### A.2.1.2.2 Association Acceptance Policy

#### A.2.1.2.2.1 Real-World Activity

This AE accepts associations for the Query/Retrieve (Q/R) SOP using the Patient Root, Study Root, and Patient/Study Only Query Model.

This AE accepts associations for the Image Storage Class using any defined IOD class.

This AE accepts associations for the Verification Service Class.

This AE accepts associations for the Print Service Class.

This AE accepts associations for the WorkList Query Service Class.

#### **A.2.1.2.1.1 Real-World Activity**

This AE is indefinitely listening for Q/R, Storage Class, Verification and Print Management associations

#### **A.2.1.2.1.2 Proposed Presentation Contexts**

Presentation Context Table – Accepted					
Abstract Syntax		Transfer Syntax		Role	Expanded Negotiation
Patient Root Query/Retrieve Info. Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Little Endian	1.2.840.10008.1.2	SCP	None
Patient Root Query/Retrieve Info. Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Little Endian	1.2.840.10008.1.2	SCP	None
Study Root Query/Retrieve Info. Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Little Endian	1.2.840.10008.1.2	SCP	None
Study Root Query/Retrieve Info. Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Little Endian	1.2.840.10008.1.2	SCP	None
Patient/Study Only Query/Retrieve Info. Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Little Endian	1.2.840.10008.1.2	SCP	None
Patient/Study Only Query/Retrieve Info. Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Little Endian	1.2.840.10008.1.2	SCP	None
Modality WorkList Query	1.2.840.10008.5.1.4.31	Little Endian	1.2.840.10008.1.2	SCP	None
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	Little Endian	1.2.840.10008.1.2	SCP	None
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	Little Endian	1.2.840.10008.1.2	SCP	None
*Unknown	*Unknown	Little Endian*	1.2.840.10008.1.2	SCP	None
Verification	1.2.840.10008.1.1	Little Endian	1.2.840.10008.1.2	SCP	None

**Note:** Due to the morphing nature of the incoming SSC-SCP engine, the specific Abstract Syntax accepted will depend upon the nature of the stored image, and the *dgatesop.lst* configuration file (of which a default version is automatically created when installing the Conquest DICOM server).

\*The server can accept many transfer syntaxes as configurable by *dgatesop.lst*.

#### **A.2.1.2.2.1.2.1 SOP Specific Conformance for Query/Retrieve FIND SOP Class SCP**

The C-FIND response status values are supported as defined in DICOM v3.0 Part 4.

All Required (R) and Unique (U) Study, Series, and Image Level Keys for the Patient Root, Study Root, and Patient/Study Only Query/Retrieve Information Model are supported. Many optional (O) Keys are supported, as described later in this document.

#### **A.2.1.2.2.1.2.2 SOP Specific Conformance for Query/Retrieve MOVE SOP Class SCP**

Prioritization of C-FIND & C-MOVE requests is all set to normal - 0.

All images requested in a single C-MOVE will be sent over a single association (the association will not be re-established for each image).

#### **A.2.1.2.2.1.2.3 SOP Specific Conformance for “Unknown” Storage SCP**

The specific Storage SCP classes accepted are programmable (by the user) at runtime, and cannot be explicitly stated here.

No optional elements are discarded.

The duration of the storage is temporary. Least recently added patients are deleted when the disk space is less than the amount specified in the “Cleanup disk space below (MB)” field in the Conquest DICOM server. This amount is run-time configurable. When the DICOM server is connected to a, e.g., jukebox archival system, the duration of storage can be made permanent.

#### **A.2.1.2.2.1.3 Presentation Context Acceptance Criterion**

No criterion.

#### **A.2.1.2.2.1.4 Transfer Syntax Selection Policies**

The server can accept most transfer syntaxes as configurable by *dgatesop.lst*. Outgoing connections can be made over uncompressed, loss-less or lossy JPEG transfer syntaxes. If so, the images are recompressed to conform to the accepted transfer syntax. The configuration is done through *acrnama.map*.

Configuration	Proposed transfer syntaxes	Name
un <sup>1</sup> , as <sup>2</sup> , n1..n4 <sup>3</sup>	1.2.840.10008.1.2	ImplicitLittleEndian
j1	1.2.840.10008.1.2.4.70	JPEG Lossless sv1
	1.2.840.10008.1.2	ImplicitLittleEndian
j2	1.2.840.10008.1.2.4.57	JPEG Lossless sv 6
	1.2.840.10008.1.2.4.70	JPEG Lossless sv1
	1.2.840.10008.1.2	ImplicitLittleEndian
j3, j4	1.2.840.10008.1.2.4.51	JPEG extended (12 bits)
	1.2.840.10008.1.2.4.50	JPEG baseline (8 bits)
	1.2.840.10008.1.2	ImplicitLittleEndian
j5	1.2.840.10008.1.2.4.53	JPEG spectral selection
	1.2.840.10008.1.2.4.51	JPEG extended (12 bits)
	1.2.840.10008.1.2.4.50	JPEG baseline (8 bits)
	1.2.840.10008.1.2	ImplicitLittleEndian
j6	1.2.840.10008.1.2.4.55	JPEG progressive
	1.2.840.10008.1.2.4.51	JPEG extended (12 bits)
	1.2.840.10008.1.2.4.50	JPEG baseline (8 bits)
	1.2.840.10008.1.2	ImplicitLittleEndian

**Note:** The transfer syntaxes are listed in order of priority. I.e., if a host is configured as j1 and it accepts JPEG lossless, the image will be lossless JPEG compressed before transmission, even if it was not stored in that way.

- 1) un = uncompressed. Images will be decompressed prior to transmission.
- 2) The configuration “as” will transmit images as-is. Independent of how images are stored on disk (with JPEG or NKI compression), they will be transmitted over an ImplicitLittleEndian connection. This behavior does not conform to the DICOM standard and for many hosts this may therefore not work. NKI clients will work, though.
- 3) Configurations n1..n4 will transmit images with NKI private compression, which can only be read by NKI clients.

### A.3. COMMUNICATION PROFILES

#### A.3.1 Supported Communication Stacks (parts 8,9)

DICOM Upper Layer (Part 8) is supported using TCP/IP.

#### A.3.2 OSI Stack

OSI stack not supported.

#### A.3.3 TCP/IP Stack

The TCP/IP stack is inherited from the Windows/Linux operating System. (Conquest addition): We have used the excellent Delphi TCP/IP components from François Piette (<http://www.overbyte.be>) in the CONQUEST user interface.

##### A.3.3.1 API

Developers can base client programs on **TEST.EXE** and **DICOMP.EXE** that are included with source code in the **DICOMLIB1412c.ZIP** release file. The actual DICOM server (with many options) is **DGATE.EXE** that is included with source code in release file **DGATE1412c.ZIP** and **DICOMLIB1412c.ZIP**. Source code of the Windows user interface and the client DLL is *not* included.

##### A.3.3.2 Physical Media Support

Any Windows (Linux) supported physical media.

#### A.3.4 Point-to-Point Stack

A 50 pin ACR-NEMA connection is not supported.

### A.4. EXTENSIONS / SPECIALIZATION / PRIVATIZATIONS

VR (0x7fdf, 0x0010) contains compressed pixel data if NKI compression is used. In the normal configuration, the server will never transmit NKI compressed data, but will compress and decompress the data on the fly. The following presentation contexts have been added to allow NKI private compressed data to be transmitted and to allow retrieval of downsized images for higher speed:

1.2.826.0.1.3680043.2.135.1066.5.1.4.1.2.1.2	PatientRootRetrieveNKI
1.2.826.0.1.3680043.2.135.1066.5.1.4.1.2.2.2	StudyRootRetrieveNKI
1.2.826.0.1.3680043.2.135.1066.5.1.4.1.2.3.2	PatientStudyOnlyRetrieveNKI

These contexts contain sub-classed versions of the standard C-MOVE commands with the following additional optional control parameters (numbers are hexadecimal):

(9999, 0100): MaxVrSize	Do not send VRs larger than this number of bytes
(9999, 0200): MaxRowsColumns	Downsize image to maximal this #rows and columns
(9999, 0300): ConsoleText	Text will be printed to server console
(9999, 0400): Silent	If sent, console does not log transaction Also used internally by GUI and WEB interface
(9999, 0500): MaxSlices	Send at most # slices irrespective of query result
(9999, 0600): MaxCompression	Maximum supported compression by NKI client (default 4)
(9999, 0700): Recompression	Recompress style NKI or JPEG (default none)

## A.5. CONFIGURATION

### A.5.1 AE Title/Presentation Address Mapping

The Local AE Title is configurable by the user by editing the dicom.ini file via the "**Configuration**" page of the Conquest DICOM server.

### A.5.2 Configuration Parameters

The following fields are configurable for this AE (local):

- Local AE Title
- Listening TCP/IP Port (port 5678 is default)
- Query & Retrieve Information Model.
- SQL Data source and databases.

The following fields are configurable for every remote DICOM AE:

- Remote AE
- Remote TCP/IP Port
- Remote IP Address
- Compression mode

#### A.5.2.1 dicom.ini

This file is placed in the same directory as the executable (e.g., c:\dicomserver). It specifies the configuration of the MicroPACSMain DICOM AE. It is written automatically by the Conquest DICOM server upon installation and when changing the configuration (use the "**Save configuration**" button on the "**Configuration**" page). Editing it by hand is generally not necessary or advised. *Note that spaces around the '=' in each entry are **REQUIRED!***

```
# This file contains configuration information for the DICOM server
# Do not edit unless you know what you are doing
```

```
[sscscp]
MicroPACS           = sscscp
Edition             = Personal
```

```
# Network configuration: server name and TCP/IP port#
MyACRNema           = CONQUESTSRV1
TCPPort              = 5678
```

```
# Reference to other files: known dicom servers; database layout; sops
ACRNemaMap          = acrnema.map
kFactorFile          = dicom.sql
SOPClassList         = d gatesop.lst
```

```
# Host(ignored), name, username and password for ODBC data source
SQLHost              = localhost
SQLServer             = E:\Dicomserver\Data\dbase\
```

```

Username                = conquest
Password                = conquest
Postgres                = 0
MySQL                   = 0
DoubleBackSlashToDB    = 0

# Configure database
TruncateFieldNames     = 10
MaxFieldLength         = 254
FileNameSyntax         = 3
MaxFileNameLength      = 255
FixPhilips             = 0
FixKodak               = 0
KeepAlive              = 0
LargeFileSizeKB        = 1024
ZipTime               = 05:
UIDPrefix              = 1.2.826.0.1.3680043.2.135.730956.43877812
EnableReadAheadThread = 1
PatientQuerySortOrder =
StudyQuerySortOrder   =
SeriesQuerySortOrder  =
ImageQuerySortOrder   =
IndexDBF              = 1
PackDBF               = 0
LongQueryDBF          = 1000
TCPIPTimeOut         = 300
FailHoldOff           = 60
RetryDelay            = 100
QueueSize             = 128
WorkListMode          = 0
DebugLevel            = 0

# Configuration of compression for incoming images and archival
DroppedFileCompression = un
IncomingCompression    = un
ArchiveCompression     = as

# Names of the database tables
PatientTableName       = DICOMPatients
StudyTableName         = DICOMStudies
SeriesTableName        = DICOMSeries
ImageTableName         = DICOMImages
DmarkTableName         = DICOMAccessUpdates
RegisteredMOPDeviceTable = RegisteredMOPIDs
UIDToMOPIDTable       = UIDToMOPID
UIDToCDRIDTable       = UIDToCDRID

# Banner and host for debug information
PACSName               = CONQUESTSRV1
OperatorConsole        = localhost

# Configuration of disk(s) to store images
MAGDeviceThreshold    = 0
MAGDevices            = 2
MAGDevice0            = c:\dicomserver\data\
MAGDevice1            = d:\dicomserver_backup
NightlyCleanThreshold = 0
NightlyMoveThreshold  = 1000
NightlyMoveTarget     = MAG1

```

```

# Configuration of mirror disk(s) to store images
MIRRORDevices          = 1
MIRRORDevice0          = H:\mirror_data\

# Configuration of disk(s) to hold images prior to archival
CACHEDDevices          = 1
CACHEDDevice0          = f:\cache\cd%02d_%04d\

# Configuration of disk jukebox(es) for archival
JUKEBOXDevices         = 1
JUKEBOXDevice0         = x:\jukebox\cd00_%04d\

# Configuration of external (browse page) and demo (on receive) viewer
ExternalViewer         = e:\quirt\runtime\planning\imview.exe
DemoViewer             =
DemoCopy               =

```

Some explanation of the most important items:

**SQLHost.** Ignored. Name of host computer with SQL server. Only used in Postgres (Linux only) and MySQL mode (Windows only).

**SQLServer.** Name of ODBC data source, path to directory with DBF database files in case the built-in DbaseIII driver is used, or name of database in MySQL mode.

**Postgres.** Linux code is included to use a PostgresSQL database. Recompiling the server with `-DPOSTGRES` and setting this flag to 1 will enable the Postgres driver. Default it is 0.

**MySQL.** (Preliminary) Windows code is included for native access to a MySQL database. For correct operation, the `libmysql.dll` of MySQL version 5.0.22 should be copied into the server directory (Windows only). Setting this flag to 1 will enable the MySQL driver. Default it is 0.

**DoubleBackSlashToDB.** If this value is 1, strings sent in queries and updates will have a `\` replaced by `\\`. This option must be set to 1 for MySQL and Postgres and to 0 for other SQL servers. The built in dbase driver accepts both settings.

**MyACRNema.** Application Entity (AE) title.

**TCPPort.** IP port on which the server listens.

**TruncateFieldNames.** DBASE files do not allow field name lengths in excess of 10 characters. This option truncates the names. Leave this option at 10, since the Delphi user interface, the WEB interface, and some of the archival options expect truncated names. Conquest addition.

**MaxFieldLength.** DBASE files do not accept field lengths in excess of 254 characters. This options overrules the setting in `DICOM.SQL`. May be

changed or removed for SQL server but this is not necessary. Conquest addition.

**FileNameSyntax.** Determines name of stored files, default 3. May be changed at any time depending on the requirements of an application that wants to read the files directly. Only affects newly stored images. Modes higher than 3 accept IODs without image or series number and are therefore suited for DICOM-RT. Options 3 and 4 force use of the cleaned PatientID as patient directory name, making sure that only a single directory is made for each unique patient ID. Option 5 uses the patient name as directory name. Options 6 to 9 provide several frequently used DICOM directory structures. From version 1.3.11, time is printed unsigned and the counter portion of the filename is extended from 2 to 4 digits. Modes 4, 8 and 9 store images in (the slower to read) standard chapter-10 DICOM format. DICOM-Works users might like mode 8 or 9 best. See also note below. Conquest addition.

**0 (original):**

filename = ID[8]\_Name[8]\Series#\_Image#\_Time.v2

**1 (safer version of original):**

filename = ID[8]\_Name[8]\Series#\_Image#\_TimeCounter.v2

**2 (include series UID in filename to ensure names sort by series):**

filename = ID[8]\_Name[8]\Seriesuid\_Series#\_Image#\_TimeCounter.v2

**3 (Uses patient ID as directory name and sets DICOM-RT required flags):**

filename = ID[16]\Seriesuid\_Series#\_Image#\_TimeCounter.v2

**4 (same as 3, but data is stored in chapter 10 format):**

filename = ID[16]\Seriesuid\_Series#\_Image#\_TimeCounter.dcm

**5 (sets DICOM-RT required flags, uses untruncated patient name as directory):**

filename = Name\Seriesuid\_Series#\_Image#\_TimeCounter.v2

**6 (standard DICOM directory structure starting at patient root):**

filename = ID[32]\Studyuid\Seriesuid\Imageuid.v2

**7 (standard DICOM directory structure starting at study root):**

filename = Studyuid\Seriesuid\Imageuid.v2

**8 (standard patient root DICOM directory structure in chapter 10 format):**

filename = ID[32]\Studyuid\Seriesuid\Imageuid.dcm

**9 (standard study root DICOM directory structure in chapter 10 format):**

filename = Studyuid\Seriesuid\Imageuid.dcm

**10(all files in one directory)**

filename = Images\Imageuid.dcm

**11(patient name as directory, UIDS as subdirectories)**

filename = Name\StudyUID\SeriesUID\Imageuid.dcm

**12(patient name\_id as directory, modality\_studyid\series\sop.dcm)**

filename = Name\_ID\Modality\_StudyID\ SeriesID\Imageuid.dcm

Here: \ is a directory separator, *ID[N]* is the cleaned patient ID truncated to N characters, *Name[N]* is the cleaned patient name truncated to N characters, *Series#* is the series number, *Image#* is the image number, *Studyuid* is the study UID, *Seriesuid* is the series UID, *Imageuid* is the Image UID, *Time* is the number of elapsed seconds since 1970 at the time the file is first written, and *Counter* is a 4 digit counter that is incremented for each stored file.

**Note: since 1.4.11, FileNameSyntax may also be string containing % that is treated as flexible filenamesyntax.** e.g., %id\%studyid\%seriesid\%sopuid.dcm.

This string may

contain: %name=(0010,0010), %id=(0010,0020), %modality=(0008,0060), %studyid=(0020,0010), %studyuid=(0020,000D), %seriesid=(0020,0010), %seriesuid=(0020,000E), %sopuid=(0008,0018), %imagenum=(0020,0013), %image=(0020,0013) as 6 digit integer, %imageid=(0054,0400), %time, %counter=(4 digit hex), %calledae, or %callingae. Any other text is treated literally – be careful to use only characters allowed in filenames plus the correct path separator: \ for Windows, and / for Linux.

**MaxFileNameLength.** If set, the filenames for the DICOM slices will be truncated (removing the starting characters of, typically, the series instance UID) to the specified length. Useful when files are to be recorded on compact disc (which often have a filename limit of 64 characters). Must be left at its default of 255 for FileNameSyntax values>6. Conquest addition.

**FixPhilips.** If set (default it is **NOT** set since version 1.4.6), a 10 digit PatientID (as a Philips Expander CT scanner produces) is stripped of leading zeros in some cases. See A.1.3. Conquest addition.

**FixKodak.** If set (default it is **NOT** set), a 8 digit PatientID (as a Kodak RIS produces) is stripped of a leading zero in some cases. See A.1.3. Conquest addition.

**WEBReadOnly.** If set to 1, web users cannot write anything. Default 0.

**KeepAlive.** If this value is not 0, server is tested every KeepAlive seconds and restarted if it doesn't respond (Windows only). Usually not necessary. Works again from version 1.4.5. Conquest addition.

**LargeFileSizeKB.** In the Windows GUI, large DICOM files are not automatically displayed in the browser. This parameter sets the threshold (default 1024). Conquest addition.

**ZipTime.** Time in hh:mm:ss (or part thereof) at which log files are zipped to reduce disk space (Windows only). Log files are zipped daily. Set to e.g., 'invalid' to disable zipping. Default value: '05:'. Conquest addition.

**UIDPrefix.** Prefix for unique identifiers generated by the server. These are used for anonymizing or changing Patient ID of images and for the print server. When the server is first installed, a unique prefix is generated automatically (1.2.826.0.1.3680043.2.135.Date.Time). Conquest addition.

**EnableReadAheadThread.** When set (default), up to 5 slices are read-ahead during any C-Move request. This option typically doubles the image retrieval speed, but increases processor load. Therefore it is may be disabled here.

**StorageFailedErrorCode.** This is the error code sent to all DICOM systems when storage fails. Default 272 = 0x110 = processing failed.

**PatientQuerySortOrder, StudyQuerySortOrder, SeriesQuerySortOrder, ImageQuerySortOrder.** Determines order in which images and query order results are sent. Must contain one or more comma separated exact (truncated) table.field names like: 'dicompatients.patientid' or 'dicomstudies.studydate, dicomseries.seriesnumb'. Does not function for DBF without ODBC. Only tested for SQL server.

**PackDBF.** If set, the internal DbaseIII driver will pack the database at startup. Is very slow for large archives, default OFF from version 1.4.5. Conquest addition.

**IndexDBF.** If set, the internal DbaseIII driver will create an internal memory index on patientID at startup. The value determines the amount of MB allocated for new database records (i.e., added later). Default is "1" = ON with 1 MB spare index space. Index generation takes about 1 minute per million images (during index generation the server cannot find not yet indexed records and the server runs in read only mode). However, this option speeds up simple queries (including PatientId, SeriesInstanceUID and/or StudyInstanceUID) enormously for large archives. New since version 1.4.5. Conquest addition.

**LongQueryDBF.** Queries with the internal DbaseIII driver taking longer than this value in ms will be reported to the user interface for troubleshooting purposes. Default 1000 ms. New since version 1.4.5. Conquest addition.

**FileCompressMode.** Obsolete. Use DroppedFileCompression and IncomingCompression instead. Conquest addition.

**TCPIPTimeOut.** TCP/IP timeout in seconds, default 300s. May be made longer when using very slow network links. Conquest addition.

**FailHoldOff.** After an export or mirror copy failure (e.g., because the receiving host is down), new requests are deferred immediately for this amount of seconds, default 60. Conquest addition.

**RetryDelay.** By this amount of seconds after an export or mirror copy failure, the deferred operations are retried, default 100. Version 1.4.11 fixes a problem where unaccepted images were retried forever. Conquest addition.

**QueueSize.** This is the size (in entries) of the in-memory queues for mirror copies and exportconverters, default 128. Each entry takes 1.5k (per export converter) or 2k (for the mirror copy queue). Conquest addition.

**WorkListMode.** WorkListMode=0: (default) Disabled. WorkListMode=1: The AccessionNumber is looked up in the local WorkList database, if it is found, any element in the DICOM object that is also present (and non-NULL) in the WorkList database, will be replaced by the value from the WorkList database. These changes are made both in the database and in the image that is stored on disk. WorkListMode=2: As mode 1, but the image will be refused if the AccessionNumber is not found. Note that there is no DICOM method of filling the worklist database. Use drag and drop to enter HL7 files into the server. Conquest addition since version 1.4.9.

**DebugLevel.** Only active when debug logging is enabled. 0: Basic debug log (default). 1: Dump incoming dicom command objects (and show memory usage on Linux). Also dump worklist query results. 2: Also dump incoming query data objects. Conquest addition (experimental).

**DroppedFileCompression.** Files dropped into the server will optionally be compressed, decompressed and/or recompressed. Supported values are (expected compression ratio stated between brackets):

as = store images as is, e.g. without changing the compression.	
is = store images as is, e.g. without changing the compression.	
un = uncompress NKI and/or JPEG compressed images	
n1 = fast NKI private loss-less compression mode 1	(50%)
n2 = as n1 but with CRC check for errors	(50%)
n3 = fast NKI private loss-less compression mode 3	(40%)
n4 = as n3 but with CRC check for errors	(40%)
j1 = JPEGLossless	(33%)
j2 = JPEGLosslessNH14	(33%)
j3 = JPEG baseline 1 (8 bit) <i>lossy</i>	(8%)
j4 = JPEGExtended2and4 <i>lossy</i>	(15%)
j5 = JPEGSpectralNH6and8 <i>lossy</i>	(15%)
j6 = JPEGFullNH10and12 <i>lossy</i>	(14%)
nj = Highest NKI mode; but leaves JPEG as is	(variable)
k1 = Downsize image>1024 pixels wide/high to 1024	(variable)
k2 = Downsize image>512 pixels wide/high to 512	(variable)
k4 = Downsize image>256 pixels wide/high to 256	(variable)
k8 = Downsize image>128 pixels wide/high to 128	(variable)

JPEG compression uses, for now, an executable from the OFFIS DICOM toolkit DCMTK and will only work if *dcmjpeg.exe* and *dcmdjpeg.exe* are present in the same directory as *dgate.exe* (download *JPEGSUP1412.ZIP*). JPEG decompression can either use built-in code (since version 1.4.7, Windows only) or an OFFIS tool (see the UseBuiltInDecompressor parameter). Note that JPEG compression is much slower than NKI compression. Compression is transparent for DICOM connections, i.e., data is decompressed or compressed if required before transmission. Default='un'; Conquest addition.

**IncomingCompression.** Images stored through DICOM communication into the server will optionally be compressed, decompressed and/or recompressed. Supported values are the same as for DroppedFileCompression with the

addition of compression 'vX'=do not store images at all (only useful for DICOM caches). Note that compression is transparent for DICOM connections, i.e., data is decompressed or compressed if required for transmission. Since version 1.4.7, if the called AE title looks like SERVER~xx (note, the total AE length must remain less than 16), then xx will override IncomingCompression. Default='un'; Conquest addition.

**ArchiveCompression.** Files prepared for archival (using the dgate -ab option) will optionally be compressed, decompressed and/or recompressed. Supported values are the same as for DroppedFileCompression. Prior to version 1.4.4 the amount of disk space to be archived was -incorrectly- computed before (re)compressing the images. Now OK. Default='as'; Conquest addition.

**UseBUILTInDecompressor.** If this value is set to 1 (default), internal code will be used (for Windows only) to decompress JPEG and RLE images. Otherwise it uses the dcmdjpeg executable of the OFFIS tools. Conquest addition since version 1.4.7.

**MAGDeviceThreshold.** If the disk space is less than this amount of MB, one or more least recently used patients are automatically deleted until the free disk space is about 5 MB larger. If set to 0, no deletion occurs (default).

**NightlyCleanThreshold.** If at 01:00 at night the disk space is less than this amount of MB, one or more least recently used patients are automatically deleted until the free disk space is about 5 MB larger (Windows only). If set to 0, no deletion occurs (default). Uses dgate option -ff. Conquest addition.

**NightlyMoveThreshold.** If at 02:00 at night the disk space of MAG0 is less than this amount of MB, one or more least recently changed patients are automatically moved (and optionally compressed using ArchiveCompression) to the selected MAG device (Windows only). The amount to move is computed such that the free disk space becomes about the value of this parameter in MB (Windows only). If set to 0, no moving occurs (default). Uses dgate options -as and -am. Conquest addition.

**NightlyMoveTarget.** If at 02:00 at night the disk space is less than NightlyMoveThreshold MB, patients are moved from MAG0 to this location (e.g. MAG1) (Windows only). Note: a mirror of the target will not be used. Uses dgate option -am. Conquest addition.

**MIRRORDevices, MIRRORDevice0, etc.** Each MAG device optionally has a mirror device where a duplicate of the image is stored for safety. Since version 1.4.8, if the mirror copy fails, it will be automatically retried using data stored in files like 'CopyFailures5678', where 5678 is the server port #. This file needs to be manually deleted to stop endless retries. Mirror copies are performed asynchronously and are queued in-memory in a queue with *QueueSize* entries. Conquest addition.

**CACHEDevices, CACHEDevice0, etc.** A CACHE device is used to temporarily store data that is made ready for archival on one of N jukebox devices. A cache device name must contain two %d fields: for example: a CACHEDevice “x:\cache\cd%02d\_%04d” will contain cache directories with names like “cd00\_0001”. This example is for jukebox device 0, and CD number 1. Image data may be moved to CACHE storage using dgate command line options –as and –ab. Conquest addition.

**JUKEBOXDevices, JUKEBOXDevice0, etc.** A JUKEBOX device is used to access data in a CD-ROM jukebox. A jukebox device name must contain one %d fields: for example: a JUKEBOXDevice “y:\jukebox\cd00\_%04d” will be used to access CD’s though directories with names like “cd00\_0001”. This example is for jukebox device 0, and CD number 1. Image data on JUKEBOX devices must be copied (burned) from CACHE devices with external software. Using dgate command line options the data can be prepared (-as), copied to cache (-ab), {then burn it}, verified (-ac) and the source images deleted (-ad). Conquest addition.

**ExportConverters, ExportConverter0, ExportModality0, ExportStationName0, ExportCalledAE0, ExportCallingAE0, ExportFilter0, etc.**

Use these options to turn a DICOM server into a fully automatic image format converter or for image forwarding. The item *ExportConverters* determines the number of export converters used: a thread is started for each.

- An export converter is an external or internal program that is run after an incoming image slice of prescribed Modality, StationName, CalledAE and CallingAE (\* matches anything, this is the default value) is stored in the database. Note that an empty string as value is not the same as ‘\*’, an empty string will only match, e.g., an empty Modality in the DICOM data. Since 1.4.12, also e.g. “RT\*” can be used for matching.
- Files that match all items above are tested against an optional SQL statement in ExportFilterN, e.g., *ImageNumber LIKE '1%'* matches all images with an image number starting on 1. All fields in the database can be used in the SQL statement with the exception of PatientID (ImagePat may be used instead), StudyInstanceUID and SeriesInstanceUID. Since the SQL filtering is relatively slow it is advised to also use the previous options. Note: When the built-in dBaseIII driver is used, filter queries are limited to fields in the de-normalized image table, and only queries like: “*ImageNumber LIKE '1%' and Modality = 'MR'*” are supported. Supported fields are listed in the DICOMImages definition in dicom.sql, while only the “and” keyword is supported. **Note that spaces around the “=” are obligatory!**
- There are **four** converter options.
  - 1) The file name of a matching slice can be passed as (only) argument to an external program specified by ExportConverterN (must be an exe file). For example, to pass all (512x512 CT images made on CT\_SCANNER send by CONQUESTSRV2 to CONQUESTSRV1) to myconverter.exe (note that spaces around ‘=’ are required, also in *ExportFilterN!*):

```

ExportConverters      = 1
ExportModality0       = CT
ExportStationName0   = CT_SCANNER
ExportCalledAE0= CONQUESTSRV1
ExportCallingAE0     = CONQUESTSRV2
ExportStationName0   = CT_SCANNER
ExportFilter0        = Rows = 512 and Cols = 512
ExportConverter0     = myconverter.exe

```

2) The ExportConverterN string may be written as '*forward to AE*', or '*forward compressed as .. to AE*' to use internal code for forwarding an image to another server (AE must be known to this server or may be written as ip:port). The 'forward compressed as .. to' option may use any style of NKI or JPEG compression using the same values as defined for DroppedFileCompression. For example, to forward all CT images to SERVER1 and forward all MR images using loss-less JPEG compression to SERVER2:

```

ExportConverters      = 2
ExportModality0       = CT
ExportConverter0      = forward to SERVER1
ExportModality1       = MR
ExportConverter1      = forward compressed as j2 to SERVER2

```

Since version 1.4.8, when an export fails, exports on that converter are blocked for 60 s (=FailHoldOff); while 100 s (=RetryDelay) after the last failure they will be automatically retried based on data stored in files like 'ExportFailures5678\_0' (where 5678=port number, 0=converter number). These files may sometimes need to be deleted (the GUI asks so at startup) to stop endless retries. Version 1.4.11 fixes endless retries for unaccepted images.

3) ExportConverterN may run a program using the following syntax (for example) '*notepad %f*', where %f=filename, %m=modality, %s=stationname, %b=file base name, %p=file path, %o=SOP instance UID, %u=CallingAE, %c=CalledAE, %n=newline, %%=%, %Vxxxx,yyyy=dicom item from image, %i=patient ID, %d=date and time. Each % variable can be appended with [first,last] to take a substring, i.e., %i[0,1] = first 2 characters of patientid. For example, to use a hypothetical DICOM to bitmap converter (a very good bitmap converter can be found in the OFFIS DICOM toolkit DCMTK) for each incoming image sent from a DICOM system with StationName = STATION1:

```

ExportConverters      = 1
ExportStationName0   = STATION1
ExportConverter0     = dicomtobitmap %f c:\bitmaps\%b.bmp

```

4) Finally, the following exportconverters are hard-coded and do not start an external program: '*nop*': do nothing, '*copy %f to destination*' (destination may be a file or a directory, don't forget the '*to*'), '*write "string" to file*', '*append "string" to file*' (don't forget the quotes around the string). Use %n in the string to write a new-line for the latter two options. For example, to copy all

incoming slices to another directory and append their filenames to a text file:

```
ExportConverters      = 2
ExportConverter0     = copy %f to c:\incoming
ExportConverter1     = append "%f%n" to c:\incoming.txt
```

Export converters are executed asynchronously (they are queued in memory in a queue of *QueueSize* length) but will somewhat slow down operation of the server. Since version 1.4.12c, multiple export converters may be specified in one rule separated by ‘;’. These are processed in sequence. See further *ImportConverters* for scripting language details.

Before version 1.4.12, each image was forwarded on a new association – causing problems on some host systems. With version 1.4.12, new options have been added to change this behaviour. The flag *ForwardAssociationLevel* may have values [GLOBAL, SOPCLASS, PATIENT, STUDY, SERIES, IMAGE]. Forwarders keep the association open as long as the UID at *ForwardAssociationLevel* does not change. The default is IMAGE, creating a new association for each image as before. By changing to more global settings more images are sent per association. However, associations are always closed when a new image type [SOPCLASS] is sent that was not sent before by this converter. After *ForwardAssociationCloseDelay* seconds of inactivity (default 5), the association is closed. After *ForwardAssociationRefreshDelay* seconds of inactivity (default 3600) the list of known sopclasses is deleted. This latter option avoids having to restart conquest when other servers change their capability. *ForwardAssociationRelease* controls whether conquest just hangs up to link (=0, default) or does a controlled close (=1, has problem). Conquest addition.

**ImportConverters, ImportConverter0, ImportModality0, ImportStationName0, ImportCalledAE0, ImportCallingAE0, etc.**

Use these options to let a DICOM server (conditionally) modify elements of each incoming image, reject images, or generate specific log files. The item *ImportConverters* determines the maximum number of import converters that can be used, it is however, not necessary to specify it explicitly.

An Import converter is an internal program that is run for each incoming image image of prescribed Modality, StationName, CalledAE and CallingAE (\* matches anything, this is the default value) and that typically will be used to change elements in the image before it is stored in the server and/or forwarded. They run after *WorkListMode* and *FixKodak* but before *ExportConverters*. Note that an empty string as value is not the same as ‘\*’, an empty string will only match, e.g., an empty Modality in the DICOM data. *ImportConverterN* may for example set a VR in the dicom image using the following syntax: *set 0010,1001 to “%V0010,0020”*, where %m=modality, %s=stationname, %o=SOP instance UID, %u=CallingAE, %c=CalledAE, %n=newline, %%=%, %Vxxxx,yyyy=any dicom item from image, %QPxxxx,yyyy=dicom item queried from patient db on patient ID, %QSxxxx,yyyy=dicom item queried from study db on patient ID

and study UID, %QExxxx,yyyy=dicom item queried from series db on patient ID, study UID, and series UID, and %QWxxxx,yyyy=dicom item queried from worklist db on accession number, %i=patient ID, %d=date and time, and %x, %y, %z are general purpose variables. Each % variable can be appended with [first,last] to take a substring, i.e., %i[0,1] = first 2 characters of patientid. For example, to change two VRs in each incoming image and reject any images acquired in 2002:

```
ImportConverter0    = set 0010,1001 to "my string and date: %d"
ImportConverter1    = set 0010,1002 to "%V0010,0010"
ImportConverter2    = ifequal "%V0008,0020[0,3]", "2002"; destroy
```

The following list illustrates all importconverter ‘I’, exportconverter ‘E’, or both ‘IE’ commands available for scripting. The parser is not very flexible: stay close to the examples in terms of spacing and semicolons.

IE	write "my string" to file.txt	write file
IE	append "date: %d" to file.txt	append to e.g. log file
IE	nop	do nothing
IE	nop any text %i	do nothing but log shows text
I	set xxxx,yyyy to "%V0010,0010"	set VR
I	set xxxx,yyyy if "%V0010,0010"	set VR if data
I	set x to "%QP0010,0010"	set variable
I	set y if "%x"	set variable if data
I	setifempty xxxx,yyyy to "hallo"	set if VR empty
I	setifempty xxxx,yyyy if "%x"	set if VR empty and %x not
I	setifempty z to "hallo"	set only if z empty
I	setifempty z if "%i"	set only if z empty and %i not
I	delete xxxx,yyyy	delete VR
I	save to %f.dcm	save image to file
I	destroy	image not stored at all
I	stop	stop parsing all converters
I	storage MAG1	set preferred storage area
E	stop	stop parsing this converter
E	forward to AE	see above
E	forward compressed as CC to AE	see above
E	copy file to file	see above
IE	ifnotempty "%i"; command	if filled then command
IE	ifempty "%V0010,0010"; nop	if "" then ..
IE	ifequal "string", "string2"; nop	test equal
IE	ifnotequal "string", "string2"; nop	test not equal
IE	ifmatch "string", "string2"; nop	test match (allow x*)
IE	ifnotmatch "string", "string2"	test not match
IE	ifnumequal "string", "string2"	test numeric
IE	ifnumnotequal "string", "string2"	test numeric
IE	ifnumgreater "string", "string2"	test numeric
IE	ifnumless "string", "string2"	test numeric
IE	ifnotempty "%i"; {nop; nop; }	{ } block (note ‘;’ use!)
IE	ifequal "%V0008,0020[0,3]", "2002";	substring to test year

**ExternalViewer.** Name of executable that can be started from the browser (Windows only) as an external viewer (through the image pop-up menu). The filename of the slice is passed as only argument. Conquest addition.

**DemoViewer.** Name of executable to be called for each incoming slice (Windows only). The filename of the slice, calling AE and called AE are passed as arguments. Conquest addition.

**DemoCopy.** Name of directory (including trailing \) to store a copy of each incoming slice (Windows only). The filename of the slice is changed to the calling AE. Conquest addition.

**SendUpperCaseAE.** If set, the called AE title is always sent UPPERCASE

**VirtualServerFor0.** Queries and move requests sent to this server are forwarded to the given AE titles in VirtualServerFor0..9. The AE titles must be known in *ACRNEMA.MAP*. The client will effectively see all data of the listed servers and this one merged – at the cost of query speed. The merging occurs during *each* query in memory. When moves are performed, images retrieved from the listed servers are stored locally (i.e., the server functions as a DICOM cache). The images are, however, automatically deleted when CacheVirtualData is 0. Since version 1.4.12, server names may be appended by ‘,FIXKODAK’ to enabled filtration of extraneous 0’s from outgoing queries and their results (see *fixkodak*). Conquest addition (experimental).

**CacheVirtualData.** If set, data passed through for other servers is kept (allowing the conquest server to act as a DICOM cache). When this option is cleared, multiple simultaneous access to the same data can give problems, as one access may be in the process of deleting images while another one thinks they are there. Default is set. Conquest addition (experimental).

#### A.5.2.2dicom.sql

This file is placed in the same directory as the executable (e.g., c:\dicomserver). It specifies the configuration of the SQL database used to store IOD module attributes for Query/Retrieve operations. The Conquest DICOM server generates (and overwrites) it automatically upon first installation (i.e., when dicom.ini does not exist). Editing this file is not necessary, except for a applying a fix when using ORACLE, where the name of the fields ‘Rows’ and ‘Columns’ in the image database must be changed to (e.g.) ‘QRows’ and ‘QColumns’ before the database is initialized (i.e., after “**Save Configuration**”). It is possible to check the syntax of this file for errors using the "**List Database Layout**" button on the "**Maintenance**" page of the Conquest DICOM server. Note that the database definitions of version 1.3.11 and up define a copy of the PatientID in both the series and the image table. This is done to allow improved query speed in future versions. From version 1.4.0 on, the contents of this file depend on the selected database driver upon installation (when dicom.ini does not exist), where the built in dBaseIII driver uses a non-normalized version of the database (not listed here), and the others use the file as listed here. *Implementing changed versions of this file requires a full regeneration of the database. Without full regeneration, the server will not function correctly! Removing fields from this database may affect the DICOM server user interface operation.*

Since version 1.4.9, the worklist database has been added. This database definition has an extra column with HL7 tags used for translating HL7 data to a dicom worklist. These tags can be changed at any time without regenerating the database, restarting the server suffices to use the new tags. *To enable worklist support when upgrading to version 1.4.10, files dicom.sql is updated (automatically) and d Gatesop.lst must be updated manually. Then restart the server and push "Clear worklist database" on the installation page of the GUI to create a fresh worklist database.*

```

/*
#       DICOM Database layout
#       Example version for all SQL servers (mostly normalized)
#
#       (File DICOM.SQL)
#       ** DO NOT EDIT THIS FILE UNLESS YOU KNOW WHAT YOU ARE DOING **
#
#       Version with modality moved to the series level and EchoNumber in image table
#       Revision 3: Patient birthday and sex, bolus agent, correct field lengths
#       Revision 4: Studymodality, Station and Department in study
#                   Manufacturer, Model, BodyPart and Protocol in series
#                   Acqdate/time, coil, acqnumber, slicelocation and pixel info in images
#       Notes for revision 4:
#       DepartmentName in study (should officially be in series, but eFilm expects it in study)
#       StationName is in study (should officially be in series, but more useful in study)
#       Revision 5: Added patientID in series and images for more efficient querying
#       Revision 6: Added frame of reference UID in series table
#       Revision 7: Added ImageType in image table, StudyModality to 64 chars, AcqDate to SQL_C_DATE
#       Revision 8: Denormalized study table (add patient ID, name, birthdate) to show consistency problems
#
#       Revision 10: Fixed width of ReceivingCoil: to 16 chars
#       Revision 13: Added ImageID to image database
#       Revision 14: Added WorkList database with HL7 tags
#
#       5 databases need to be defined:
#
#           *Patient*
#               *Study*
#                   *Series*
#                       *Image*
#               *WorkList*
#
#       # The last defined element of Study is a link back to Patient
#       # The last defined element of Series is a link back to Study
#       # The last defined element of Image is a link back to Series
#
#       # Format:
#       #       { Group, Element, Column Name, Column Length, SQL-Type, DICOM-Type }
#       */

*Patient*
{
    { 0x0010, 0x0020, "PatientID", 64, SQL_C_CHAR, DT_STR },
    { 0x0010, 0x0010, "PatientName", 64, SQL_C_CHAR, DT_STR },
    { 0x0010, 0x0030, "PatientBirthDate", 8, SQL_C_DATE, DT_DATE },
    { 0x0010, 0x0040, "PatientSex", 16, SQL_C_CHAR, DT_STR }
}

*Study*
{
    { 0x0020, 0x000d, "StudyInstanceUID", 64, SQL_C_CHAR, DT_UI },
    { 0x0008, 0x0020, "StudyDate", 8, SQL_C_DATE, DT_DATE },
    { 0x0008, 0x0030, "StudyTime", 16, SQL_C_CHAR, DT_TIME },
    { 0x0020, 0x0010, "StudyID", 16, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x1030, "StudyDescription", 64, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0050, "AccessionNumber", 16, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0090, "ReferPhysician", 64, SQL_C_CHAR, DT_STR },
    { 0x0010, 0x1010, "PatientsAge", 16, SQL_C_CHAR, DT_STR },
}

```

```

    { 0x0010, 0x1030, "PatientsWeight", 16, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0061, "StudyModality", 64, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x1010, "StationName", 16, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x1040, "InstitutionalDepartmentName", 64, SQL_C_CHAR, DT_STR },

    { 0x0010, 0x0010, "PatientName", 64, SQL_C_CHAR, DT_STR },
    { 0x0010, 0x0030, "PatientBirthDate", 8, SQL_C_DATE, DT_DATE },
    { 0x0010, 0x0040, "PatientSex", 16, SQL_C_CHAR, DT_STR }

    { 0x0010, 0x0020, "PatientID", 64, SQL_C_CHAR, DT_STR }
}

*Series*
{
    { 0x0020, 0x000e, "SeriesInstanceUID", 64, SQL_C_CHAR, DT_UI },
    { 0x0020, 0x0011, "SeriesNumber", 12, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0021, "SeriesDate", 8, SQL_C_DATE, DT_DATE },
    { 0x0008, 0x0031, "SeriesTime", 16, SQL_C_CHAR, DT_TIME },
    { 0x0008, 0x103e, "SeriesDescription", 64, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0060, "Modality", 16, SQL_C_CHAR, DT_STR },
    { 0x0018, 0x5100, "PatientPosition", 16, SQL_C_CHAR, DT_STR },
    { 0x0018, 0x0010, "ContrastBolusAgent", 64, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0070, "Manufacturer", 64, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x1090, "ModelName", 64, SQL_C_CHAR, DT_STR },
    { 0x0018, 0x0015, "BodyPartExamined", 64, SQL_C_CHAR, DT_STR },
    { 0x0018, 0x1030, "ProtocolName", 64, SQL_C_CHAR, DT_STR },
    { 0x0020, 0x0052, "FrameOfReferenceUID", 64, SQL_C_CHAR, DT_UI },
    { 0x0010, 0x0020, "SeriesPat", 64, SQL_C_CHAR, DT_STR },
    { 0x0020, 0x000d, "StudyInstanceUID", 64, SQL_C_CHAR, DT_UI }
}

*Image*
{
    { 0x0008, 0x0018, "SOPInstanceUID", 64, SQL_C_CHAR, DT_UI },
    { 0x0008, 0x0016, "SOPClassUID", 64, SQL_C_CHAR, DT_UI },
    { 0x0020, 0x0013, "ImageNumber", 12, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0023, "ImageDate", 8, SQL_C_DATE, DT_DATE },
    { 0x0008, 0x0033, "ImageTime", 16, SQL_C_CHAR, DT_TIME },
    { 0x0018, 0x0086, "EchoNumber", 12, SQL_C_CHAR, DT_STR },
    { 0x0028, 0x0008, "NumberOfFrames", 12, SQL_C_CHAR, DT_STR },
    { 0x0008, 0x0022, "AcqDate", 8, SQL_C_DATE, DT_DATE },
    { 0x0008, 0x0032, "AcqTime", 16, SQL_C_CHAR, DT_TIME },
    { 0x0018, 0x1250, "ReceivingCoil", 16, SQL_C_CHAR, DT_STR },
    { 0x0020, 0x0012, "AcqNumber", 12, SQL_C_CHAR, DT_STR },
    { 0x0020, 0x1041, "SliceLocation", 16, SQL_C_CHAR, DT_STR },
    { 0x0028, 0x0002, "SamplesPerPixel", 5, SQL_C_CHAR, DT_UINT16 },
    { 0x0028, 0x0004, "PhotoMetricInterpretation", 16, SQL_C_CHAR, DT_STR },
    { 0x0028, 0x0010, "Rows", 5, SQL_C_CHAR, DT_UINT16 },
    { 0x0028, 0x0011, "Columns", 5, SQL_C_CHAR, DT_UINT16 },
    { 0x0028, 0x0101, "BitsStored", 5, SQL_C_CHAR, DT_UINT16 },
    { 0x0008, 0x0008, "ImageType", 128, SQL_C_CHAR, DT_STR },
    { 0x0054, 0x0400, "ImageID", 16, SQL_C_CHAR, DT_STR },
    { 0x0010, 0x0020, "ImagePat", 64, SQL_C_CHAR, DT_STR },
    { 0x0020, 0x000e, "SeriesInstanceUID", 64, SQL_C_CHAR, DT_UI }
}

*WorkList*
{
    { 0x0008, 0x0050, "AccessionNumber", 16, SQL_C_CHAR, DT_STR, "OBR.3" },
    { 0x0010, 0x0020, "PatientID", 64, SQL_C_CHAR, DT_STR, "PID.4" },
    { 0x0010, 0x0010, "PatientName", 64, SQL_C_CHAR, DT_STR, "PID.5" },
    { 0x0010, 0x0030, "PatientBirthDate", 8, SQL_C_DATE, DT_DATE, "PID.7" },
    { 0x0010, 0x0040, "PatientSex", 16, SQL_C_CHAR, DT_STR, "PID.8" },

    { 0x0010, 0x2000, "MedicalAlerts", 64, SQL_C_CHAR, DT_STR, "---" },
    { 0x0010, 0x2110, "ContrastAllergies", 64, SQL_C_CHAR, DT_STR, "---" },
    { 0x0020, 0x000d, "StudyInstanceUID", 64, SQL_C_CHAR, DT_UI, "---" },
    { 0x0032, 0x1032, "ReqPhysician", 64, SQL_C_CHAR, DT_STR, "OBR.16" },
    { 0x0032, 0x1060, "ReqProcDescription", 16, SQL_C_CHAR, DT_STR, "OBR.4.1" },

    { 0x0040, 0x0100, "-----", 0, SQL_C_CHAR, DT_STARTSEQUENCE, "---" },
    { 0x0008, 0x0060, "Modality", 16, SQL_C_CHAR, DT_STR, "OBR.21" },
    { 0x0032, 0x1070, "ReqContrastAgent", 64, SQL_C_CHAR, DT_STR, "---" },
    { 0x0040, 0x0001, "ScheduledAE", 16, SQL_C_CHAR, DT_STR, "---" },

```

```

    { 0x0040, 0x0002, "StartDate",      8, SQL_C_DATE, DT_DATE, "OBR.7.DATE" },
    { 0x0040, 0x0003, "StartTime",     16, SQL_C_CHAR, DT_TIME, "OBR.7.TIME" },
    { 0x0040, 0x0006, "PerfPhysician",  64, SQL_C_CHAR, DT_STR, "---" },
    { 0x0040, 0x0007, "SchedPSDescription", 64, SQL_C_CHAR, DT_STR, "---" },
    { 0x0040, 0x0009, "SchedPSID",     16, SQL_C_CHAR, DT_STR, "OBR.4" },
    { 0x0040, 0x0010, "SchedStationName", 16, SQL_C_CHAR, DT_STR, "OBR.24" },
    { 0x0040, 0x0011, "SchedPSLocation", 16, SQL_C_CHAR, DT_STR, "---" },
    { 0x0040, 0x0012, "PreMedication",  64, SQL_C_CHAR, DT_STR, "---" },
    { 0x0040, 0x0400, "SchedPSComments", 64, SQL_C_CHAR, DT_STR, "---" },
    { 0x0040, 0x0100, "-----",       0, SQL_C_CHAR, DT_ENDSEQUENCE, "---" },

    { 0x0040, 0x1001, "ReqProcID",     16, SQL_C_CHAR, DT_STR, "OBR.4.0" },
    { 0x0040, 0x1003, "ReqProcPriority", 16, SQL_C_CHAR, DT_STR, "OBR.27" }
}

```

### A.5.2.3acrnama.map

This file is placed in the same directory as the executable (e.g., c:\dicomserver). It specifies the configuration of the ACR-NEMA to IP address and port map, used for Query/Retrieve operations. Most DICOM servers and applications will NOT communicate with the Conquest DICOM server unless they have been correctly added to this list and this server has been made known to them. This file also specifies the type of compression that will be proposed for outgoing connections. The accepted values are the same as for DroppedFileCompression in *dicom.ini*, with the exception that transmission of dicom objects in "as" and "nj" modes is not correctly implemented and should only be used with NKI clients or the Conquest DICOM server. Upon installation, an empty version of this file is created automatically (the installation program will NOT overwrite this file if it exists). Edit the contents of this file through the "**Known DICOM providers**" page of the Conquest DICOM server. Do *not* change the file header. It is possible to check the syntax of this file for errors using the "**List DICOM providers**" button on the "**Maintenance**" page of the Conquest DICOM server. It is possible to test communication with other DICOM servers (that support the Query/Move functionality, i.e., image servers) through the "**Query / Move**" page of the Conquest DICOM server. Conquest addition: this file supports a simple wild-card mechanism. The AE, host name and IP port may all end on a \*. The \* part of the AE is copied into the host name and/or IP port without change. In the following example any application with an AE of "V" followed by its IP number or host name will be allowed to communicate through port 1234. The wildcard option is highly useful to let a group of, e.g., viewer applications or servers communicate without having to configure each of them individually in the server.

```

/* *****
*
* DICOM AE (Application entity) -> IP address / Port map
* (This is file ACRNEMA.MAP)
*
* All DICOM systems that want to retrieve images from the
* Conquest DICOM server must be listed here with correct
* AE name, (IP address or hostname) and port number.
* The first entry is the Conquest system as example.
*
*
* The syntax for each entry is :
* AE <IP address|Host name> port number compression
*

```

```

* For compression see manual. Values are un=uncompressed; *
* j1,j2=lossless jpeg;j3..j6=lossy jpeg;n1..n4=nki private *
*
***** */
CONQUESTSRV1      127.0.0.1      5678      un
V*                *                1234      n4
S*                *                5678      as

```

### A.5.2.4dgatesop.lst

This file is placed in the same directory as the executable (e.g., c:\dicomserver). It specifies the configuration of the SSC-SCP engine. This file can also be used to selectively reject other SOP classes, as well as provide security for incoming AE's. The Conquest DICOM server generates it automatically upon installation. A copy of this file is present in the TEMP directory. This latter copy is automatically removed when closing the server. To enable printing in version 1.3.12 up, this file should be manually removed prior to installation. From version 1.4.0, GEMRStorage and GECTStorage are disabled (using '#'), thereby forcing GE scanners to transmit standard DICOM images that other viewers can handle. From version 1.4.2 up, JPEG transfer syntaxes are enabled for incoming connections if JPEG support is configured as ON.

```

#
# DICOM Application / sop / transfer UID list.
#
# This list is used by the CheckedPDU_Service ( "filename" ) service
# class. All incoming associations will be verified against this
# file.
#
# Revision 2: disabled GEMRStorage and GECTStorage
# Revision 3: extended with new sops and with JPEG transfer syntaxes
# Revision 4: added Modality Worklist query
#
#None                none                RemoteAE
#None                none                LocalAE
#DICOM               1.2.840.10008.3.1.1.1    application
Verification        1.2.840.10008.1.1      sop
StoredPrintStorage  1.2.840.10008.5.1.1.27  sop
HardcopyGrayscaleImageStorage 1.2.840.10008.5.1.1.29  sop
HardcopyColorImageStorage 1.2.840.10008.5.1.1.30  sop
CRStorage           1.2.840.10008.5.1.4.1.1.1  sop
DXStorageForPresentation 1.2.840.10008.5.1.4.1.1.1.1  sop
DXStorageForProcessing  1.2.840.10008.5.1.4.1.1.1.1.1  sop
DMStorageForPresentation 1.2.840.10008.5.1.4.1.1.1.2  sop
DMStorageForProcessing  1.2.840.10008.5.1.4.1.1.1.2.1  sop
DOralStorageForPresentation 1.2.840.10008.5.1.4.1.1.1.3  sop
DOralStorageForProcessing 1.2.840.10008.5.1.4.1.1.1.3.1  sop
CTStorage           1.2.840.10008.5.1.4.1.1.2  sop
RetiredUSMultiframeStorage 1.2.840.10008.5.1.4.1.1.3  sop
USMultiframeStorage 1.2.840.10008.5.1.4.1.1.3.1  sop
MRStorage           1.2.840.10008.5.1.4.1.1.4  sop
MRImageStorageEnhanced 1.2.840.10008.5.1.4.1.1.4.1  sop
MRStorageSpectroscopy 1.2.840.10008.5.1.4.1.1.4.2  sop
RetiredNMStorage    1.2.840.10008.5.1.4.1.1.5  sop
RetiredUSStorage    1.2.840.10008.5.1.4.1.1.6  sop

```

USStorage	1.2.840.10008.5.1.4.1.1.6.1	sop
SCStorage	1.2.840.10008.5.1.4.1.1.7	sop
SCStorageSingleBitMF	1.2.840.10008.5.1.4.1.1.7.1	sop
SCStorageGrayscaleByteMF	1.2.840.10008.5.1.4.1.1.7.2	sop
SCStorageGrayscaleWordMF	1.2.840.10008.5.1.4.1.1.7.3	sop
SCStorageTrueColorMF	1.2.840.10008.5.1.4.1.1.7.4	sop
StandaloneOverlayStorage	1.2.840.10008.5.1.4.1.1.8	sop
StandaloneCurveStorage	1.2.840.10008.5.1.4.1.1.9	sop
#WFStorageTwelveLeadECG	1.2.840.10008.5.1.4.1.1.9.1.1	sop
#WFStorageGeneralECG	1.2.840.10008.5.1.4.1.1.9.1.2	sop
#WFStorageAmbulatoryECG	1.2.840.10008.5.1.4.1.1.9.1.3	sop
#WFStorageHemodynamic	1.2.840.10008.5.1.4.1.1.9.2.1	sop
#WFStorageCardiacElectrophysiology	1.2.840.10008.5.1.4.1.1.9.3.1	sop
#WFStorageBasicVoiceAudio	1.2.840.10008.5.1.4.1.1.9.4.1	sop
StandaloneModalityLUTStorage	1.2.840.10008.5.1.4.1.1.10	sop
StandaloneVOILUTStorage	1.2.840.10008.5.1.4.1.1.11	sop
GrayscaleSoftcopyPresentationStateStorage	1.2.840.10008.5.1.4.1.1.11.1	sop
RetiredXASinglePlaneStorage	1.2.840.10008.5.1.4.1.1.12	sop
XASinglePlaneStorage	1.2.840.10008.5.1.4.1.1.12.1	sop
RFSStorage	1.2.840.10008.5.1.4.1.1.12.2	sop
XABiPlaneStorage	1.2.840.10008.5.1.4.1.1.12.3	sop
NMStorage	1.2.840.10008.5.1.4.1.1.20	sop
RawDataStorage	1.2.840.10008.5.1.4.1.1.66	sop
RetiredVLImageStorage	1.2.840.10008.5.1.4.1.1.77.1	sop
RetiredVLMultiFrameImageStorage	1.2.840.10008.5.1.4.1.1.77.2	sop
RetiredVLMicroscopicSlideStorage	1.2.840.10008.5.1.4.1.1.77.3	sop
RetiredVLPhotographicStorage	1.2.840.10008.5.1.4.1.1.77.4	sop
VLEndoscopicImageStorage	1.2.840.10008.5.1.4.1.1.77.1.1	sop
VLMicroscopicImageStorage	1.2.840.10008.5.1.4.1.1.77.1.2	sop
VLSlideCoordinatesMicroscopicImageStorage	1.2.840.10008.5.1.4.1.1.77.1.3	sop
VLPhotographicImageStorage	1.2.840.10008.5.1.4.1.1.77.1.4	sop
BasicTextSR	1.2.840.10008.5.1.4.1.1.88.11	sop
EnhancedSR	1.2.840.10008.5.1.4.1.1.88.22	sop
ComprehensiveSR	1.2.840.10008.5.1.4.1.1.88.33	sop
MammographyCADSR	1.2.840.10008.5.1.4.1.1.88.50	sop
KeyObjectSelectionDocument	1.2.840.10008.5.1.4.1.1.88.59	sop
PETStorage	1.2.840.10008.5.1.4.1.1.128	sop
StandalonePETCurveStorage	1.2.840.10008.5.1.4.1.1.129	sop
RTImageStorage	1.2.840.10008.5.1.4.1.1.481.1	sop
RTDoseStorage	1.2.840.10008.5.1.4.1.1.481.2	sop
RTStructureStorage	1.2.840.10008.5.1.4.1.1.481.3	sop
RTTreatmentRecordStorage	1.2.840.10008.5.1.4.1.1.481.4	sop
RTPlanStorage	1.2.840.10008.5.1.4.1.1.481.5	sop
RTBrachyTreatmentRecordStorage	1.2.840.10008.5.1.4.1.1.481.6	sop
RTTreatmentSummaryRecordStorage	1.2.840.10008.5.1.4.1.1.481.7	sop
#GEMRStorage	1.2.840.113619.4.2	sop
#GECTStorage	1.2.840.113619.4.3	sop
GE3DModelObjectStorage	1.2.840.113619.4.26	sop
GERTPlanStorage	1.2.840.113619.5.249	sop
GERTPlanStorage2	1.2.840.113619.4.5.249	sop
GESaturnTDSObjectStorage	1.2.840.113619.5.253	sop
Philips3DVVolumeStorage	1.2.46.670589.5.0.1	sop
Philips3DObjectStorage	1.2.46.670589.5.0.2	sop
PhilipsSurfaceStorage	1.2.46.670589.5.0.3	sop
PhilipsCompositeObjectStorage	1.2.46.670589.5.0.4	sop
PhilipsMRCardioProfileStorage	1.2.46.670589.5.0.7	sop
PhilipsMRCardioImageStorage	1.2.46.670589.5.0.8	sop
PatientRootQuery	1.2.840.10008.5.1.4.1.2.1.1	sop
PatientRootRetrieve	1.2.840.10008.5.1.4.1.2.1.2	sop

StudyRootQuery	1.2.840.10008.5.1.4.1.2.2.1	sop
StudyRootRetrieve	1.2.840.10008.5.1.4.1.2.2.2	sop
PatientStudyOnlyQuery	1.2.840.10008.5.1.4.1.2.3.1	sop
PatientStudyOnlyRetrieve	1.2.840.10008.5.1.4.1.2.3.2	sop
PatientRootRetrieveNKI	1.2.826.0.1.3680043.2.135.1066.5.1.4.1.2.1.2	sop
StudyRootRetrieveNKI	1.2.826.0.1.3680043.2.135.1066.5.1.4.1.2.2.2	sop
PatientStudyOnlyRetrieveNKI	1.2.826.0.1.3680043.2.135.1066.5.1.4.1.2.3.2	sop
BasicGrayscalePrintManagementMeta	1.2.840.10008.5.1.1.9	sop
BasicColorPrintManagementMeta	1.2.840.10008.5.1.1.18	sop
BasicFilmSession	1.2.840.10008.5.1.1.1	sop
BasicFilmBox	1.2.840.10008.5.1.1.2	sop
BasicGrayscaleImageBox	1.2.840.10008.5.1.1.4	sop
BasicColorImageBox	1.2.840.10008.5.1.1.4.1	sop
BasicPrinter	1.2.840.10008.5.1.1.16	sop
FindModalityWorkList	1.2.840.10008.5.1.4.31	sop
LittleEndianImplicit	1.2.840.10008.1.2	transfer
#LittleEndianExplicit	1.2.840.10008.1.2.1	transfer
#BigEndianExplicit	1.2.840.10008.1.2.2	transfer
JPEGBaseLine1	1.2.840.10008.1.2.4.50	transfer LittleEndianExplicit
JPEGExtended2and4	1.2.840.10008.1.2.4.51	transfer LittleEndianExplicit
#JPEGExtended3and5	1.2.840.10008.1.2.4.52	transfer LittleEndianExplicit
JPEGSpectralNH6and8	1.2.840.10008.1.2.4.53	transfer LittleEndianExplicit
#JPEGSpectralNH7and9	1.2.840.10008.1.2.4.54	transfer LittleEndianExplicit
JPEGFullNH10and12	1.2.840.10008.1.2.4.55	transfer LittleEndianExplicit
#JPEGFullNH11and13	1.2.840.10008.1.2.4.56	transfer LittleEndianExplicit
JPEGLosslessNH14	1.2.840.10008.1.2.4.57	transfer LittleEndianExplicit
#JPEGLosslessNH15	1.2.840.10008.1.2.4.58	transfer LittleEndianExplicit
#JPEGExtended16and18	1.2.840.10008.1.2.4.59	transfer LittleEndianExplicit
#JPEGExtended17and19	1.2.840.10008.1.2.4.60	transfer LittleEndianExplicit
#JPEGSpectral20and22	1.2.840.10008.1.2.4.61	transfer LittleEndianExplicit
#JPEGSpectral21and23	1.2.840.10008.1.2.4.62	transfer LittleEndianExplicit
#JPEGFul24and26	1.2.840.10008.1.2.4.63	transfer LittleEndianExplicit
#JPEGFul25and27	1.2.840.10008.1.2.4.64	transfer LittleEndianExplicit
#JPEGLossless28	1.2.840.10008.1.2.4.65	transfer LittleEndianExplicit
#JPEGLossless29	1.2.840.10008.1.2.4.66	transfer LittleEndianExplicit
JPEGLossless	1.2.840.10008.1.2.4.70	transfer LittleEndianExplicit
#JPEGLS_Lossless	1.2.840.10008.1.2.4.80	transfer LittleEndianExplicit
#JPEGLS_Lossy	1.2.840.10008.1.2.4.81	transfer LittleEndianExplicit
#RLELossless	1.2.840.10008.1.2.5	transfer LittleEndianExplicit
#LittleEndianExplicitDeflated	1.2.840.10008.1.2.1.99	transfer LittleEndianExplicit
#JPEG2000LosslessOnly	1.2.840.10008.1.2.4.90	transfer LittleEndianExplicit
#JPEG2000	1.2.840.10008.1.2.4.91	transfer LittleEndianExplicit

### A.5.2.5 DICOM print server configuration

No printer configuration options are provided: the default Windows printer is always used. One must use the default document settings of the default printer to change, e.g., the resolution of the printout or the paper size.

### A.5.2.6 Compression configuration

The compression settings for dropped images, incoming images, and archival are configured in *dicom.ini*. These define the compression mode of images stored on disk by the server.

Dropped images → DroppedFileCompression → Disk,  
 Remote host → IncomingCompression → Disk,  
 Disk → ArchiveCompression → Archive disk.

The values for these compression settings may be “un” for uncompressed, “as” for as-is (no change in compression), “n1”..”n4” for NKI compression styles, “j1”..”j2” for loss-less JPEG compression, “j3”..”j6” for lossy JPEG compression, “nj” for NKI or JPEG compression (chooses highest NKI, but leaves JPEG as is), and k1, k2, k4 and.k8 for downsizing to 1024..128 pixels. The original compression type of incoming images (used with “as”) is defined by the remote host, which can choose one of the transfer syntaxes defined in *dgatesop.lst*. Since version 1.4.7, if the called AE title in a C-STORE looks like SERVER~xx, then xx will override IncomingCompression (e.g., images sent to a conquest server addressed from the remote host as ‘CONQUESTSRV1~k4’ will be downsized by the server to 256 pixels prior to storage). Note, however, that the total AE may not exceed 16 characters. So this option works correctly only if the base name of the server (CONQUESTSRV1 in the example) has 13 characters or less.

The compression of forwarded images can be set through *dicom.ini* as well.

Disk → ExportConverterN → Remote host.

The type of compression setting is passed using a command “forward compressed as xx to”, where xx is one of the compression types defined for DroppedFileCompression. If the command “forward to” is used instead, the compression type defined in *acrnama.map* is used. If the remote host does not accept the offered compression, images will automatically be sent with simpler compression or uncompressed. Such negotiation is not implemented for NKI compression.

Images may also be sent as result of a move request to a remote host using different compressions. This option is configured per host in *acrnama.map*.

Disk → Setting in *acrnama.map* → Remote host.

The values for these compression settings may be “un” for uncompressed, “n1”..”n4” for NKI compression styles, “j1”..”j2” for loss-less JPEG compression, “j3”..”j6” for lossy JPEG compression, and “k1”..”k8” for downsizing the image. Options “as” and “nj” are not correctly implemented for outgoing connections due to the complexity of the transfer syntax negotiation involved. These options may therefore only be used for NKI clients or the Conquest DICOM server. If the remote host does not accept the offered JPEG compression, images will automatically be sent with a simpler compression or uncompressed. Such negotiation is not implemented for NKI compression and “k” downsize compression. Since version 1.4.7, if the called AE title in the C-MOVE looks like SERVER~xx, then xx will override the compression setting in *acrnama.map*. (E.g., images sent by a conquest server addressed from the remote host as ‘CONQUESTSRV1~k4’ will be downsized

by the server to 256 pixels prior to sending). This allows any host/viewer to receive downsized images on request. Note, however, that the total AE length may not exceed 16 characters. So this option works correctly only if the base name of the server (CONQUESTSRV1 in the example) has 13 characters or less.

#### A.5.2.7 Worklist configuration

When dropping a HL7 file onto the server, it initiates the command ‘dgate – loadhl7:file’. This will read the hl7 file and populate the modality worklist database. A sample HL7 file (sample.hl7) is provided for testing. For translating the hl7 data into the DICOM worklist, an extra column has been added to the worklist database definition. Typically this column can contain:

---	No import of values from hl7
*AN	Generate a unique 16 character accession number
*UI	Generate a unique 64 character UID
SEQ.N	Read HL7 sequence <i>seq</i> field N
SEQ.N.M	Read HL7 sequence <i>seq</i> field N, subfield M
SEQ.N.DATE	Read HL7 sequence <i>seq</i> field N, date part
SEQ.N.TIME	Read HL7 sequence <i>seq</i> field N, time part

Hospitals wanting to use HL7 import should edit this table such that the correct HL7 items are filled in into the worklist database. When changing the translation part of the worklist database definition, the server must only be restarted to use the adaptations (enable debug log to view the hl7 translation progress). When the database layout of the modality worklist is changed, one should clear the database through the maintenance page and its contents are lost. Note that database fields marked with ‘DT\_STARTSEQUENCE’ and ‘DT\_ENDSEQUENCE’ are not used by the program and are descriptive only. The modality worklist query will mimic the organization of the query in sequences in its reply so the sequence organization needs not be specified.

#### A.6 SUPPORT OF EXTENDED CHARACTER SETS

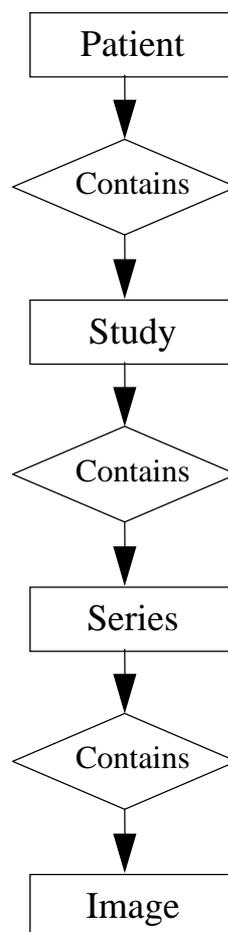
No extended character sets are supported.

### SECTION 3 DEFAULT QUERY/RETRIEVE INFORMATION MODEL DEFINITION

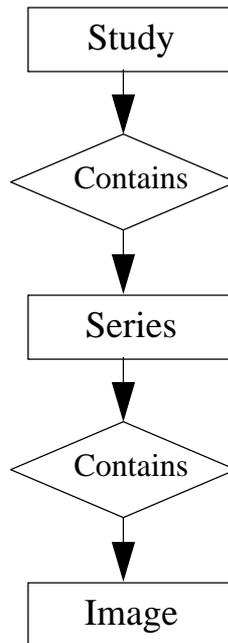
This section describes the subset of the DICOM v3.0 Patient Root, Study Root, and Patient/Study Only, Query/Retrieve Information Model Definition used by this product.

#### 3.0 INTEROPERABILITY SCHEMA

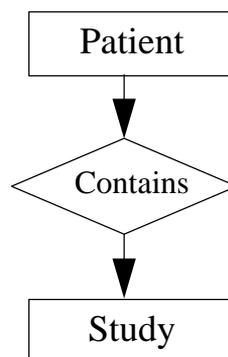
##### 3.0.1 PATIENT ROOT QUERY/RETRIEVE ENTITY RELATIONSHIP



### 3.0.2 STUDY ROOT QUERY/RETRIEVE ENTITY RELATIONSHIP



### 3.0.1 PATIENT/STUDY ONLY QUERY/RETRIEVE ENTITY RELATIONSHIP



### 3.1 ENTITY DESCRIPTIONS

See DICOM Standard Part 4

### 3.2 PATIENT ROOT QUERY/RETRIEVE INFORMATION OBJECT DEFINITION

#### 3.2.1 Patient Level Keys for Patient Root Query/Retrieve Information Model

Attribute Name	Element Tag	Type	Notes
----------------	-------------	------	-------

Revision: 10			
Patient Name	(0010,0010)	R	
Patient ID	(0010,0020)	U	
Patient Birth Date	(0010,0030)	O	
Patient Sex	(0010,0040)	O	

### 3.2.2 Study Level Keys for Patient Root Query/Retrieve Information Model

Attribute Name	Element Tag	Type	Notes
Revision: 10			
Study Instance UID	(0020,000D)	U	
Study Date	(0008,0020)	R	
Study Time	(0008,0030)	R	
Study ID	(0020,0010)	R	
Study Description	(0008,1030)	O	
Accession Number	(0008,0050)	O	
Referring Physician	(0009,0090)	O	
Patients Age	(0010,1010)	O	
Patients Weight	(0010,1030)	O	
Study Modality	(0008,0061)	O	
Station Name	(0008,1010)	O	
Department Name	(0008,1040)	O	

### 3.2.3 Series Level Keys for Patient Root Query/Retrieve Information Model

Attribute Name	Element Tag	Type	Notes
Revision: 10			
Series Instance UID	(0020,000E)	U	
Series Number	(0020,0011)	R	
Series Date	(0008,0021)	R	
Series Time	(0008,0031)	R	
Series Description	(0008,103E)	O	
Modality	(0008,0060)	O	
Patient Position	(0018,5100)	O	
Contrast Bolus Agent	(0018,0010)	O	
Manufacturer	(0008,0070)	O	
Model Name	(0008,1090)	O	
Body Part Examined	(0018,0015)	O	
Protocol Name	(0018,1030)	O	
Frame of Reference UID	(0020,0052)	O	

### 3.2.4 Image Level Keys for Patient Root Query/Retrieve Information Model

Attribute Name	Element Tag	Type	Notes
Revision: 13			
SOP Instance UID	(0008,0018)	U	
SOP Class UID	(0008,0016)	O	
Image Number	(0020,0013)	O	
Image Date	(0008,0023)	O	
Image Time	(0008,0033)	O	
Echo Number	(0018,0086)	O	
Number Of Frames	(0028,0008)	O	
Acq Date	(0008,0022)	O	
Acq Time	(0008,0032)	O	
Receiving Coil	(0018,1240)	O	
Acq Number	(0020,0012)	O	
Slice Location	(0020,1041)	O	
Samples Per Pixel	(0028,0002)	O	
Photometric Interpret.	(0028,0004)	O	
Rows	(0028,0010)	O	
Columns	(0028,0011)	O	
Bits Stored	(0028,0101)	O	
Image Type	(0008,0008)	O	
Image ID	(0054,0400)	O	

### 3.3 STUDY ROOT QUERY/RETRIEVE INFORMATION OBJECT DEFINITION

#### 3.3.1 Study Level Keys for Study Root Query/Retrieve Information Model

Attribute Name	Element Tag	Type	Notes
Revision: 10			
Patient Name	(0010,0010)	O	
Patient ID	(0010,0020)	O	
Study Instance UID	(0020,000D)	U	
Study Date	(0008,0020)	R	
Study Time	(0008,0030)	R	
Study Number	(0020,0010)	R	(Official: Study ID)
Study Description	(0008,1030)	O	
Accession Number	(0008,0050)	O	
Referring Physician	(0009,0090)	O	
Patients Age	(0010,1010)	O	
Patients Weight	(0010,1030)	O	

Study Modality	(0008,0061)	O	
Station Name	(0008,1010)	O	
Department Name	(0008,1040)	O	

### 3.3.2 Series Level Keys for Study Root Query/Retrieve Information Model

See Section 3.2.3

### 3.3.3 Image Level Keys for Study Root Query/Retrieve Information Model

See Section 3.2.4

## 3.4 PATIENT/STUDY ONLY QUERY/RETRIEVE INFORMATION OBJECT DEFINITION

### 3.4.1 Patient Level Keys for Patient/Study Only Query/Retrieve Information Model

See Section 3.2.1

### 3.4.1 Study Level Keys for Patient/Study Only Query/Retrieve Information Model

See Section 3.2.2

## 3.5 MODALITY WORKLIST QUERY INFORMATION OBJECT DEFINITION

### 3.3.1 Keys for Modality Worklist Query Information Model

Attribute Name	Element Tag	Type	Notes
Revision: 14			
Accession Number	(0008,0050)	O	Primary Key
Patient ID	(0010,0020)	R	
Patient Name	(0010,0010)	R	
Patient Birth Date	(0010,0030)	O	
Patient Sex	(0010,0040)	O	
Medical Alerts	(0010,2000)	O	
Contrast Allergies	(0010,2110)	O	
Study Instance UID	(0020,000D)	O	
Requesting Physician	(0032,1032)	O	
Requested Procedure Description	(0032,1060)	O	
Requested Procedure Code Sequence	(0032,1064)	R	1 instances of this sequence required

>Modality	(0008,0060)	R	
>Requested contrast agent	(0032,1070)	O	
>Scheduled AE	(0040,0001)	R	
>Start date	(0040,0002)	R	
>Start time	(0040,0003)	R	
>Performing Physician	(0040,0006)	R	
>Scheduled Procedure Step Description	(0040,0007)	O	
>Scheduled Procedure Step ID	(0040,0009)	O	
>Scheduled Station Name	(0040,0010)	O	
>Scheduled Procedure Step Location	(0040,0011)	O	
>Premedication	(0040,0012)	O	
>Scheduled Procedure Step Comments	(0040,0400)	O	
Requested Procedure ID	(0040,1001)	O	
Requested Procedure Priority	(0040,1003)	O	

To code this information into a database, the contents of the sequence are unfolded to the same level as the other fields.

## SECTION 4. INSTALLATION GUIDE

This section details how to setup the Conquest DICOM server / MicroPACS system, as well as how the various components work together. For Linux operation see appendix 3.

### 4.0 INTRODUCTION

For clarity/brevity, this section makes the following assumptions:

The server is located in "c:\dicomserver"  
 Your Image Storage drive is "c:\dicomserver\data"  
 You have only one image drive  
 All Conquest DICOM server / MicroPACS files are on "A:\", i.e., after unzipping 'dicomserver1412c.zip'.

Minimum System Requirements:

- \* Windows95/98/ME/NT/2000/XP (for Linux see appendix 3).
- \* 96 megabytes of memory
- \* 1024x768x256 display.

- \* 20 MB free hard disk space (for some images).
- \* TCP/IP functioning on your machine [WSOCK32.DLL compatible].
- \* BDE (Borland Database Engine) installed on your machine. If not, the system will attempt to use ADO or use built-in DBF support.

#### Recommended System Configuration:

- \* Windows NT4 or higher (for Linux see appendix 3).
- \* Pentium 100 or faster
- \* 256 megabytes of memory or more
- \* 1024x768 true color display (requires 2 MB display card).
- \* As much disk space as you can get.
- \* TCP/IP functioning on your machine [WSOCK32.DLL compatible].
- \* BDE (Borland Database Engine) installed on your machine. If not, the system will attempt to use ADO or use built-in DBF support.

## 4.1 INSTALLATION (WINDOWS)

### 4.1.1 First time installation.

Any part of the installation can be repeated at any time without loss of data, since the database may be (re-) generated from the images stored on disk. However, database regeneration may take a long time and active connections may be terminated during some of the installation steps. Also, the modality worklist cannot be regenerated; it therefore has its own clear button.

First, optionally, install the BDE. To install it, download bdeinstall5.zip from the web page, unzip it and run setup.exe. Without the BDE, the database browser will use ADO or built-in DBF support.

Alternatively, copy libmysql.dll (from version 5.0.22) to the directory where the server will be installed. Then the GUI and the server will both use native MySQL drivers. By default database conquest on localhost with empty username and empty password will be used for MySQL; it must be created before installation.

Then, unless an install program is used (not provided) you must enter the following commands from the command prompt (or perform similar functions using the explorer):

```
md c:\dicomserver
cd \dicomserver
unzip DICOMSERVER1412c.ZIP here, using folder names
optionally unzip JPEGSUP1412.ZIP here
conquestdicomserver
```

JPEGSUP1412.ZIP is required only for JPEG support (transfer and storage). It is preferred to install the server in a directory without spaces in its name (a

warning will be given if you try otherwise). If everything went correctly, the server should display a message that this is a first time installation (this window can be recalled at any time by deleting **dicom.ini** and starting the server):



The database type for automatic (ODBC) data source setup should be selected here. You can choose: Dbase III without ODBC, Microsoft Access, Microsoft SQL server, or a native MySQL driver (only shows when libmysql.dll is present). Dbase III without ODBC is used as default, since this driver does not require pre-installed software or ODBC configuration. This default is advised for small archives of up to 100.000 images and can also be used for huge archives with some restrictions on queries.

To use ODBC access to SQL servers or database drivers not listed here (e.g., Interbase or Oracle), an ODBC data source *must* be selected here. Then, ODBC configuration must be made by hand instead of using the “**Make ODBC data source**” button that will be explained later. The SQL server option requires a running Microsoft SQL server running on this or another PC with a configured database (default called “conquest”, set through ODBC), login name (“conquest”, set in dicom.ini) and password (“conquest”, set in dicom.ini). The login should have full permissions for the ‘conquest’ database. SQL server is much more stable than Microsoft Access and is therefore recommended for large-scale and multi-user archives.

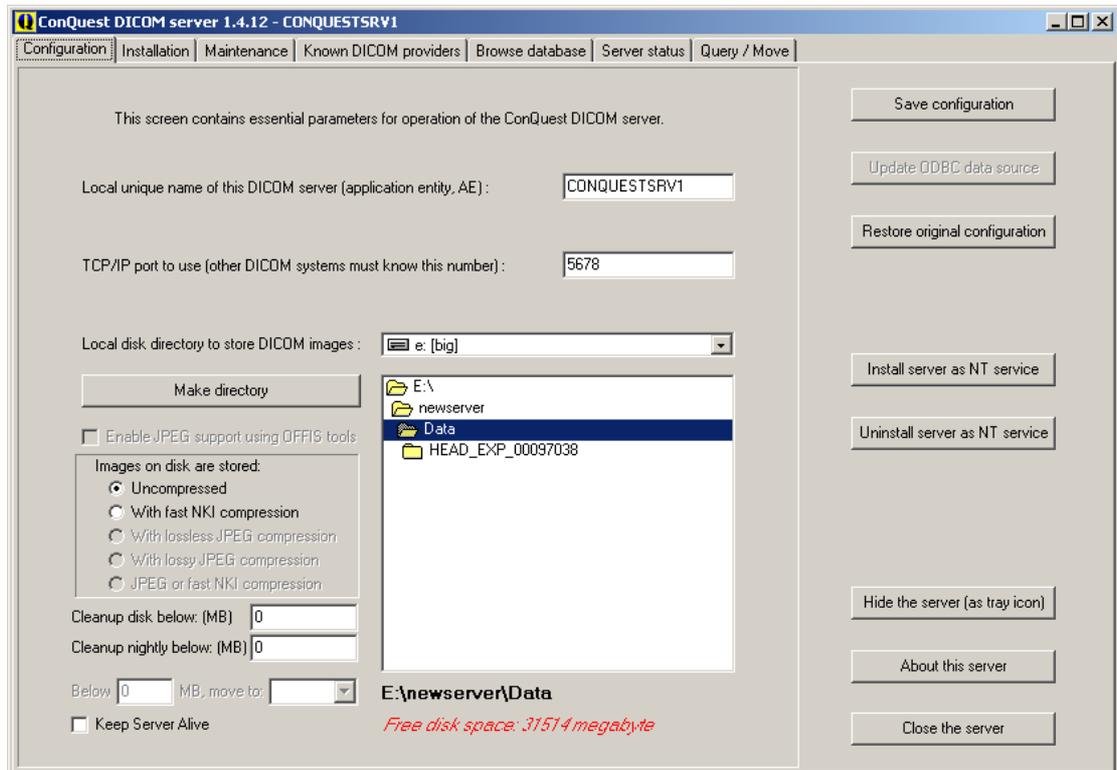
After pushing “OK”, the server window should open. If this does not happen the following problems may exist:

- ODBC not installed (not required for Dbase III without ODBC).
- ODBC comes with Microsoft Office.
- TCP/IP not installed (comes standard with Windows 95 up)

Ask your system administrator for help in installing/updating these products.

The following steps are not required when choosing “Default install”.

Fill all entries in the "**Configuration page**" of the Conquest DICOM server.



These settings can be changed later at any time if required. The following entries may be configured (the defaults are OK as a first test):

- \* Local unique name of this DICOM server (default "CONQUESTSRV1")  
(AE name of this server, maximal 16 characters)
- \* TCP/IP port to use (default 5678)  
(use another value if there are multiple DICOM AE's on one machine)
- \* Local disk directory to store data (default c:\dicomserver\data)  
(NOTE: **double** click a directory to select it. Patient directories will be made under the selected directory. The selector does not work when a UNC path is set in dicom.ini, e.g., '\\server\share\path')
- \* Enable JPEG support using OFFIS DICOM toolkit DCMTK (default state depends on presence of executables to be downloaded from *JPEGSUP1412.ZIP*)  
When set, the server accepts incoming JPEG compressed images over the network, and will compress and decompress JPEG images as required by the following option.
- \* Images on disk are stored: (default uncompressed)  
Storing images compressed may limit your ability to read the images directly from disk using third party software. JPEG compression is slow and lossy compression affects the fidelity of the images. The options presented in the user interface correspond with the parameters in *dicom.ini* named IncomingCompression and DroppedFileCompression set to 'un', 'n4', 'j2', 'j6' and 'nj', respectively.

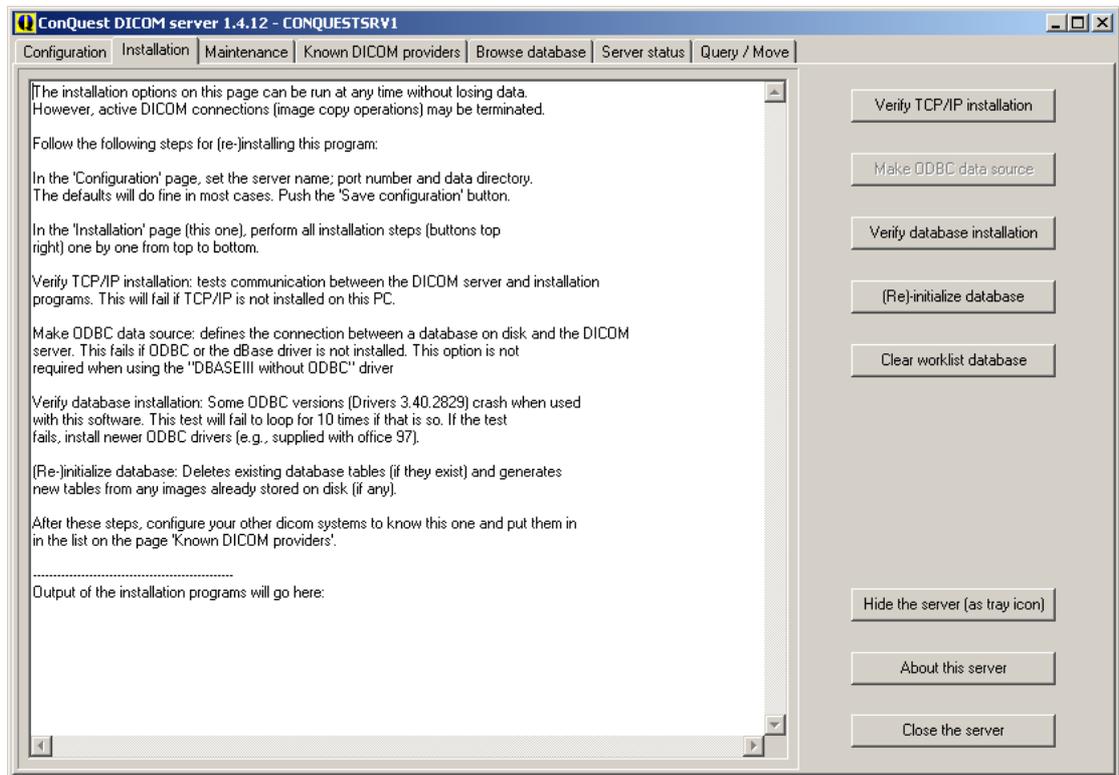
- \* Cleanup disk below ... megabyte (default 0= do not delete even if disk full)  
(Cleaning the disk involves deleting least recently used patients)
- \* Cleanup nightly below ... MB (default 0= do not delete even if disk full)  
(This cleaning of the disk occurs each night at 01:00)
- \* Below ... MB move to ... (default 0= do not move even if disk full)  
(Moves ... MB data from MAG0 to e.g., MAG1 at 02:00)
- \* Keep server alive: if set, the server self tests once per minute and is automatically restarted in the rare event of a software crash

Push "**Save Configuration**". When JPEG support is changed the user will be prompted about overwriting *dgate.sop.lst*, which specifies the accepted transfer syntaxes. When the file *dicom.sql* existed, a backup will be made of it, and it is overwritten. The user will be warned that full db regeneration is required when its layout has changed. On a first install, the installation page is then automatically displayed (you can go back for the next item later).

Optional (NT4 and up): Use "**Install server as NT service**" to run the actual DICOM server (*dgate.exe*) independent of this user interface (it will then also re-start automatically when the computer is booted). This option will install the service such that it logs in with a system account. Only system administrators should use this option. To work, the databases and images should reside on the local system with sufficient access rights. Otherwise an error message is generated (push 'Uninstall server as NT service' to restore the previous situation). Since version 1.4.4, ODBC is installed with a system datasource and should also work without modifying the service. 'Kill and restart the server' from the server status page can be used at any time to restart the service. The name of the server is used as service name, and cannot be changed while using this option. Use "**Uninstall server as NT service**" to restore that the DICOM server functions only if *conquestdicomserver.exe* is running and to allow a change of server name. NOTE: this version (v1.4.12) will not run as service if the directory path where the server executables reside includes space characters. Since version 1.4.7 a service will log to *serverstatus.log* even if this user interface is closed.

The following hidden option exists: when the service buttons are alt-right clicked, the service is installed four times (e.g., with ports 5678...5681). Each server runs independently against the same data(base). Use to increase speed or reliability or for testing purposes.

Next go to the "**Installation**" page of the Conquest DICOM server.



Push button **"Verify TCP/IP installation"**. It should respond with the following messages:

```
----- Start TCP/IP test -----
[CONQUESTSRV1] This output is generated by the dicom server application
[CONQUESTSRV1] If you can read this, the console communication is OK
[CONQUESTSRV1] This is systemdebug output; can you read this ?
[CONQUESTSRV1] This is a very long text output for testing -- This is a very
long text output for testing -- This is a very long text output for testing --
This is a very long text output for testing -- This is a very long text output
for testing -- This is a very long text output for testing --
[CONQUESTSRV1] ----- Succesful end of test -----
```

If the response is different, TCP/IP may not be installed (correctly) on your computer. Ask your system administrator for help.

When not using Dbase III without ODBC or native MySQL, push button **"Make ODBC data source"**, unless you want to configure the ODBC data source by hand. After a confirm, it should respond with the following messages:

```
----- Start ODBC data source update or creation -----
[CONQUESTSRV1] Creating data source
[CONQUESTSRV1] Driver = Microsoft Access Driver (*.mdb)
[CONQUESTSRV1] Options = DSN=conquestpacs_s;Description=ConQuest DICOM server...
[CONQUESTSRV1] Datasource configuration succesful
[CONQUESTSRV1] -----
[CONQUESTSRV1] Creating data source
[CONQUESTSRV1] Driver = Microsoft Access Driver (*.mdb)
[CONQUESTSRV1] Options = DSN=conquestpacs_s;Description=ConQuest DICOM server...
[CONQUESTSRV1] Datasource configuration succesful
[CONQUESTSRV1] -----
```

If the response is different, ODBC may not be installed on your computer or the selected driver has not been installed. Ask your system administrator for help. It is best to have a recent full ODBC installation, e.g., from Microsoft

Office 97 or later. Note that it is perfectly possible to create or edit an ODBC datasource by hand. This is required to use another database driver as the two ODBC options given in the first time installation window.

Push button "**Verify database installation**". It should respond with the following messages:

```
----- Start ODBC test -----
[CONQUESTSRV1] Attempting to open database; test #1 of 10
[CONQUESTSRV1] Creating test table
[CONQUESTSRV1] Adding a record
[CONQUESTSRV1] Dropping test table
[CONQUESTSRV1] Closing database
[CONQUESTSRV1] Attempting to open database; test #2 of 10
[CONQUESTSRV1] Creating test table
[CONQUESTSRV1] Adding a record
[CONQUESTSRV1] Dropping test table
[CONQUESTSRV1] Closing database
.
[CONQUESTSRV1] Attempting to open database; test #10 of 10
[CONQUESTSRV1] Creating test table
[CONQUESTSRV1] Adding a record
[CONQUESTSRV1] Dropping test table
[CONQUESTSRV1] Closing database
[CONQUESTSRV1] ----- Successful end of test -----
```

When using ODBC, if the response is different, the ODBC version may be buggy. You may need to install a new version of ODBC (e.g., from Microsoft Office 97). Ask your system administrator for help.

When using native MySQL and the response is different, database conquest may not exist (or password and username may be wrong) or mysql may not be running. Create the database using mysqladmin (with 'mysqladmin -u root create conquest') and make sure mysql runs using mysqld-nt.

Push button "**(Re)-initialize database**". After confirmation, it should respond with the following messages (plus some indexing messages for the built-in DbaseIII driver):

```
----- Start database init and regeneration -----
[CONQUESTSRV1] Regen Database
[CONQUESTSRV1] Step 1: Re-initialize SQL Tables
[CONQUESTSRV1] ***Failed SQLExecDirect : DROP TABLE DICOMPatients
[CONQUESTSRV1] ***Failed SQLExecDirect : DROP TABLE DICOMStudies
[CONQUESTSRV1] ***Failed SQLExecDirect : DROP TABLE DICOMSeries
[CONQUESTSRV1] ***Failed SQLExecDirect : DROP TABLE DICOMImages
[CONQUESTSRV1] ***Failed SQLExecDirect : DROP TABLE UIDMODS
[CONQUESTSRV1] ***Failed SQLExecDirect : DROP TABLE DicomWorkList
[CONQUESTSRV1] Step 2: Load / Add DICOM Object files
[CONQUESTSRV1] [Regen]
           E:\QUIRT\APP\CONQUEST\DICOMserver\newinstall\Data\HEAD_EXP_00097038\000
           1_002000_892665661.v2 -SUCCESS
[CONQUESTSRV1] [Regen]
           E:\QUIRT\APP\CONQUEST\DICOMserver\newinstall\Data\HEAD_EXP_00097038\000
           1_003000_892665662.v2 -SUCCESS
[CONQUESTSRV1] Regeneration Complete
```

These or similar "failed" messages occur when the server attempts to delete tables that are not there. The [regen] messages show that each image file is entered into the database. They will be missing if the database is empty. If the response is otherwise different, you may have not performed the full installation correctly. Best is to retry from the start or get help.

The button “Clear worklist” will create and/or re-initialize the worklist table: it will not be re-created automatically if it already contained data.

Go to the "**Known DICOM providers**" page and enter information about the systems that you want to communicate with. A similar step is required at those systems to make the Conquest DICOM server known to them. **Push the "Save this list"** button. The server will load the changed list at this point, without a restart (since version 1.4.7). Note that only a single server reloads the list. If multiple servers run (using the hidden four-service option), they have to be restarted in another way to reload the list.

After installation is complete: you can test the server in the following ways:

1) Try buttons on the "**Maintenance**" page (with the exception of "**(Re)-initialize database**" since this action can take quite some time).

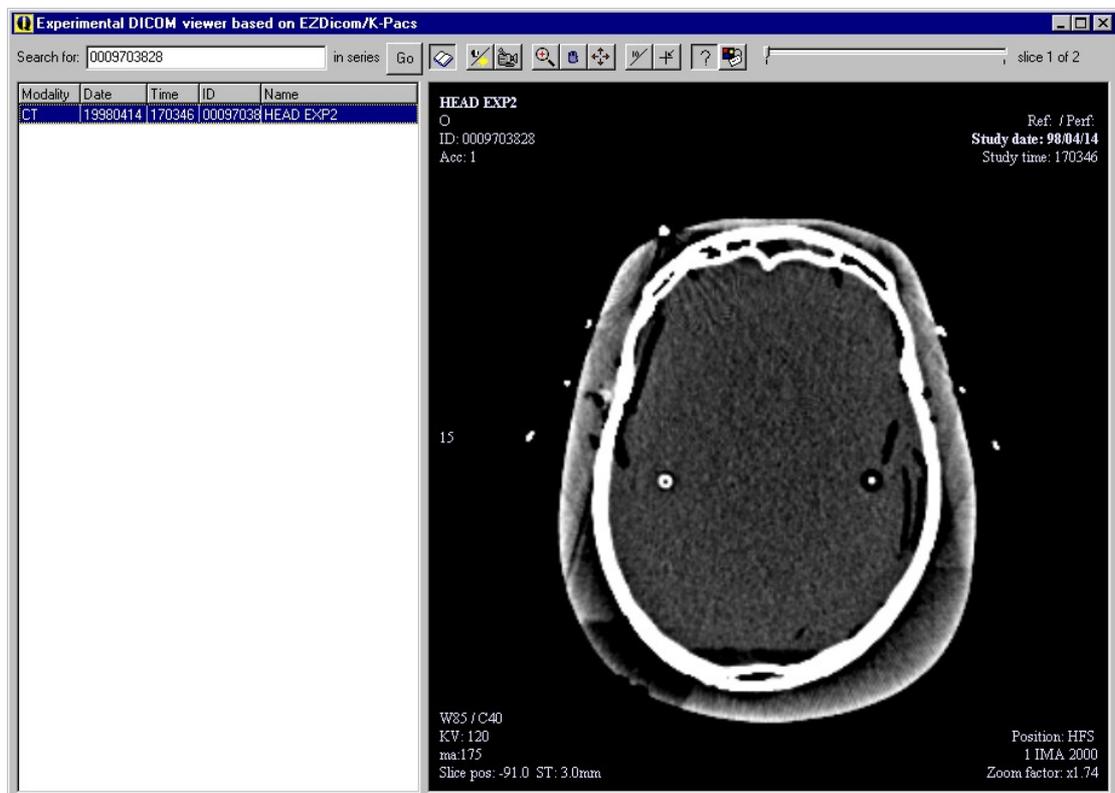
2) Browse through the database and look at some pictures in the "**Browse database**" page. When the ‘**View incoming**’ checkbox on the browser page is set, each newly stored slice is displayed, with a red overlay of the calling AE. This option also displays incoming images to be printed; while this option is ON, the built-in elementary DICOM printer is therefore disabled. Right-click the image with the mouse for several extra options:

- “**Show header**” lists the DICOM header of the currently selected image. Use keys CTRL-A = select all, CTRL-C = copy to clipboard, CTRL-F = find text, CTRL-S = save as text file and F3 = search again.
- “**Save as Bitmap**” saves the currently visible file as windows BMP file.
- “**Force display of (large) image**” can be used to display images that exceed 1 MB (configurable) or that are stored on a jukebox that are normally not shown by the browser.
- “**Run K-Pacs viewer**” shows a more advanced viewer (since version 1.4.11, experimental).
- “**Run external viewer**” (if configured in **dicom.ini**) starts an external viewer program with the selected DICOM image as argument.
- The “**Animate Display**” options animate the current series in various ways.
- The “**Send ... To**” options allow sending the current image, selected images of the current series, the current series, the current study, or the current patient to another DICOM station.
- The “**Print Image on local DICOM printer**” option prints a full page printout of the selected image using the built-in DICOM print server on the default Windows printer.
- The “**Print Selected Images on local DICOM server**” option prints a selection of images of the current series using a selectable page layout (default 4x6 images on a portrait page) on the default Windows printer.

- The **“Remove image from database”** option effectively hides an image from queries (until the database is re-generated or the image is re-entered, e.g., by dropping it onto the server from an explorer window). Also allows removal of orphaned DB entries (without an image) from version 1.4.7.



*Database browser and its popup menu.*



*The K-PACS viewer – first in version 1.4.11*

- The **“Refresh Database Display”** option can be used to show changes in data when editing the DICOM database through a third party product or when new data has been sent to the server while the browser window is open.
- The **“Anonymize”** options remove patient information from the selected images and generate a new study, series and SOP instance UIDs for consistency.
- The **“Change patient ID”** options change a patient ID for the selected series/study and generate a new study, series and SOP instance UIDs for consistency. Because of the changed UIDs, the changed slices will belong to new studies and series even if the patient ID is changed back to its original value. I.e., images with a new patient ID are considered as completely new images.
- The **“Merge selected series”** option will give a list of all series in this study and will next merge selected series (generating a new series UID and new SOP UIDs for consistency).
- The **“Split series”** option will give a list of all images in this series and will next split selected images from this series (generating a new series UID and new SOP UIDs for the selected images for consistency).
- The **“Delete ..”** options will delete the selected images one by one or an entire patient at once.

Note that in some cases, the database browser may not correctly update changes made through the menu. In those cases, select a different page of the server and go back to the browser page to fully refresh the database browser.

3) Try to query or copy some images using the "**Query / Move**" page. You may query your own database or copy *from* the own database *to* the own database as a first test. Hint: try different "**Query levels**" and observe the results. To quickly fill in information such as the patient ID, double click on the result window where the patient ID is shown. Double clicking a patient ID with the control button pressed will add that ID to a comma separated patient ID list to copy several patients at once. This feature is only available for the patient ID. The "**Query level**" button also allows you to select three query methods. The default method is a PatientRoot query, but lower in the list you will find query levels which use the StudyRoot and PatientStudyOnly query methods. These query levels are provided because many DICOM servers do not support the default PatientRoot query method. Finally, it is possible to query a *modality worklist*. Default the queries are on human-readable entries. Since version 1.4.12, by double-clicking on the label next to the Series number edit box, the query mechanism switches over to using UIDs. This is less readable but supported by more servers. To read the long responses, it is possible to resize the GUI. The "**Find Local Missing Patients**" button finds all patient data on the selected DICOM system that is not present on the LOCAL server for copying to a DESTINATION server. For example, to grab all new data from a CT scanner, enter today's date into "**Study date**", select the CT scanner as DICOM system, and select the local server as DESTINATION. Push "**Find Local Missing Patients**", which may take a while. The missing patients (if any) are listed. Then push "**Copy to destination**" to copy the missing patients into the local server.

4) Entering DICOM or HL7 files into the server is provided through a drag and drop interface. Just drag and drop files or directories from the explorer to add them. The dropped files are copied into the data directory of the server and the database is updated to include the new files. Images of a single patient may be entered with a changed patient ID by pressing the ALT key while dropping the files or the directory. This latter option will generate new study, series and SOP instance UIDs for consistency. HL7 files update the worklist database only and patient ID changing is not available.

5) Look at the "**Server status**" page to see connection activity and print server progress. To read long lines, it is possible to resize the GUI. This page also contains the "**Kill and restart the server**" button which is needed when the DICOM server has crashed (has not happened in our hospital the last year). The "**Hide this server (as tray icon)**" and other buttons do what you expect of them. The small up/down arrows set the amount of debug information displayed when **debug log** is switched on (up=more, down=less). At high debug levels also internal communication from the server is logged.

#### 4.1.2 Installing multiple servers on the same PC.

Installing two or more servers on one PC is a nice way to test DICOM since it allows copying and querying in a simple way. Many servers can be running simultaneously. However, it is *essential to leave the first server(s) running*

while attempting to *install* new ones (otherwise the same TCP/IP ports will be used and the servers will fail to operate simultaneously). The installation must be done in different directories. So replace "c:\dicomserver\" by, e.g., "c:\dicomserver2\" and perform all installation steps again. The servers must be made known to each other using the "**Known DICOM providers**" page. If SQL server is used as database, each DICOM server should have its own SQL server database and login.

### 4.1.3 Updating to newer versions.

Typically, a new version can be installed by just replacing the **exe** and **dll** files with newer versions (it is a good idea to keep backups of the older ones). One exception is that versions 1.4.2 up require a slightly different **acrnema.map** file than previous versions, i.e., the compression column has been added. For full function, version 1.4.11 requires addition of the worklist database in **dicom.sql** (this is automatic), initializing (clearing) it through the installation page, and updating **dgatesop.lst**. Naturally, the server must be stopped before files can be replaced. In case the server runs as a service it must be stopped using the control panel or by un-installing it as a service. To enable use of a new database layout (*requires a full regen!*) and/or new modalities and JPEG communication, the files **dicom.sql** and/or **dgatesop.lst** must be manually deleted prior to installation. New versions of these files are then recreated when **conquestdicomserver.exe** is restarted. To choose a new database driver delete **dicom.ini**, which also causes **dicom.sql** to be overwritten. Be careful, since installing a modified version of **dicom.sql** *requires re-initialization of the image and/or worklist database* using the buttons on the installation or maintenance page. Typical regeneration speed is 10-60 slices per second. Regeneration may take a very long time (several days) for large databases. For this reason, the database definition of from version 1.4.8 (still the same for 1.4.12) is very complete and it should suffice for most users. *If you do not want to regenerate the database, keep a copy of your previous dicom.sql and restore it (making sure it has the worklist database entries in it) after upgrading.* To create entries for new options in **dicom.ini** use the "**Save configuration**" button. To enable the DICOM printer function of version 1.3.12 up or the worklist query of 1.4.9 up, the older version of file **dgatesop.lst** must be manually deleted and the server restarted.

Note 1: If you used version 1.4.4 (between April 6 and April 26, 2004) with MS-Access or SQL server, we recommend db regeneration to remove false \\ from filenames in the database.

Note 2: The linux version uses / in paths in the database instead of \. Therefore, do not exchange database files between Windows and Linux.

## 4.2 FILES

### Installation files (in DicomServer1412c.zip):

conquestpacs.pdf	Conformance statement & Documentation
conquestdicomserver.exe	User interface
dgate.exe	Console mode version of MicroPACS system
dgate.dic	DICOM dictionary for dgate.exe
cqdicom.dll	Conquest DICOM client DLL.

dgateserv.exe	NT service wrapper for dgate.exe
zipdll.dll	ZipMaster DLL for zipping log files
sample.hl7	Example HL7 input file

### Optional JPEG support files (in JPEGSUP1412.zip):

dcmjpeg.exe	OFFIS DICOM toolkit jpeg compression utility v3.5.3
dcmjpeg.txt	description of this utility
dcmdjpeg.exe	OFFIS DICOM toolkit jpeg decompression utility v3.5.3
dcmdjpeg.txt	description of this utility
offis.txt	OFFIS copyright notice

### Configuration files (automatically generated):

dicom.ini	Configuration file
dicom.sql	Database table definition file
acrnama.map	System/IP map file
dgatesop.lst	SOP Class definition file
USE.....	Determines database driver to be installed

### Database files (automatically generated, example for DBASEIII):

data\dbase\Dicompatients.dbf	patient database table
data\dbase\Dicomstudies.dbf	study database table
data\dbase\Dicomseries.dbf	series database table
data\dbase\Dicomimages.dbf	image database table
data\dbase\Dicomworklist.dbf	worklist database table
data\dbase\XDicompatients.dbf	extract of database table used by browser for dbaseIII
data\dbase\XDicomstudies.dbf	extract of database table used by browser for dbaseIII
data\dbase\XDicomseries.dbf	extract of database table used by browser for dbaseIII
data\dbase\XDicomimages.dbf	extract of database table used by browser for dbaseIII
data\dbase\XDicomworklist.dbf	extract of database table (not used)
data\dbase\testtable.dbf	not used
data\dbase\UIDMODS.dbf	used for changing Patient ID and anonymizing

### Log files (automatically generated):

Installation.log	information from installation page
Maintenance.log	information from maintenance page
ServerStatus.log	information from server status page or service
PacsTrouble.log	relevant errors
PacsUser.log	all users who accessed the server
ConquestDicomServer.log	log about main actions and server start/stop
logs_yyyymmdd.zip	automatically zipped set of log files

### Data files (automatically generated – 5678 is the servers port #):

ExportFailures5678_0	data of failed exports for later retrying
CopyFailures5678	data of failed mirror copies for later retrying

Note: These files need to be manually deleted to stop endless retries

### Image file (example, for FileNameSyntax parameter set to 3) :

Dir	PatientID		seriesUID		series	slice		time		counter
Data\QA_phantom\	1.2.840.113619.2.22.287.1.19980710.202026_0001_000006_9537982720005.v2									

### 4.3 PRODUCT INTERACTION / DESCRIPTION

**dgate.exe:** DICOM MicroPACS AE Main. This is the principal PACS application. It handles all connections (see threading model note in section 4.4 of this part). Contained in this executable are verification, storage, print, and various query and retrieve DICOM SOP classes. This executable interfaces to the PACS database via ODBC-32 v2.0, or using a built-in dBaseIII driver. In the event that disk space is low, it will optionally delete least recently entered patients. This application also contains code for installation, maintenance and archival operations that is used by the Conquest DICOM server. For these purposes a second copy of dgate.exe is started. Type “**dgate -?**” for more information. Finally, the same executable may act as CGI server application. In some rare cases, the dgate process may still be running even though the user interface has closed (after a crash or after killing it with the task manager). The user interface, when restarted, then assumes that the dgate process belongs to a service (and displays “**user interface**” in the caption), but cannot control the running process. Killing the dgate process with the task manager or rebooting will solve this problem. All source code of dgate.exe is included in **DGATE1412b.ZIP** and **DICOMLIB1412.ZIP**. However, source code of the built-in JPEG decompressor is not included. To compile dgate.exe (without built-in decompressor) one can best modify and use makttotal.bat.

**dgate.dic:** DICOM dictionary used by dgate.exe.

**dgateserv.exe:** Wrapper for dgate.exe to make it run as a Windows service. May be used (advanced users only) to manually (even remotely) start / stop / install / uninstall service(s). Type “**dgateserv /?**” for more information. Note that DICOM server services are named after the AE of the server. Once dgate.exe is installed as a service, the DICOM server(s) starts automatically when the computer is booted. When the user interface is started it will detect that the server is already running and connect to it. Source code is not included.

**conquestdicomserver.exe:**  
This executable is the user interface and installation program and contains parts of the print server. See the installation section of this document for its functions. The database browser tries to use the Borland Database Engine. Without BDE, the server will run but with reduced filter options. Source code is not included.

**cqdicom.dll:** This is code for the Conquest DICOM client. It is used here to display the images in the database browser, convert DICOM

images for printing, list the image file header and provide query, move and echo actions. The source code of this DLL is not included but it is based on the programs “TEST.EXE” and “DICOMP.EXE” that are included with source code.

zipdll.dll: This DLL is part of the zipmaster VCL component that is used in the server to automatically zip the log files once a day. Source code is not included.

### **Optional files from JPEGSUP1412.ZIP**

dcmcjpeg.exe: jpeg compression utility from the OFFIS DICOM toolkit DCMTK version 3.5.3. This executable is called by dgate.exe to compress DICOM images in jpeg format. Copyright (C) 1994-2004, OFFIS. This software and supporting documentation were developed by Kuratorium OFFIS e.V. Healthcare Information and Communication Systems Escherweg 2 D-26121 Oldenburg, Germany. This software is made available, as is, and OFFIS makes no warranty regarding the software, its performance, its merchantability or fitness for any particular use, freedom from any computer diseases or its conformity to any specification. The entire risk as to quality and performance of the software is with the user. Copyright of the software and supporting documentation is, unless otherwise stated, owned by OFFIS, and free access is hereby granted as a license to use this software, copy this software and prepare derivative works based upon this software. However, any distribution of this software source code or supporting documentation or derivative works (source code and supporting documentation) must include the three paragraphs of this copyright notice.

dcmdjpeg.exe: jpeg decompression utility from the OFFIS package version 3.5.3. This executable is called by dgate.exe to decompress DICOM images in jpeg format if UseBuiltInDecompressor in dicom.ini is set to 0. See further dcmcjpege.exe.

### **Optional files from NATIVEMYSQL1412b.ZIP**

Libmysql.dll: When present, provides native access to MySQL, both for GUI and the server core. Redistributed because binary compatibility is required between compiled applications and the interface DLL: i.e. this file has to be of a specific version, even if it is used to communicate with MySQL databases of other versions. Comes from <http://downloads.mysql.com/archives/mysql-5.0/mysql-noinstall-5.0.22-win32.zip>

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#### 4.4 THREADING ARCHITECTURE

The MicroPACS system was designed to run in two multithreading models. The first model is "Multithreaded", the second is "Multiprocess". The Multithreaded model can best be described as a monolithic application. Each incoming DICOM association is allocated a separate thread of execution within the same memory and address space of the master process. These threads share the same code within the single (monolithic) executable. The Multiprocess model is similar to "inet" on UNIX operating systems. There is a controlling application (conquestdicomserver.exe) which handles incoming TCP/IP connections. For each connection, a new copy of the MicroPACS main executable (dgate.exe) is loaded and executed. A separate process that runs in a separate address space from all other associations handles each DICOM association.

The multithreaded application is slightly faster than the multiprocess one; But the multiprocess one is more secure, and should be more reliable. Because each process runs in it's own address space, an association from one connection cannot corrupt or undermine (in any possible way) another simultaneous association. For this reason, the default installation of the MicroPACS was the multiprocess model.

However, extensive testing of the Conquest DICOM server showed that the multiprocess version sometimes failed to work correctly on Windows (some ODBC problem). For this reason, the multithreaded version is currently used with the Conquest DICOM server. Several fixes have increased its speed and made it very reliable.

Also, the built-in DBASEIII driver applies in-memory indexing and depends on the server process staying in memory to achieve a high speed. In the Linux version, the built-in DBASEIII driver and PostGres are the only database drivers available.

## APPENDIX 1.

### Fixes, modifications and extensions of MicroPACS by Marcel van Herk and Lambert Zijp of the Conquest project:

#### DICOM.SQL (Database definition):

19980624	StudyNumber (StudyID in DICOM) is now 64 long Required for correct operation with SQL server
19990109	Made imagenumber 10 characters wide
19991222	Moved MODALITY to the series level (for DICOM-RT)
19990315	Added EchoNumber and NumberOfFrames in image table
20010830	Revision to 4, extended database significantly
20010416	Revision 5: Added patientID in series and images for more efficient querying
20010416	Revision 6: Added frame of reference UID in series table
20020519	Revision 7: Added ImageType in image table, StudyModality to 64 chars, AcqDate to SQL_C_DATE
20021028	Revision 8: Denormalized study table (add patient ID, name, birthdate) to show consistency problems. Revision 9 is a further de-normalized version that is used with the built-in DbaseIII driver.
20030319	Revision 10: Fixed width of ReceivingCoil: to 16 chars
20030907	Note: revisions 9, 11 and 12 refer to the ODBC-less version
20040402	Revision 13: Added ImageID to image database
20040905	Revision 14: Added WorkList database with HL7 tags

#### DGATE.CPP (main of DGATE.EXE):

19980327:	Disable logfile for speed and save disk
19980327:	-! Enables logging to Personal pacs console; RunServer works; -p breaks
19980327:	All printf's to systemdebug
19980320:	Integrated dumppacs code here for convenience
19980320:	Fixed -p option; SaveToDisk returns filename, printed in stats
19980320:	Documented and added print of usage (-? option)
19980404:	Added test options, ODBC config option and command line specified console pipe / udp logging
19980409:	added FileCompressMode option; use local save to disk code instead of pdu member
19980409:	Return on failed GenerateFileName in SaveToDisk
19980409:	Cleaned up NKI private compression code and allow >15 bit differences
19980410:	Added run length encoding for equal pixels to compressor; fix 3-byte case
19980415:	Cleaned up the messages; -! does not enable debug; do not enable accessupdates (use aroute)
19980618:	Some work on manual and database layout listing

- 19980621: Added -z option: zap patient
- 19980624: Comm test also produces systemdebug and long text output; added \n to some output
- 19980625: SaveDicomDataObject in loadddo.cpp supports NKI private compression
- 19980704: Added some test code for counting disk space and renaming device for patient
- 19980705: Added CACHE devices in free store check; added FindPhysicalDevice (searches for file)
- 19980709: Added archiving options: -as, -au, -ab, -ac, -ad
- 19981217: Temporary use PDU.Save... code for testing DICOM objects (does not compress)
- 19981218: Temp use Pdu.Load as well (no compression)
- 19981228: Disabled ljz's code until it has been completed
- 19990108: Reenabled ljz's code: Replace uncompressed by compressed pixeldata VR in SaveToDisk (it seemed to work anyway...)
- 19990109: Removed some commented out code; added comments for alternative load and save routines. Added Regen of specified device
- 19990110: Added n, for MAGn, as parameter in -as and -ab archiving options (default all). Use exit(1) on failure
- 19990111: Fixed exit code on -ar option
- 19990117: If the filename is \*.dcm (depends on FileNameSyntax) use uncompressed chapter 10 format
- 19990317: Added NKI-private stuff
- 19990628: Temporary enabled debug in -!nnnn option
- 19990630: Added MIRROR option; disabled debug in -!nnnn option
- 19990707: Fixed MIRROR option; added MIRROR message; added check on FindPhysicalDevice result
- 19990817: Added ability to spawn ExportConverters at the end of SaveToDisk
- 19990827: Optimized read of slices: cache a DB to pass to GetFileName (10% faster)
- 19991117: Added parameter FileCompressMode to in nki\_private\_compress call
- 20000318: Added private command object 9999, 0300 = print to console  
Added private command object 9999, 0400 = force C-Echo to be 'silent' (no log). Display C-Move Destination; print time info about threads
- 20000323: Serious fix: MainThread 'hangs' when several associations occur simultaneously, caused by compiler-optimization. Solution: DriverApp.Lock should be 'volatile'.
- 20000329: On request by ljz: designed crash of server if silent VR receives 'DEAD'
- 20000501: Compare dicom modality with UPPER-case ini-file setting (ExportConverters)
- 20000621: Initialize TroubleLogFile and UserLogFile; log C-STORE and C-MOVE
- 20000703: Logging of trouble now starts with '\*\*\*'

- 20000703: Exclude archival messages from trouble log; removed force dcm code
- 20001104: Added WINAPI to thread routines
- 20001105: Replaced malloc by new where a mix could occur (vr->data)  
Made compilable for MSC and BC and WC using some #ifdefs  
Changed order of verification and store; better localized  
new/delete DDO more
- 20001106: Run-time load odbinst routine for BC and WC, use spawn...  
i/s/o \_spawn...
- 20001106: Use delete [] operation for vr->Data
- 20010328: Added -av: verify mirror disk
- 20010415: Added DeleteSeries, DeleteStudy and DeleteImage routines  
and -f options
- 20010416: Added -f options: -feFile = enter MAGN file into DB, -fdFile =  
delete file from DB -faFile = add (also makes copy) file into  
server, -f?=ask UID of file, -fu = generate UID, -  
fcNEWPATID,file = modify patient ID of image file (moves  
file!). NOTE: -fc is irreversible in the sense that if a portion of  
a study/series is changed and changed back it winds up as a  
different study/series. This occurs because the UIDs must be  
changed for each image modification. This problem does not  
occur when a whole series or study is changed
- 20010417: Simplified code to change uids to allow easy extension to  
referenced SOPs. Check after load on common UIDs to avoid  
accepting dropped non-dicom files. NOTE: ChangeUIDinDDO  
should also change sequences and referenced SOPs  
(0008,1155)
- 20010418: Fix in above change
- 20010418: Changed names of database fields in UIDMODS - did not work  
on MsAccess
- 20010419: Added -fk option: copy image file to other patient ID (as -fc but  
no delete). Added version number 1.3.9 to command line help
- 20010429: Added -fz option: zap file from server and database
- 20010430: Some work on read ahead thread: note that thread must not use  
any pointer copy!
- 20010502: Made read ahead thread working; fixed thread counter; fix odbc  
option: strings too short
- 20020506: Fixed handle leak in read ahead thread
- 20020507: Fixed memory leak in read ahead thread; kbhit() test #ifdef  
DO\_LEAK\_DETECTION
- 20010509: Added RenameDevice is -ae option
- 20010730: Replaced parameter argv[0] of ExportConverters to proper  
value.
- 20010829: Added ExportStationName as export filter; default Export...  
value set to "\*"; Made export comparisons case insensitive;  
added special 'forward to AE' ExportConverter; Version to  
1.3.10
- 20010831: Added extended syntax for exportconverters with %f=filename,  
%m=modality, %s=stationname, %b=file base name, %p=file

- path; Also allows 'copy %f destination', but for windows NT only (uses cmd.exe). Added ExportFilter option that uses an SQL statement to filter.
- 20010901: Added a simple queue to process exportconverters asynchronously; Create a queue for each converter; queue mirror copy requests
- 20010902: Added %o = SOP; %n = newline; added the following hard coded converters: append "text" to file; write "text" to file; copy file to file; copy file to dir
- 20010904: Re-entered change of 20010730
- 20010905: Fix: After 'SaveToDisk', do not free pDDO
- 20011109: Fix: made ExportConverter stuff case insensitive  
Note: empty filter tests for empty contents - this is not the same as '\*'
- 20011110: Note: in release 1.3.10, the " to " in e.g., write "%f%n" to file must be lowercase
- 20011115: Made " to" case insensitive; Added \*\*\* before some error messages for better logging. Removed cache db: would hang the server if SQL has gone down and up. Now use one DB per thread which is passed to the read ahead thread = fast too!
- 20011207: Added extra errormessage when creation of datasource fails
- 20020109: Disabled this code for watcom or borland (instead of run-time loading an address)
- 20020314: Implemented ignore of C-CANCEL request for ADAC NM (was error before). Blocked out SQLInstallerError call; does not compile on clinical MS4.2
- 20020413: Added some notes about thread safety and db's: The serverchild is not thread safe when reading and writing is done on the same association.
- 20020415: Added -atDEVICE option: sanity check of images on disk; version to 1.3.11
- 20020416: Made UID generator configurable through UIDPrefix in dicom.ini; made time print unsigned
- 20020422: Sleazy fix of ModifyPatID: time(null) created same UID: now wait 1 s per changed file
- 20020426: Generate filename no longer gives an error: is done at higher level
- 20020428: Only serious error messages use \*\*\* in message
- 20020428: Added FAILSAFE\_STORAGE: tries to save incoming files even when DB errors occur
- 20020429: Put SaveToDisk in myUnknownStorage: pass DB failures to caller; Disabled FAILSAFE\_STORAGE: any storage failures should now be detected by client
- 20020508: Do not rewrite image not on MAG but it is not an error (warning is generated earlier)
- 20020520: Added -gSERVER,DATE option: grab images on date from remote server
- 20020521: fix displaying junk filename when rewriting image not on MAG

- 20020522: Fix in SetStringVR: strings must be padded with a space
- 20020529: -i and -r now have mode parameter (0=normal and default, 1=simple, e.g., for DBASEIII)
- 20020531: In 'QualifyOn', support case-sensitive call to 'GetACRNema', but make AE-Title uppercase after retrieving IP and port.
- 20020613: Better handling of Compression ON/OFF in 'SaveToDisk'
- 20020613: Fixed crash in DeleteImageFile (twice free of VR->Data)
- 20020613: compress to specified mode, check (de)compress result, decompresses data before forward; added 'export compressed to AE' export; -fa has optional ,NEWPATID syntax;
- 20020802: Simplified rmdir code and allow multiple subdirectories in rmdir and mkdir code. Version to 1.3.12 (unreleased)
- 20020804: Use PATHSEPCHAR where possible
- 20020807: Changed SaveToDisk order: only make patientdir when DB save succeeded
- 20020812: Added skeleton of printer support
- 20020816: Added color imagebox; Save incoming print DDO as file
- 20020819: UIDs of imageboxes end on rows.cols.position for easy print handling
- 20020819: Fix in delete unexistent mirror files for changepatientUID
- 20020819: Extract pixel data from sequence in ImageBox; added sleep(10) in -fk option
- 20020819: Added better UID generation (but gets close to 64 chars)
- 20020821: Fix printer UID generation; display page orientation and film #; shorter info
- 20021016: Added (indexed) patid to exportfilter query and getfilename for speed; The option tests for rev5 db or higher; increase 64 strings to 66; Note: GrabImagesFromServer option does not yet pass patid to the query (i.e., will be slow with non-odbc driver)
- 20021017: Control NeedPack from here; added -c option: set UID counter at startup. Removed Sleep from anonimize options; do not re-create UIDMODS
- 20021018: Pass NoKill through GenerateFilename for interactive DGATE
- 20021028: Fix query on study in PatientStudyOnlyQuery (did an image query)
- 20021105: Revamped read-ahead thread logic to try fix rare crash where ratd->DDOOutPtr became NULL
- 20021115: Use Generic style retrieve classes with NKIqrsop code instead of older qrsop code. Advantages: read ahead thread used, and allows print of error messages from C-MOVE. Required changes such that ratd->pcdo can be NULL.
- 20021121: Disabled read-ahead thread for time being
- 20021212: Also loop ServerApp.Server(Port) in threaded mode server
- 20021213: Re-entered fix by Hanne Kooy: compressed forwarding had extra ;
- 20021213: Re-enabled use of generic query classes with read-ahead thread; but made read-ahead thread configurable with "EnableReadAheadThread". Made grab query faster by including date - note grab is independent of FixPhilips

- 20021215: Found read-ahead thread problem reported by Aaron Cann - missing Sleep in wait for slices
- 20021223: Version to 1.4.1 pre-release; added in dgatefn forbidden filename chars suggest by Thomas Buerer
- 20030113: Removed loop ServerApp.Server(Port): gave endless loop error messages
- 20030120: Added cleanup-code when DO\_LEAK\_DETECTION is defined for easy leak checking
- 20030205: Fix bug found by Frank-Andre Siebert: read ahead thread crashed when ID or SOP is missing. Also fix 2 other potential missing VR problems
- 20030228: Fixed bug reported by Jeff Babcock: series retrieve from E-film crashed (patid not passed)
- 20030424: Changed calls to obsolete PDU.Write(&DDO). In 'SaveToDisk' the call to PDU.SaveDICOMDataObject now has parameter DICOM\_CHAPTER\_10\_EXPLICIT (which writes IMPLICIT files if not compressed)
- 20030606: Fixed incremental counter when creating UIDs or generating filenames Fix: QueryRetrieveLevel is mandatory for a QueryResponse
- 20030625: Fix NGET of BasicPrinterSOPClass
- 20030625: Fix in above fix
- 20030627: Adapted for MSC4.2; Finally really fix NGET of BasicPrinterSOPClass (wrong UID used)
- 20030629: Added -nd, -nc, -jd and -jc options: (de)compress NKI; (de)compress JPEG (used OFFIS executables)
- 20030630: Started on compression for dropped, incoming, transmitted; NKI vr 0x9999,0x700=custom compression. Added 'forward compressed as xx to ...'
- 20030701: QualifyOn now also has compression parameter
- 20030703: Moved compression code to nkiqrsop; dgate -j-xx and -j\*xx = test compression options. Removed "forward compressed to" because "forward compressed as .. to" is better. Note that FileCompressMode is now obsolete. KNOWN BUG: JPEG compressed images may be rewritten as V2 (when written originally as NKI) which are then not correctly read.
- 20030704: Made that FileCompressMode parameter still works even though is obsolete. Moved faulty delete DDO after SOPUnknownStorage.Read
- 20030705: Added check of Transfer Syntax next to extension for save type; ProcessDDO takes \*\*DDO
- 20030706: Use dgate.dic; Attach VRType to PDU's for implicit little endian support; small fix in dump code
- 20030709: Printer support fix; version to 1.4.2; Added SendUpperCaseAE parameter (default 0)
- 20030730: Force ImplicitLittleEndian, ExplicitLittleEndian and ExplicitBigEndian objects that must be stored in Chapter10 format, to ImplicitLittleEndian.
- 20030815: Version to 1.4.3

- 20030905: Allow longer filenames
- 20030910: Added check on rights to write (trouble) log file and printer\_files in MAG0
- 20030921: Allow write to any MIRROR if MAG is full; added -ff# option: delete until # MB free
- 20030922: Added StorageFailedErrorCode (default 0x110 = 272 decimal = failed processing)  
Added ExportCallingAE and ExportCalledAE export filters (also %u=SCU, %c=calledAE in converter)
- 20030401: Version to 1.4.4; pass status pointer to compress routines
- 20040402: Delete DDOptr when SaveToDisk cannot write but does not give an error; Added "Cannot rewrite jpeg/rle image in v2 format" check; Use system DSN for ODBC (easier login)
- 20040406: Always use EXPLICIT syntax for jpeg, fix v2 always use DUMP
- 20040426: Version to 1.4.4a
- 20040520: Version to 1.4.4b
- 20040523: Added patient ID to speed GetFileName for single slice move
- 20040528: Set NeedPack (controls DbaseIII indexing) for regen, archive, maintenance; Version to 1.4.4c
- 20040528: Added built-in maintenance commands through silent VR in ECHO; pass patid in DeleteImageFile
- 20040530: extract (DBF only) to database like XDicomImages in same directory; Version to 1.4.5
- 20040601: Added deletestudy, deleteseries and packdbf maintenance commands
- 20040602: Fix: 'forward compressed as' always failed
- 20040605: packdbf maintenance command sets NeedPack to 3: forces pack
- 20040606: fix rewrite to not MAG (JUKEBOX) was NOT ignored
- 20040607: Merged fix ljz 20040602; do not allow rename and delete with empty name
- 20040610: Added maintenance server tasks for archival and regeneration
- 20040612: Added indexdbf maintenance server task
- 20040614: dgate command line maintenance options use NeedPack=5: non-threaded index generation. Added -am option: move(all) device data; for selected data use -amMAG0.Archiving,MAG1
- 20040624: Version to 1.4.5a
- 20040626: Pass study and series UID to getfilename; version to 1.4.5b; Fixed leak of pats array
- 20040713: Version to 1.4.6
- 20040805: Fix in C-MOVE for single file (from jlz); version to 1.4.6b
- 20040909: Increased length of ExportFilter (was 64, now 510)
- 20041020: Added mergeseries(file) and mergestudy(file) maintenance commands, silenttext to 1024
- 20041101: Added deletesopfromdb maintenance command; version to 1.4.7
- 20041103: called, e.g., AE~nj overrides IncomingCompression to nj

- 20041108: Added \$c test compression mode (alt-drop files with \$c as patient ID tests compression modes)
- 20041109: Added \$tSERVER test compressed forward; some fixes in forward compressed to (server name read wrong)  
\$s tests all filename syntaxes
- 20041112: Added \$rN N times repeated entry test, and \$tN which enters image N time each on its own thread
- 20041128: Added -^file: log to file (timestamped) instead of to server console; -#file: same with debug
- 20041129: Added silent commands debuglog\_on and log\_on to set logging to UDP or file; Added silent command read\_amac to re-read acrnema.map without restarting the server
- 20050102: Small modifications to allow compile through total.cxx
- 20050107: Added code to hold and retry queued forwards and mirror copies when failed: After failed export/copy, start storing entries in file ExportFailuresN (CopyFailures). If a new export/copy is requested >1 minute after last failed one, try again; if queue is empty, >100 seconds after last fail, try export/copy stored ones. Processing queued entries has priority over processing stored entries.
- 20050107: Version to 1.4.8; modifications for linux compile
- 20050108: Added server PORT# to fail files, so that multiple servers on different ports do not share files
- 20050109: Added configurable TCPIPTimeOut, FailHoldOff, RetryDelay and QueueSize
- 20050109: Adapted thread code for linux; still need to implement WaitForSingleObject
- 20050111: Added ctype.h (for mingw)
- 20050118: Linux: crudely implemented WaitForSingleObject; detach pthreads to avoid leaks; crudely implemented export converter apps
- 20050119: Added grabimagesfromserver, regendir and makespace server commands; dgate -- sends server commands to other running server; adapted manual
- 20050121: Small updates to manual
- 20050124: Replaced BackgroundExec with simpler system() for Linux; added query server command, e.g., dgate "-- query:DICOMpatients|patientid,patientname,patientsex|patients ex='F'%"s %s %s|t.t"; Added read\_ini: server command to reread dicom.ini; changes most config except: TCPPort (busy), UseBuiltInDecompressor (cached) and FileNameSyntax (cached)
- 20050130: added get\_param, get\_freestore, get\_amac, get\_sqldef that respond through echo-response; also: get\_sop, get\_transfer, get\_application, get\_localae, get\_remoteae, get\_dic, forward. added: dump\_header (to file), convert\_to\_gif (to file); adapted query (to file) where file="cgi" for stdout in cgi/mime mode, file="" to send to stdout as is; most GUI commands can now pass PatientID|SOPInstanceUID instead of filename of dicom

- object; added put\_amap, write\_amap, put\_sop, put\_transfer, put\_application, put\_localae, put\_remoteae, put\_param. Note: get/put\_param work through disk (read\_ini activates), get/put\_amap through memory (write\_amap writes to disk), get/put\_sop etc read from memory and write to mem and disk.
- 20050204: Added delete\_param, delete\_amap and fix cgi out (double \n)
- 20050204: most GUI commands can now pass PatientID|?\*:SOPInstanceUID; added delete sop etc commands  
More fixes in cgi data passing VR vr() is mostly wrong; use VR \*vr=new VR()
- 20050205: Allow up to 16 output fields in query:, repeat queried fields over all 16 outputs. Added counters for server status; start on display\_status server command
- 20050206: More work at display\_status, renamed testtable to xtesttable: default not opened. Access ObjectFile and DeviceName through query instead of with GetFileName up to 3 x faster!! Also fixes potential leak in read ahead thread: pats, series and studies not always freed. Allow up to 32 cgi query outputs, tidied dump layout, start on web interface (put dgate and ini in cgi-bin)
- 20050207: Added query2 option: limits number of output rows as asked; gui command not counted as association. Some more work for web interface
- 20050210: Adapted web interface queries such that they run on sql server
- 20050212: Removed need for thread local storage; automatically adapt dgate extension in cgi scripts depending in OS
- 20050213: Added more parameters to server configuration web page
- 20050214: Added update button to server config (updateconfig page to be implemented)
- 20050215: Fix in LoadForGUI: Drag 'n' drop of files in the server did not work anymore. Fixed dgate crash in case of failure in 'recompress()' (pDDO=NULL when OFFIS failes). Merged
- 20050327: Added rudimentary gz unzip support for dropped files (uses 7za.exe)
- 20050401: Start on Modality WorkList Support
- 20050404: List End/Start sequence db types (only supported for worklist)
- 20050411: Fix incorrect space after filename and device in C-MOVE internal query
- 20050414: Added addrecord server command: for now only option to enter worklist entries
- 20050603: Fix servercommand query(2) for empty where part
- 20050825: Fix web interface queries for sql server (were OK for dbase)
- 20050826: More work on web interface and added worklist there; deleterecord command
- 20050827: Fixes in addrecord and query commands, editworklist,saveworklist,deleteworklist
- 20050829: More fixes in web interface, disable caching for most/all? of it
- 20050831: Allow command line length of up to 4096, allow edit all worklist database fields

- 20050901: Removed invalid cache-control: cache; added WorkListMode:0= off, 1=optional, 2=compulsory
- 20050902: Read db config for worklist edit page in web interface; use generic webpages for db edit. Added HL7Tag in DumpDD
- 20050903: Added 'simple' loadhl7: server task implementation and HL7->DICOM translation. Also addimagefile will enter HL7 files into the server, i.e., drag and drop works
- 20050904: Fix some web queries for sql server with denormalized tables  
Some more tweaks to hl7 code; max query formats to 48; max format to 8192
- 20050905: Auto split HL7 subfields and repeats without using a list
- 20050907: Merged change by Hans-Peter Hellemann: fixes extension problem for linux web interface for some browsers
- 20050908: Protect convert\_to\_gif when file not found
- 20051121: Recompute SQLResultLength because it does not work in PostGres BindField
- 20051123: put in #ifdef POSTGRES
- 20051208: put in #if 0 (fixed in odbci.cpp); start on virtual server: will grab images from other server as needed in read-ahead thread: when in db but not on disk; for now use R.A.T also for single image access to avoid code duplication
- 20051209: Start on virtual query: image (!) query is passed to other server, results populate db
- 20051210: Added "vX" incomingcompression (stores dbf but not image; forwarding disabled). Added virtual queries on all queries and moves: now works as transparant file cache. Added VirtualServerFor0..9 configuration entries: server merges own data with these AE's. Added CacheVirtualData control; if set data not deleted after use (db kept for now)
- 20051211: Fix: override query level in virtual query
- 20051212: Store virtual server # in device; saved on query, used when retrieving, stripped when storing
- 20051214: Use different sleep lenghts under linux - not all sleep(0); small fix in virtual server
- 20051215: Implemented a linux version of Sleep using nanosleep
- 20051217: Use new VR::ReAlloc method to replace data in VR; added quit: command
- 20051218: Use ReplaceVR instead of Push in anonymize etc; also changes in sequences. Version to 1.4.10; show version and exe date in startup log. Do not start mirror copy queue unless it is needed; show some thread startup info. Added -b = NOTHREAD: run server as single process, useful for debugging and profiling. Fixed doc of --regendir: command
- 20051219: Fixed several small leaks - as tested with Linux malloc\_stats
- 20051222: Started on bypass server for virtual query - not functional yet (cleanup required)
- 20051228: Removed debugVR logic: errors should now list DCO  
Fix virtual device logic for VirtualServerFor0;

- Cleanup vr's and duplicates when bypassing server for virtual query, seems functional
- 20051229: NonDestructiveDumpDICOMObject now also list sequences; DebugLevel>0 lists DCO, >1 lists query DDO; fixed leaks in virtual query and some others
- 20051230: Added --debuglevel: command, small fix in NonDestructiveDumpDICOMObject
- 20060103: Small fix in virtual query; disabled virtual query for worklist; debuglevel 3 shows some query results
- 20060123: Added patient/study/seriesfinder (server parameter ignored for now, later for virtual servers etc)
- 20060125: Added serieslister (server parameter ignored for now, later for virtual servers etc)
- 20060128: Renamed to imagelister, added serieslister
- 20060131: Sort filenames from imagelister on ImageNumber (0020,0013)
- 20060226: Version to 1.4.11
- 20060228: Small fix in isxdigit thanks to ljz
- 20060311: Use ReplaceVR in virtual query - level was sent twice (thanks David Lang)  
Added WEBReadOnly flag
- 20060317: Support calledae and callingae in filenamesyntax - for virtualquery called is always MYACRNEMA
- 20060324: Strip group 2 from outgoing c-stores if not compression "as" or "is"
- 20060328: Improved forwarder, always propose Verification and use IsAbstractSyntaxAccepted(iUID) to test if host accepts image
- 20060402: Fix hang condition when a file failed to read in the read-ahead thread
- 20060402: Do not remove transfer syntax prior to dcmdjpeg/dcmjpeg (here in test recompress only)
- 20060405: Tried fix for multiple moves on same assoc (thanks Andrej Savelov)
- 20060405: Added message when IOD fails to read
- 20060603: Fix crash when started as dgate -v: empty statbuf
- 20060607: Finally fixed multiple moves on same assoc (thanks Andrej Savelov and Fred Röhner)
- 20060618: Renamed dfilecopy and define ODBC\_ADD\_SYS\_DSN if needed
- 20060619: Set version to 1.4.12alpha1
- 20060621: Added clonedb: command; transfer FULL db from other server to this one using virtualquery
- 20060628: AddToDatabase has JustAdd parameter: skip one unnecessary query
- 20060701: Speeded filter string handling
- 20060702: Pass DB to GenerateFilename to avoid zillions of db open and closes
- 20060704: Print number of records found in all queries
- 20060708: Set version to 1.4.12alpha

- 20061126: Moved servertask temporary files to MAG0/printer\_files;  
protected query: and query2 against empty input
- 20061126: Experimental forwarding on same association: close unused  
association after 5 seconds. Clean collected sopclasses after one  
hour of inactivity.  
Note 1: there is a problem with AReleaseRQ: do not use in this  
task  
Note 2: maximal 20 forwarders have a remaining association
- 20061127: Added ForwardAssociationLevel (PATIENT, SERIES,  
STUDY, IMAGE, SOPCLASS; default STUDY),  
ForwardAssociationRefreshDelay (default 3600 s), and  
ForwardAssociationCloseDelay (default 5 s).  
Limit maximum number of ExportConverters to  
MAXExportConverters=20 (for static arrays used in  
forwarders). Forwarders keep association open as long as UID  
at ForwardAssociationLevel does not change. Show filename in  
forward log; document where fixkodak should operate for  
virtual queries
- 20061128: Added ForwardAssociationLevel GLOBAL: use association  
until timeout or incompatible  
Close ForwardAssociation after send when  
ForwardAssociationLevel is IMAGE
- 20061129: VirtualServerForN may be "server, FIXKODAK" to clean  
queries (add 0) and their response (remove 0)  
Hardcoded filters for exportconverters (modality, called,  
calling, station) can now match e.g., RT\*
- 20061130: Pass series and study in virtualserver outgoing c-move
- 20061213: Fixed nasty bug in query2 and TestFilter: Query without  
bindfield overwrites previous bound strings!  
Maybe was problem causing crash on linux with query2: and  
problem with option -g reportedly stopping incorrectly
- 20061219: Version to 1.4.12
- 20061231: Added ForwardAssociationRelease to allow testing reconnect  
problem (default 0 = just hangup)
- 20070103: FixKodak blocks \*xxxx wildcard virtual queries on date (not  
allowed in Kodak)
- 20070103: Version to 1.4.12b; start on ImportConverters e.g., <set  
0008,1040 to "%V0008,0080">
- 20070104: ImportConverters %QP %QS %QE %QW; <destroy> <delete  
xxxx,yyyy> <save to filename>  
Added %% and %i to Export and Import converters
- 20070105: <set 0008,1040 if "...">, <setifempty 0008,1040 to "...">,  
<setifempty 0008,1040 if "...">  
Import/export converters only report when syntax OK and  
report when action is void  
Added %Vxxxx,yyyy to export converters and %d(date/time)  
to import and export converters  
An import/export converter can thus be used to extensively log  
incoming images

- Added import converters: <stop>, <if "string">, <ifempty "string">, <nop> (also export)  
 Added general purpose variables x, y, z (read as %x, %y, %z) to import converters  
 Definition of number of ImportConverters now unnecessary.  
 Note: importconverter and exportconverter strings may be changed run-time in dicom.ini
- 20070105: Some fixes in dgate --archiving options manual; fixed dgate --restoremagflags:
- 20070107: Fix web access broken by change in odbci for dbaseIII; query must now always include spaces around =
- 20070113: Do not store NKI compressed data in v2 format: decompress and give error message  
 Recompress to NKI format now enables StripGroup2; Tested with \$c server debug command
- 20070117: Allow multiple rules per Export or ImportConverter separated by ; and zero or more spaces  
 <nop> statement prints itself on console: useful for logging anything that follows
- 20070117: Now maintain multiple connections per ExportConverter line (max 20x20 forwards)  
 Added <stop>, <silentstop>, <if> and <ifempty> to ExportConverters; but they only affect single rule (while these would cross over to the subsequent rules in ImportConverters)
- 20070122: Now also show free space on mirror devices
- 20070123: Fixed TestFilter for patientid with '
- 20070125: Removed <if> and added <ifnotempty>, <ifequal>, <ifnotequal>, <ifmatch>, <ifnotmatch>, <ifnumequal>, <ifnumnotequal>, <ifnumgreater>, <ifnumless> as im/exportconverters  
 Added %xxx[first,last] substring operator; and protect it against overrange  
 <ifxxx> no longer crosses over importconverters; added { } block for im/exportconverters  
 E.g.: ifequal "%V0008,0020[0,3]", "2004"; { forward to CONQUESTSRV3; forward to CONQUESTSRV4; } nop test  
 Note: 1) all (also ifxxxx) statements end with ; 2) statements may begin with { or };  
 3) extra spaces only allowed after ;{ } and single space after ,
- 20070127: Fix { } in exportconverters. Release 1.4.12b to fix more or less critical odbci error
- 20070131: Fix in TestFilter (quotes double); Version to 1.4.12c
- 20070201: Added <storage MAGn> import converter: sets device to store this (new) image to (default MAG0). Fixed importconverters stop and destroy: did not break current line

### **DGATE.HPP (part of DGATE.EXE):**

- 19980705: Added CACHEDevices and JUKEBOXDevices, FindPhysicalDevice
- 19990108: Added LoadImplicitLittleEndianFile and NKI PrivateCompression algorithms
- 19990109: Regen has extra parameter
- 19990317: Changed parameters of LoadImplicitLittleEndianFile
- 19991117: Added parameter FileCompressMode to prototype of nki\_private\_compress
- 20000629: Added TroubleLogFile and UserLogFile
- 20010415: Added KeepImages flag to RemoveFromPacs: clear from DB only Added SubDir parameter to regen to allow regen of one directory only
- 20010416: Added ChangeUID routine and RegenFile - to allow modification of images
- 20010429: Changed decompressor: now has extra parameter
- 20020529: InitializeTables now has mode parameter (0=normal, 1=simple)
- 20021018: GenerateFileName has NoKill option (for interactive dgate tasks)
- 20030120: Added prototype of FreeDeviceTables
- 20030701: compression parameter for amap
- 20030703: Added prototypes of recompression functions + ArchiveCompression
- 20030706: Optional filename parameter for recompress
- 20030706: Export VRType for implicit little endian support
- 20030921: Added DEVICE\_TYPE\_MIRROR
- 20040401: Added Changed and ActualMode flags to compress routines
- 20040626: Added study and series UID to getfilename interface
- 20040930: Adapted return type of SetString; added maxlen to BuildSearchString
- 20041013: Added MAXQUERYLENGTH
- 20041029: Added MergeUIDs
- 20041108: Added Syntax input to GenerateFileName
- 20050108: Adapted for linux compile
- 20050109: Added configurable TCPIPTimeOut
- 20050129: Added optional FILE to DumpVR, added CheckFreeStoreOnMIRRORDevice
- 20050401: Added QueryOnModalityWorkList, WorkListTableName, WorkListDB
- 20050404: Added DT\_START/ENDSEQUENCE to code sequence in WorkList table
- 20050902: Made space for HL7Tag in DBEntry
- 20051229: Added iDepth to DumpVR
- 20060317: Added called and calling to GenerateFilename
- 20060324: Added StripGroup2 option to recompress
- 20060628: AddToDatabase has JustAdd parameter: skip one unnecessary query
- 20060702: Pass DB to GenerateFilename to avoid zillions of db open and closes
- 20070122: Added MIRRORDevices

20070201: Added DebugLevel

### **LOADDDO.CPP (part of DGATE.EXE):**

19980409: added NKI private decompression engine VR 0x7fdf,0x0010  
 19980410: added run length encoding of zero differences  
 19980410: Fix 16 bit absolute value decode  
 19980415: Fix leak on decompress  
 19980625: Added compression in SaveDicomDataObject(C10)  
 19980703: Made DObjectSerialize thread save (removed statics)  
 19990105: Fix: SaveDICOMDataObjectC10 created VR 0x0002 0x0013 twice. Added comment in SaveDICOMDataObjectC10; CleanUp. Put the nki-routines also in dgate.hpp. Added LoadImplicitLittleEndianFile  
 19990317: Decompression removed from LoadImplicitLittleEndianFile; added a VR-sizelimit of that reader  
 19990827: NOTE: LoadImplicitLittleEndianFile allocates 100 MB and crashes when passing chapter 10 file (happens when extension is wrongly .v2)  
 19990830: Fixed problem above: 'LoadImplicitLittleEndianFile' uses 'PDU.LoadDICOMDataObject' in such cases.  
 19991117: Added parameter FileCompressMode to in nki\_private\_compress call  
 20000629: Logging of trouble now starts with '\*\*\*'  
 20001104: Renamed \_LittleEndianUID to \_LittleEndianUID\_space  
 20001105: Fixed where malloc and new were mixed (vr->data)  
 20001106: Use delete [] operation for vr->Data  
 20001128: Fix in 'Implicit length' code in LoadImplicitLittleEndian  
 20010429: Use faster and safer decompressor  
 20020412: Added class CBufferedIO for faster reading from DVD (stream functions do not seem to be caching.)  
 20020415: Removed diagnostic time code (did not compile on ms4.2). Made buffer size dependent on iVrSizelimit (i.e, use smaller for regen, slightly faster)  
 20030706: Attach VRType to PDU's for implicit little endian support  
 20041130: Documented crash on win2000 server in code - remains to be fixed – rare crash related to read error of DVD  
 20050107: Adapted for linux compile  
 20051219: Use ReAlloc instead of new BYTE[] to fill VR data

### **DGATEFN.CPP (part of DGATE.EXE):**

19980326: changed file name generator to ensure correct sorting of image files by external applications  
 19980327: Added FileNameSyntax option in dicom.ini; 0=original, 1=allow sorting by name  
 19980407: avoid /;<>| in filename; for Philips: allow up to 9999 series and 999999 slices  
 19980409: do not free passed DDOPtr on failure: crashed the lot

- 19980415: Error messages to operatorconsole
- 19980620: Check error flag from GetDevice (for out of disk message)
- 19981005: Added FileNameSyntax 2: filename starts with SeriesUID\_
- 19981005: Replaced size%64 by min(size, 63) for correct truncation
- 19981217: FileNameSyntax 3: same as 2 but accept errors
- 19981220: Fixed FileNameSyntax code
- 19990117: FileNameSyntax 4: same as 3 but .dcm extension (forces ch10 format)
- 19990117: Avoid attempts to rewrite image that is not on MAG store (e.g., on CD)
- 19990315: Do not allow '.' in directory name. In Syntax 3 directory name is now patient ID only (better for ACRVIEW). Better unique filenames by using time + counter.
- 20000127: FileNameSyntax 4 now does not truncate patid, as 3 already did
- 20000131: FileNameSyntax 4 has patient ID only as directory name (same as 3)
- 20000701: Added MaxFileNameLenght option: truncates from start
- 20010419: FileNameSyntax 5 on request of Jason Foster - uses patientname as dir
- 20011109: Made MAG name check case insensitive
- 20020416: Made filename counter 4 digits for when writing >100 files/s
- 20020416: Made all instances of time() unsigned
- 20020426: Cannot rewrite image not on MAG store is now a message without \*\*\*
- 20020508: The above message will not lead to a fail of GenerateFileName
- 20020802: Added FileNameSyntaxes 6..9; cleaned FileNameSyntax code a bit
- 20020804: Truncate patient ID to 32 chars for mode 6 and 8 (make sure len<255)
- 20021016: Pass indexed patid to GetFilename for speed
- 20021018: GenerateFileName has NoKill option (for interactive dgate tasks)
- 20021223: Added forbidden chars \*, ?, " and : (comment from Thomas Buerer)
- 20030401: Ovrerrule '.v2' filenames with '.dcm' when object is not ImplicitLittleEndian
- 20030522: Replaced 'static int counter' by 'unsigned int gl\_iCounter'
- 20030606: Fixed incremental counter when creating UIDs or generating filenames
- 20030730: Overrule v2 only when not ImplicitLittleEndian, ExplicitLittleEndian ExplicitBigEndian (c.f. 20020401)
- 20030819: Allow longer filenames
- 20030921: Added DEVICE\_TYPE\_MIRROR TO GetDevice call
- 20040129: Added FileNameSyntax 10 = all files in one directory
- 20040301: Small fix for FileNameSyntax 10
- 20041108: Added Syntax input to GenerateFileName (overrides ini setting)
- 20050107: Adapted for linux compile
- 20050126: FileNameSyntax 11: StudyUID\SeriesUID\SOPUID.dcm

- 20050131: Changed root to 'name' for FileNameSyntax 11
- 20051210: Clear root output string when image already in database
- 20060312: FileNameSyntax 12: similar to 11 but uses Modality\_StudyID as dir
- 20060312: Checked it:  
12=name\_ID\Modality\_StudyID\SeriesUID\SOPUID.dcm
- 20060314: 12=name\_ID\Modality\_StudyID\SeriesID\SOPUID.dcm
- 20060314: new filenamesyntax,  
e.g., %name\_%id%\%modality\_%studyid%\%seriesid%\sopuid.dcm
- 20060317: Added calledae and callingae to GenerateFilename flexible syntax
- 20060325: imagenum is image number as text, fix imageid, accept all errors
- 20060402: Fix potential problem when patient ID not there
- 20060701: Speeded string handling in new filenamesyntax
- 20060702: Pass DB to GenerateFilename to avoid zillions of db open and closes
- 20070125: Fix %modality; add %studydate and substring (year = %studydate[0,3])

#### **DEVICE.CPP (part of DGATE.EXE):**

- 19980620: Setting MAGDeviceThreshHold to 0 causes out of disk error below 10 MB without cleanup
- 19980620: Implemented PanicKillOff thread here as alternative to spawning killer.exe
- 19980702: Started support functions for maintaining/determining amount of used space on device
- 19980704: NOTE: JukeBox code only TruncateFieldNames compatible for now; used mp's filecopy
- 19980709: Finished first version of archive options: prepare, undo, copy, compare, delete
- 19980721: Set default # cache and jukebox devices to 0
- 19990110: Made strings longer since got truncated, fixed some messages
- 19990110: Archive one MAG device or MAG?; fixed SQL syntax for update; speeded 0x7fffffff. Return False if SelectLRUForarchival selects no data
- 19990111: Reset archive flag reports to operator console; protected against illegal device#
- 19990113: Run up to 10 patient further to try and fill CD more exact; max patients = 10000
- 19990114: Added quick routine MakeListOfPatientsOnDevice and used instead of 0x7fffffff
- 19990117: Accept any, not only \*.v2, for computing patient size, assume max file size=30 Mb
- 19990630: Added support for MIRROR devices (e.g., try MIRROR1 if MAG1 fails)
- 19990707: Fixed default MIRRORDevices (now 0)

- 19990708: NOTE: archiving should make use of mirror device if required as well!
- 19990712: Fixed that MagRampage thread was started over and over again (fixed for WIN32 only)
- 19990831: Fix: Several BOOL functions returned -1, which is TRUE !!
- 20000621: Changed layout of this update-history
- 20000629: Logging of trouble now starts with '\*\*\*'
- 20001104: Fixed aDB.Close -> should be aDB.Close(); added WINAPI to MagRampage thread
- 20010328 Added verify mirror disk
- 20010329 DeleteBunchAfterBurning also deletes data on MIRROR0 if it exists; verify mirror disk keeps on going after error but does return error
- 20010312 Check if we already selected some patients for archiving from the device
- 20010509 Added RenameDevice
- 20010522 Do not call RestoreMagFlags if something goes in wrong in PrepareBunchForBurning
- 20011114 Replaced slow updates for magdevice by much faster ones. The update that now no longer has the IN part might not work for ACCESS or DBF. So: for jukebox purposes, SQL server is required
- 20011115 Replaced 'LIKE' by faster '=' in query strings; fixed previous fix
- 20020412 PanicKilloff will delete now delete 5 MB data at a time. (high water = low water + 5)
- 20020415 Added TestImages: sanity check of images on disk
- 20020416 Reversed read order for TestImages and VerifyMirrorDisk: MRU first
- 20020802 Allow multiple subdirectories in rmdir and mkdir code
- 20020804 Cleaned up a bit
- 20021018 GenerateFileName has NoKill option (for interactive dgate tasks); moved ALERT warning
- 20021020 Simplified and speeded queries for archiving using ImagePat field (requires rev5+ of db); Removed " and added [ in MakeSafeString; hand-code one query for built-in dbase driver; Changed SQL construct in SelectLRUForArchival for compatibility with built-in driver
- 20030120 Added FreeDeviceTables
- 20030702 Start on ArchiveCompression; for now KB is specified - before!- compression
- 20030705 Replaced ProcessDDO by more correct DecompressNKI to check pixel data
- 20030706 Attach VRType to PDU's for implicit little endian support
- 20030724 Fix in GetKBUsedForPatient: missing %s in printf
- 20030819 Allow longer filenames
- 20030905 Allow longer filenames when reading device paths
- 20030921 Added DEVICE\_TYPE\_MIRROR in GetDevice; allow PanicKillOff to be called with variable threshold

- 20031217 Fix: Support harddisks bigger than 2 GigaByte!!! in CalcMegsOnDevice (Thanks to Clifford Sweet)
- 20040403 Moved ArchiveCompression to SelectLRUForArchival -> fills disks correctly
- 20040614 Added MoveDataToDevice
- 20050107 Adapted for linux compile (no threads yet, no check of disk space on device)
- 20050109 Added threads for linux
- 20050118 Detach thread after starting it to avoid leaks
- 20050119 GetKBUsedOnDevice is not used --> no problem to return -1 under linux
- 20050414 Fix CalcMegsOnDevice for relative path
- 20050421 Fix: MAGThreshHold is space for largest file != space for cleanup. Now set to 30 MB independent of MAGDeviceThreshHold
- 20050901 Fix free space check for unc paths (error counting \)
- 20060311 When GetDiskFreeSpaceEx fails allow storing data anyway (fix for Marius Petruc)
- 20061213 Fixed nasty bug in MakeListOfPatientsOnDevice: Query without bindfield overwrites previous bound strings!

#### **DBSQL.CPP (part of DGATE.EXE):**

- 19980321: Changed ObjectFile and DeviceName field length to 250 for dbf compatibility
- 19980321: Added define TRUNCATEFIELDNAMES for DBF compatibility (apply in makefile)
- 19980322: Added run-time check on DbaseIII (should also be added in parse.cpp somehow)
- 19980325: Added TruncateFieldNames entry in dicom.ini to allow DBF compatibility
- 19980327: Made MaxFieldLength configurable
- 19980327: Set default event notification to UDP (for personal pacs)
- 19980407: Added FileCompressMode config
- 19980409: Check vr!=NULL in MakeSafeString, MakeSafeDate
- 19990630: Remove also files from MIRROR disks
- 19990707: Added UpdateOrAddToTable to refresh database contents without first removing
- 19990707: Cache Updates; and AccessTime with ~31 to allow update times to be the same
- 19990707 Added fix for Philips PATID; fix cleaning of MIRROR device
- 19990708 Added (and disabled) stress code for SQL server
- 19990712 Fixed FIX\_PHILIPS; atoi failed sometimes because vr->data not zero terminated
- 19990827 Added creation of key and link indices
- 19991117 Added a check on ini-file value of FileCompressMode
- 20000621 Changed layout of this update-history. Fix: In 'SetString', type DT\_UINT32 was treated as DT\_UINT16 Added TroubleLogFile and UserLogFile

- When updating PatientRecord, verify the new Name and BirthDate
- 20000629 Logging of trouble now starts with '\*\*\*\*'
- 20000701 Remove \*all\* trailing spaces in MakeSafeString before enters database
- 20000703 Merged changes: made patient change verification table and record name independent and extended to other databases as well; removed trailing before comparison; show patid on all error messages
- 20000705 refuse inconsistent update of link: show error on operatorconsole
- 20000707 fixed above addition
- 20001104 Replaced \_rmdir by equally valid rmdir
- 20001106 Use delete [] operation for vr->Data
- 20001128 Fix: protected 'GetFileName' with a critical section.
- 20010415 Added KeepImages flag to RemoveFromPacs: clear from DB only
- 20010416 Added ChangeUID routine and UIDMODS table - to allow modification of images
- 20010418 Changed names of database fields in UIDMODS - did not work on msaccess
- 20010429 Renamed genuid routine and variables to allow compile in one big file
- 20010713 Reduced devicename to 32 chars to space space
- 20010902 Improved UpdateCache to be thread safe and made it longer, no test on image db.
- 20011109 Made MAG check and database field consistency check case insensitive.
- 20011115 Replaced 'LIKE' by faster '=' when possible
- 20011116 Fixed error handling of db entry. It was possible that db entry failed without any message!
- 20011121 Create indices on ImagePat and SeriesPat if these fields exist
- 20020403 Do not overrrule the PatientTable with: empty data, or birthdate xxxx0101, or sex other than MmFf.
- 20020409 made LastPatid non-static
- 20020409 Removed non-thread safe caching of LastADBE
- 20020409 Moved entry into UpdateCache to after succesful Update
- 20020412 Made NCACHE configurable and changed it from 16 to 1024 (8 MB); Set lastfield (limit of #fields) to 20 (was 16)
- Added checksum code in update cache to make it faster
- 20020412 Made key fields unique. Reversed writing of db's. In this case a db write fail will still result in a valid db. The db write code is not multi-user safe. A new record may be written at the same time by two processes -> fail
- 20020413 Set NCACHE to 256, enough for single thread regen
- Modified another non-thread safe construct
- 20020415 Fix display of PatientID in 'Inconsistent' error message

- 20020416 Made UID generator configurable through UIDPrefix in dicom.ini. Made all instances of time unsigned. Note: accesstime in the db is signed int: problem around 2038
- 20020418 Added TimeStamp, Flags, and Spare fields on all dbs for future use
- 20020430 Fix in spare fields: name was reserved in some odbc implementations
- 20020515 Process all db fields; enter (1) Modality into StudyModality
- 20020517 Modality is merged into StudyModality without size limit (enforced by sql server)
- 20020518 Skip missing VR's again; max nr fields to 30; fix reading of NULL fields (clear s[[]])
- 20020519 Also skip writing empty VR's (vr->Length==0); made FixPhilips configurable (default 1). Remove / from date to allow writing mm/dd/yyyy into sql server
- 20020522 Test on empty Modality vr
- 20020529 Added PRIMARY KEY to key DB fields (needed for replication)
- 20020529 InitializeTables now has mode parameter (0=normal, 1=simple)  
Do not make Index for primary keys (is done automatically)
- 20020609 Added compression modes 3 and 4
- 20020802 Simplified rmdir code and allow multiple subdirectories
- 20020804 Use PATHSEPCHAR where possible
- 20020806 Fix: cleanup entries of refused item in database
- 20020819 Added better UID generation
- 20021016 Use patid in SaveToDatabase and GetFileName query (both test for rev5 or higher of the database)
- 20021017 Allow set of UIDpostfix from extern (-c option of dgate)  
Removed creation of unused tables
- 20021020 Added [ to MakeSafeString; removed "  
Note: VR's containing ', ? give spurious inconsistency warning when rewritten
- 20021028 Also removed dropping of unused tables; reversed table search to image..pat in FindDBE. Made inconsistent birtdate a severe error message (added \*\*\*)
- 20021110 Made date range inclusive (bug reported by Aaron Cann)
- 20030113 Added PatientQuerySortOrder etc overrides for sorting
- 20030205 Fix potential empty patient ID and SOP problems in GetFilename
- 20030321 Extra check on vr!=NULL in SaveToDatabase
- 20031104 Added \\ to MakeSafeString
- 20040301 Do not double \\ when allready doubled
- 20030425 Added DoubleBackSlashToDB control for \\
- 20040528 Pass patient ID in RemoveFromPacs and Enable KeyOnAll
- 20040529 Implemented faster delete from database
- 20040530 Pass a field to query in delete - obligatory for sql server
- 20040601 Removed enable KeyOnAll - added some more checks in NewDeleteFromDB
- 20040609 Check for DB revision for fast delete from database queries

- 20040610 Truncate too long VR's before putting into db; log to pacstrouble
- 20040623 Fix for non-DBASE datasources in 'UpdateOrAddToTable'
- 20040626 Added study and series UID to getfilename interface
- 20040713 Added FixKodak: replace pat 0nnnnnnnn with nnnnnnnn
- 20040722 Defaults for FixKodak and FixPhilips to 0 (!)
- 20040930 Added multiple UID matching: UID\UID\UID in BuildSearchString (list truncates at maximum length)  
SetString now returns a char \* which is newed (with lots of extra space for MakeSafeString which is done in-place) if Max length is passed 0. DICOM2SQLQuery has no max length anymore
- 20041003 Truncated printf's of SqlStatement
- 20041029 Added MergeUIDs routine
- 20041101 Added NewDeleteSopFromDB
- 20041220 Fix: in 'RemoveFromPACS', an even PatientID was not zero-terminated !!
- 20050109 Adapted for linux compile
- 20050111 Added ctype.h (for mingw)
- 20050205 Added counters for database activity
- 20050206 Allow empty DBE in ConstructVRFromSQL: used to get ObjectFile and Device in query
- 20050401 Added WorkListDB and WorkListTableName
- 20050404 Dicom types DT\_START/ENDSEQUENCE are ignored during table creation/adding to table
- 20050414 Allow undefined worklist database;  
Delete patient will delete worklist entries as well (but needs at least one image)
- 20050417 Delete from DB will also delete worklist as patient goes
- 20050826 Added mode 2 for initializetables: clear/create worklist only
- 20050831 Mode 0 and 1 will now not delete worklist if it contains data
- 20050831 VerifyIsInDBE will not return DT\_START/ENDSEQUENCE
- 20050901 Do not call FixImage in SaveToDataBase: is done in SaveToDisk before
- 20051121 Enabled SQLRealSize because SQLResultLength does not work in PostGres BindField
- 20051123 Fixed it, and only enable it when #ifdef POSTGRES
- 20051204 Disabled it, fixed postgres driver instead
- 20051210 GetFilename returns FALSE for an image that has no filename or device set
- 20051212 Clear update cache when any records deleted - drastic but safe
- 20051216 Small fix in above
- 20051217 Use new VR::ReAlloc method to replace data in VR
- 20051218 Fix study modality when DoubleBackSlashToDB=1; changed modality search
- 20051228 Truncate invalid trailing spaces (>1) from patient ID. Fiximage warns to SystemDebug
- 20060210 Removed order: first remove spaces and then fix the patient ID because patient ID consisting of 14 spaces caused huge troubles

- 20060220 Check max 50 fields when update; fix Inconsistent check for DoubleBackSlashToDB
- 20060607 Fix character translation for entering \*?%[' into sql using MakeSafeStringValue. Fix consistency check for these characters as well (thanks Robert Chrzan)
- 20060607 Added "not null" to "PRIMARY KEY" to satisfy Sybase (thanks Marcin Litoborski)
- 20060618 Added not null to UIDmods as well, unified case of DICOMWorkList table name (may be done for other tables as well) (thanks Marcin Litoborski)
- 20060618 Remove " added by MakeSafeStringValue prior to inconsistency check (thanks Robert Chrzan)
- 20060621 Increased size of s from [50][255] to [51][256] in UpdateOrAddToTable fixes VirtualQuery crash
- 20060628 AddToDatabase has JustAdd parameter: skip one unnecessary query
- 20060706 Replaced faulty new vr construct when doing consistency check: faulted on Linux
- 20061213 Protect Clear\_UpdateCache with critical section  
Fixed nasty bug in NewDeleteFromDB. MergeUIDs, NewDeleteSopFromDB: Query without bindfield overwrites previous bound strings!
- 20070123 Fixed GetFileName for patientid with '  
Recoded some of the inconsistency checking: now no failure on patient ID (link) with '
- 20070131 Fixed GetFileName for all patientid's ;->>>>
- 20070201 Fixed (unused) UpdateAccessTimes for weird patient IDs

### **VRTOSQL.CPP (part of DGATE.EXE)**

- 20000629 Logging of trouble now starts with '\*\*\*'
- 20010330 Added a few debug printf's
- 20010420 Fixed memory leaks in all query levels
- 20020519 Clear BindField result strings before reading (NULL does not read)
- 20021028 Restructured queries to give lowest level of de-normalized databases. Fixed sorting on PatientName in denormalized study query
- 20021030 Reversed this again apart from study level because SQL server becomes very slow
- 20030113 Added PatientQuerySortOrder etc overrides for sorting
- 20030114 Added in querycolumns (even if already present); tested for SQL server, requires testing for other datasources
- 20030122 Remove unused entries from Tables string in queries
- 20040930 Started adapt such that query strings etc and not limited in length. For now: query string max 8192 (here and in odbci.cpp); sql statement max 16384 (in odbci.hpp)  
Enough for query with one multiple values UID of about 100

- images (list truncated if too long). Added safestrcat protection of SearchString
- 20041003 Truncated debug prints, malloc strings at image level. Analysed string lengths; limited 'records =' debug log
  - 20041013 Used MAXQUERYLENGTH
  - 20050107 Removed UNIX flags: solve difference in database interface
  - 20050206 Image query can send filename and device in 0x9999,0x800 / 0x0801
  - 20050401 Added QueryOnModalityWorkList; - todo - put selected items into sequence 0040,0100
  - 20050404 Take query for Scheduled Procedure Step from sequence, put results into sequence
  - 20050414 Made sequence unfolding for worklist more generic - accepts any number of and nested N=1 sequences. This is correct behavior for query input, but limited for query results
  - 20050417 Removed unused variable
  - 20050831 Fixes in worklist code: is ok for all OFFIS tests except 1 (empty seq not returned) and 10 (undef non-empty seq takes one entry from higher level) - good enough for initial release?
  - 20050901 Fix for test 10: allow undefined sequence in query
  - 20050907 Merged change by Hans-Peter Hellemann: fix missing max() macro
  - 20051229 Debug log show records of all queries. DumpVR only left in worklistquery and shows sequence layout
  - 20051230 Removed 2 forgotten dumpvr's
  - 20050103 Added debug info from testing phase inside nested sequences for modality query
  - 20050211 Added empty required modality sequences 8,1110 and 8,1120 when not there
  - 20050224 Fixed modality worklist query: empty result sequences were not handled correctly (Thanks Tony Tong)
  - 20050311 Worklist change was tested OK with Agfa (thanks Frank Grogan), cleaned debug log a bit
  - 20060607 Fix crash when coding empty sequence as last item in worklist query (thanks Francois Piette)
  - 20061219 Small fix in layout debug log

#### **DPRINTF.CPP (part of DGATE.EXE):**

- 20000211 Removed MajorEvent and MinorEvent instances of 'Debug'. Cosmetics. Added UserLog and TroubleLog. Added timestamp option. Added CriticalSection when printing to file or stdout.
- 20011110 Post release 1.3.10: keep log files closed while working
- 20021027 Avoid crash when logfile cannot be opened
- 20041003 Note: max 1200 chars (use %.1000s to print long strings)
- 20060618 Define \_SH\_DENYNO if needed
- 20070105 Added timestamp for linux users (thanks, Mark Pearson)

**REGEN.CPP (part of DGATE.EXE):**

- 19980327: put messages in one SystemDebug for UDP message layout
- 19980415: changed messages to OperatorConsole
- 19980605: Need to add regen for optical devices and cachedevices !!!!!
- 19981218: temp use pdu.load
- 19990108: Replaced PDU.Load by LoadImplicitLittleEndian in RegenToDatabase
- 19990109: Set HeaderOnly flag for LoadImplicitLittleEndianFile to TRUE. Added regen of CACHE and JUKEBOX devices; NOTE: full regen imposes name restrictions on JUKEBOX and CACHE directories
- 19990117: Filenames with .v2 are assumed raw; added extension .dcm for chapter 10 format
- 19990317: Parameters of LoadImplicitLittleEndianFile have been changed
- 19990521: .img files react same as .dcm files
- 20000629: Logging of trouble now starts with '\*\*\*'
- 20010415: Added SubDir parameter to regen to allow regen of one directory only
- 20010416: Added RegenFile - to allow modification of images
- 20011109: Made file extension checking case insensitive
- 20020409: Experimental multithread version.
- 20020413: Made NTHREADS variable and tested. Time to regen 6900 files about 3 min and 40 s.
- 20020415: Tested with new loaddo code by ljz. Note: multithread works and has allowed fixing MT some errors in other modules. However, due to a problem in concurrent db writing (in UpdateOrAddToTable) it should not be used clinically.
- 20020613: Removed some warnings
- 20020802: Simplified regen code; traverse subdirectories recursively (allow e.g., e-film data format)
- 20020804: Use PATHSEPCHAR where possible
- 20021014: Exclude directory PRINTER\_FILES during regen (contains slices without ID and such)
- 20030120: Removed some warnings
- 20030706: Attach VRType to PDU for implicit little endian support
- 20030819: Allow longer filenames
- 20040614: Do not regen CACHE devices; first regen JUKEBOX then MAG (e.g., in historical order)
- 20050118: Adapted for LINUX compile
- 20060628: AddToDatabase has JustAdd parameter

**PARSE.CPP (part of DGATE.EXE):**

- 19980321: Added define TRUNCATEFIELDNAMES for DBF compatibility (apply in makefile)
- 19980325: Added TruncateFieldNames entry in dicom.ini to allow DBF compatibility

- 19980327: Added MaxFieldLength entry in dicom.ini to allow DBF compatibility
- 20001105: Renamed some enums and variables to allow compile in one big chunk
- 20010713 Renamed DT\_UINTxx to DT\_INTxx as temp fix for bug in LEX.CPP
- 20010829 Undone above change as LEX.CPP has been fixed by ljl
- 20050107 Added include file gpps for GetPrivateProfileString
- 20050401 Added WorkList Support
- 20050404 Added DT\_START/ENDSEQUENCE to code sequence in WorkList table
- 20050902 Added HL7 column to be used for WorkList table
- 20050908 Fixed pointer error that crashed linux version

#### **LEX.CPP (part of DGATE.EXE):**

- 20000822 Created
- 20000823 Support cases where the input-file is empty or contains only white-space.
- 20010716 Fix: Allow TOKENs that are substrings of other TOKENs.
- 20050103 Changed include file to lower case (for linux)
- 20050108 Removed window.h for linux compile
- 20050118 GNU C++ knows BOOL etc, do not redefine

#### **NKIQRSOP.CXX (part of DGATE.EXE):**

- 19990317 NKI-specific code moved here
- 19990903 Implemented NKI MaxRowColumn VR in DCO
- 19990906 Improved implementation of MaxRowColumn
- 19991022 Changed the root of NKI-made UIDs to the official one supplied by Medical Connections(UK):  
1.2.826.0.1.3680043.2.135.1066.xxxxxxxxxxx
- 19991122 Added NKI-CompressionMode 2: safer, with CRC checks
- 20000131 Regardless the FileCompressMode in Dicom.ini, always send images compressed (mode=2) when communicating with an NKI application.
- 20001105 Fixed where malloc and new were mixed (vr->data)
- 20001106 Use delete [] operation for vr->Data
- 20001106 Temporary fix of BC leak in CompressNKI and DecompressNKI
- 20001120 Fix bug - vr->data was reallocated without changing vr->length
- 20001127 Fix: Crashes happened when more than one 'ServerChildThread' was active. m\_pDCO is wrongly shared by all threads !!
- 20010424 Plugged in faster and safer decompress
- 20010426 Fixed leak when connection is aborted
- 20010429 Interleaved CRC computation with compress code (factor 2 faster) Added GetADDO to allow read ahead within calling program

- 20010501 Merged liz's change of 20010426
- 20010502 Added extrabytes pointer to Read and RetrieveOn
- 20010502 Added vr(9999,0300)=SliceLimit: send at most so many slices
- 20010502 Changed this vr to (9999,0500)=SliceLimit
- 20011219 Added extra check in case other manufacturers than NKI use VR (0x7fe0, 0x0010), such as ACUSON
- 20020317 Replace true by TRUE
- 20020415 Added error handling on ProcessDDO
- 20020429 fixed reporting of number of complete slices (now starts with 1) return cancel status if C\_STORE failed
- 20020609 Added compressor modes 3 and 4
- 20020609 Added VR (9999,0600): MaxCompressionLevel (default 2)  
Note: This level (max of 4) is also used when downsizing
- 20020613 Exported DecompressNKI and CompressNKI
- 20020619 Damn! ELSCINT uses (0x7fe0, 0x0010) too (see modification on 20011219). Extra check on zero-length pixeldata
- 20020930 Fixed SliceLimit VR
- 20021016 Removed \_\_BORLANDC\_\_ language construct - to fix downsize with BC55
- 20021115 Added Generic style retrieve classes; print error messages from c-move
- 20030522 Added function ComputeCRC
- 20030605 Fix in DecompressNKI: dgate crashed when DCMTK's 'storecu.exe' wants to send an NKIcompressed image to dgate; it refuses to send the pixeldata!
- 20030701 QualifyOn now also has compression parameter; transfer syntax work in progress
- 20030703 Tested recompress functions
- 20030704 Disabled decompression in ProcessDDO for non-nki clients; is done by recompress. When downsizing use DecompressImage(); also supports JPEG; Removed MaybeRecompress. Recompression for NKI clients only when downsizing; otherwise as specified in acrnema.map
- 20030705 Moved recompression out of ProcessDDO into StandardRetrieveNKI::Read. Skip recompression to same level as incoming
- 20030706 Optional filename parameter for recompress (not used yet); set env for offis tools
- 20030706 Attach VRType to PDU's for implicit little endian support
- 20030709 Removed DCMDICPATH; is not needed
- 20030819 Allow longer filenames
- 20030905 Note: recompressfile; DecompressImageFile and CompressJPEGImageFile do not allow spaces in filename
- 20040401 Added Changed and ActualMode flags to compress routines; only give compress message if something changed
- 20040401 Set maxcompression to 4 for NKI send
- 20040403 Added own SaveDICOMDataObject as in dgate.cpp
- 20040406 Also copy TypeCode in DecompressNKI when converting (0x7fdf, 0x0010) to (0x7fe0, 0x0010); Make TypeCode of

- (0x7fdf, 0x0010) OW instead of OB, because OFFIS refuses to compress OB
- 20040406 Always use EXPLICIT syntax for jpeg, fix v2 always use DUMP; Use -F +ti option for dcmdjpeg for writing to v2: creates raw dump, implicit; Refuse to jpeg compress V2 files and images != 16 bits; \n is all messages; Fix error handling of CompressJpegImage
- 20040530 Removed unused variable
- 20040722 Added "nj" compression: leaves JPEG as is; else MAXNKICOMPRESSION
- 20041101 Added built-in JPEG and RLE decompressor
- 20041102 Fix problem with external JPEG compression: clear transfer syntax prior to save for OFFIS tools with DICOM\_CHAPTER\_10\_EXPLICIT
- 20041103 Added k1,k2,k4,k8 compressors: downsize to 1024,512,256,128 pixels if bigger to start with
- 20041112 Called AE SERVER~xx in C-MOVE lets xx override outgoing compression as well (e.g., call CONQUESTSRV1~k4 to always get images downsized to 256x256)
- 20050102 Added NOINTJPEG flag to allow compile through total.cxx
- 20050103 Changed include file to lower case (for linux)
- 20050108 Adapted for linux compile (work in progress)
- 20050109 Added configurable TCPIPTimeOut
- 20050118 replaced thread local storage under linux with variables in object
- 20050119 added rudimentary support to start external (de)compressors under linux
- 20050121 Changed filename to lower case
- 20050122 Improved external jpeg support under Linux: load dictionary, wait until ready
- 20050130 Added To8BitMonochrome and ToGif
- 20050204 Small fix in ToGif for non-square images; also interpret RescaleIntercept as float
- 20050205 Added counters for compression activity
- 20050206 Optimized downsizing: do not decompress if no downsizing to occur
- 20050206 Note: replaced thread local storage under linux with variables in object is incorrect. Under linux, the server now can also serve one at a time. Fix for color to gif; added limited auto scaling in 16 bits to gif.
- 20050211 Now really removed need for thread local storage
- 20051210 Added "vX" compression (same as as is)
- 20051217 Use system() to call on offis apps in linux (now works)
- 20051217 Use new VR::ReAlloc method to replace data in VR; fixed 2 float warnings
- 20051229 Fixed several leaks in (jpeg)compression code; changed alloc for nki compression
- 20051230 Added +sr option to dcmdjpeg: compress without changing rescaleslope/intercept

- This option is required for our viewers: slices must all have same rescale
- 20060219 Removed warning in writgif
  - 20060222 Added extra checks (not on ID strings) to pass as NKI compressed data
  - 20060311 dcmjpeg opts string got truncated (thanks Rainer Libowski) fixed unused CompressJPEGImageFile (wrong exe called) external decompress temporary files now in printer\_files (thanks Rainer Libowski)
  - 20060324 Added StripGroup2 option to recompress; strip group 2 from outgoing c-stores if not compression "as" or "is"
  - 20060328 Use IsAbstractSyntaxAccepted(iUID) to test if host accepts image
  - 20060402 Fix crash when receiving or dropping jpeg compressed color images. Consider not removing transfer syntax (0x0002, 0x0010) prior to dcmdjpeg/dcmjpeg. Would fix problem with external decoding color jpeg images
  - 20060402 Changed IsAbstractSyntaxAccepted(iUID) test back (thanks Andrej Savelov)
  - 20060405 That was not the problem
  - 20060618 Tested IsAbstractSyntaxAccepted - seems to work. Removed need for min()
  - 20060619 Do not remove transfer syntax before decompression (20060402 suggestion). Maintain original object when decompression fails, changed wording of message. Only complain about internal decompressor for jpeg
  - 20070104 Export automatic SaveDICOMDataObject
  - 20070113 Never delete transfer syntax (was left in CompressJpegImage, solves coding error in jpeg store). Tested with \$c server debug command

#### **NKIQRSOP.HPP (part of DGATE.EXE):**

- 19990317 NKI-specific code
- 20001128 Fix: Crashes happened when more than one ServerChildThread' was active. m\_pDCO was wrongly shared by all threads !!
- 20010429 Added GETADDO to allow optional read ahead withing calling program
- 20010502 Added extrabytes pointer to Read and RetrieveOn
- 20020415 ProcessDDO now returns status (to allow compression error check)
- 20020613 Added prototypes for DecompressNKI and CompressNKI
- 20021115 Added Generic retrieve classes
- 20030522 Added prototype of ComputeCRC
- 20030701 QualifyOn now also has compression parameter
- 20030702 added ExtendedPDU\_Service
- 20030704 Changed ProcessDDO parameter to \*\*DDO (for recompress)
- 20050118 replaced thread local storage under linux with variables in object

20050121 Changed filename to lower case  
 20050211 Removed need for thread local storage

**ODBCI.CPP (part of DGATE.EXE):**

19980415 Blocked one error message  
 19990628: experimental locking call  
 19990628 temp defined DB\_DEBUG and introduced experimental statement options  
 19990707: Undefined DB\_DEBUG and removed statement options  
 19990827: Added CreateIndex  
 20000629 Logging of trouble now starts with '\*\*\*\*' \*/  
 20001105 Run-time load ODBC routines for BC and WC  
 20001128: Added InitializeCriticalSection in 'Open' and DeleteCriticalSection in 'Close'  
 20010829: Enabled DB\_DEBUG to show db errors in verbose mode  
 20020412 Use SQLExecDirectWithRetry to retry in case of any error (deadlock=1205). Added CreateUniqueIndex function, and GetLastError. Ignore error from unique index to make multi-user safe.  
 20020413: NOTE: A SINGLE DB MAY NOT BE USED BY MULTIPLE THREADS.  
 20020417: Extended deadlock wait time to about 1 min for safety  
 20021014: Added built-in dbf support for stable ODBC less-operation  
 Note: requires fully de-normalized database; notes: in dbsql, first bind row not set; in vrtosql; debug query print with %s in search crashes  
 20021016: Added about 1 MB of in-memory hashed index in patient ID for all tables; speed OK to 10.000 objects; pack db on server start (for speed it is wise to keep DBF files on local harddisk)  
 20021017: Made NeedPack a global for control from dgate; fix base\_trunc; fix in Updaterecords; fix first num field in AddRecord  
 20021020: Made querymodes an array, so that each query field can be key, key% or %key% ; Use querymode also when hashing the entries (part of db entry); Fix process\_escape for " and \[ and also use it before dbase\_write  
 20021028: Set open retries shorter for normal readonly access  
 20021030: Match alternative patientID fieldname such that built-in DBF queries work  
 20021113: Added <= comparison in dbase\_query (used for date comparison)  
 20030113: Do not use () in sort order when multiple columns specified  
 20030128: Added alternative field names for series  
 20030321 Also handle 'write lock' for M\$Access (NativeError 1205 for sql-server equals -1102 in M\$Access). Other dbf-drivers???  
 20030819 Allow longer filenames  
 20031104 Added \\ to process\_escape  
 20030425 Added DoubleBackSlashToDB control

- 20030520 Speedup by fix dbaseIII hashing, setting hashfield was wrong
- 20030523 Implemented in-memory index to speed dbase queries; added IndexDBF and PackDBF settings
- 20040528 Fix built-in DbaseIII for > 2 GB; index fixed at 10.000.000 records; Fix problem when spaces in patient ID in index generation
- 20040528 Added ExtractRecords (dbase III only); fix update/delete for record 0
- 20040530 IndexDBF gives MB extra to allocate; skip dbf files starting with X; convert normal queries in SeriesInstanceUID or StudyInstanceUID to indexed ones
- 20040601 Added LongQueryDBF flag: report if query took longer than LongQueryDBF ms (default 1000); Min 20 MB index during regen; allow pack on command (NeedPack=TRUE; DB.Open) Increase query buffer size to 16384 (often reread), pack buffer to 65536
- 20040605 Optimize speed for huge files, extract max 100000 records; made lockstart \_\_int64; Do not lock for read in extract (is very slow for huge files); Record lock no longer on physical bytes but on rec#; attempt to speed memory index; NeedPack==3 -> force pack
- 20040606 Fix lock whole file; fix index patient ID database; fix in dbcreate for test
- 20040609 Implemented fast in-memory locking and enabled for all shared files
- 20040610 on dbase\_create set indexcount to 0; dbase\_trunc truncs indexcount
- 20040612 Put index creation in a thread; server runs (but does not find non yet indexed records) during indexing; implemented indexdbf command NeedPack=4
- 20040614 Added NeedPack=5: create non-threaded index (for archival options)
- 20040615 Added warning when index is full; keep indices when creating db
- 20040930 Added multiple value query; protect length of copy of where string
- 20041003 Reused very long SQLStatement string for wheres string  
For lengths see dbsql.cpp; truncated debug printf  
set cols length to 4096; malloc tmp in query at 310000;  
for length calculation see dbsql.cpp
- 20041013 Used MAXQUERYLENGTH
- 20041029 Fixes in multiple query (query string truncated + mode mix problem)
- 20041101 DB is read only while in-memory indexing of DbaseIII active
- 20050102 Small modifications to allow compile through total.cxx
- 20050107 Export NumIndexing to tell dgate when indexing is done
- 20050116 Adapted for use with LINUX (built-in dbase driver only)  
Notes: 1) delay poorly implemented; 2) no support for >2 GB
- 20050118 Detach pthreads to avoid leaks

- 20050119 Documented rare crash in Fill\_Memory\_Index
- 20050124 Added support for huge files under Linux (not suitable for ext2 filesystem); Allow = without spaces in query
- 20050205 Added counters for db activity
- 20050206 Small fixes to counters; allow "&" instead of " and " for CGI use
- 20050905 Postgres code by Piotr Filipczuk checked by mvh, will not affect other operations, but not tested yet (postgres will not compile on my linux system)
- 20050907 Merged change by Hans-Peter Hellemann: lseek64 not always defined, should be mapped by unistd.h
- 20050909 Put check for = in query below >=: date range matching failed (Thanks Paolo Marcheschi)
- 20050911 Removed postgres print statements
- 2005112 Fixed BindField for postgres - now returns actual and not reserved length
- 20051217 Maximum locks in dbaseIII driver from 1000 to 100 to speed up qunlock (20% regen speed)
- 20051218 Respond to -b = NOTHREAD: run server as single process, useful for debugging and profiling
- 20051219 Fixed slow leak of queryfields for built-in dbase driver
- 20051230 Put index of DicomWorkList on AccessionNumber
- 20060219 Start on native mysql driver
- 20060220 Some more work: get correct length in bindfield; todo: user and password
- 20060226 Runtime load MYSQL in WIN32
- 20060313 Use username and password for mysql
- 20060402 Start index threads with a short delay to give GUI priority to test startup
- 20060607 Changed escape char processing for sql values (not queries) to match dbsql.cpp change
- 20060618 Fix for Borland C++ builder
- 20060628 Moved location of disabled query logging
- 20060630 Speeded dbaseIII AddRecord lots and linux string handling
- 20060701 Added and use mysql\_fetch\_lengths; protect query result
- 20060702 Tested native mysql driver: does not like fast open/close: clonedb crashed after 4000 or so (avoided now)
- 20061212 Found critical error in built-in dbase driver sql parser: Adding patient with ID containing certain character sequences will immediately overwrite the whole patient database. Queries with these sequences will return too many records (less dangerous). Issue not yet really fixed but greatly reduced its likelihood
- 20061213 Fixed issue by replacing spaces inside strings in sql statement with non-breaking spaces. Only match on keywords and field names which include spaces; replace with normal spaces in process\_escape
- 20070123 clear NativeError, State and Msg on db.open (e.g. for dbf that does not use them but prints)

- 20070126 Added missing break in non breaking space field of process\_escape: failed on multiple spaces in string
- 20070201 DebugLevel 4 prints all sql activity

### **ODBCI.HPP**

- 19990827 Added CreateIndex
- 20001128 Added CRITICAL\_SECTION member of 'Database'
- 20020415 Added error info, GetNativeError, SQLExecDirectWithRetry and CreateUniqueIndex
- 20021020 Added built-in dbf support (for stable operation without ODBC) Note: requires de-normalized database
- 20030120 Ignore Micro\$oft complaint C4200
- 20030321 Enlarged buffer for SqlErrorMessages (Database->Msg)
- 20030819 Allow longer filenames
- 20040528 Added ExtractRecords (dbase III only)
- 20040530 Added InternalQuery (for converting normal to indexed queries)
- 20040605 Made lockstart \_\_int64
- 20040612 Made lockstart in again - now pure record#; added TotalRec, MBExtra
- 20041003 Statement length set to 310 kb (see dbsql.cpp for explanation)
- 20041013 Malloc SQLStatement instead
- 20050109 Adapted for linux compile
- 20050905 Postgres code by Piotr Filipczuk checked by mvh, will not affect other operations
- 20060219 Start on native mysql driver
- 20060220 Include all required mysql defines here
- 20060226 Runtime load MYSQL in WIN32
- 20060628 Use mysql.h proper (for datastructures) even when runtime loading (sorry for the hard include path)
- 20060701 Added mysql\_fetch\_lengths

### **AMAP.CPP (part of DGATE.EXE):**

- 19990827: added (limited) wildcard mapping in GetACRNema: AE, port or IP may end on '\*'
- 20001105: replaced m-alloc by new
- 20011109: Made AE mapping case insensitive
- 20020524: In function 'GetACRNema', first try case SENSITIVE then INSENSITIVE
- 20030701: Added compression column (with this code is this column is not optional!)
- 20030703: KNOWN BUG: number of columns may not be 3 (crashes)
- 20030709: Solved above problem; rewritten parsing of Acrnema.map
- 20030709: known bug: trailing spaces lead skip of next line
- 20030711: Fixed trailing spaces in acrnema.map
- 20031118: Fixed leak InitACRNemaAddressArray

**XVGIFWR.C (part of DGATE.EXE):**

20050129 Adapted for use in the Conquest DICOM server (see //)  
 20050130 Made it ansi C  
 20050826 Made it reentrant to avoid gif file corruption in server  
 20051219 Fixed leak

**WINTYPES.HPP (part of DGATE.EXE, Linux only):**

20050111 added SWORD and UWORD

**NPIPE.CPP (part of DGATE.EXE, Linux only):**

20050111 Blocked out sys/conf.h; compiles with linux but gives linker warning: fattach not implemented and will always fail  
 20051217 Return (unsigned) 0xFFFFFFFF instead of signed -1

**GPPS.CPP (part of DGATE.EXE, Linux only):**

20040111 Fixes: defaults now work, allow DOS files, case insensitive

**KILLER.CPP (main of KILLER.EXE, which is not part of this release of the Conquest DICOM server ):**

19980619: Added some doc on command line options and modes  
 Fixed -L option (moved db.close)  
 19980620: Made code suitable for external calling; copied some of it to device.cpp. Killer.exe is not needed anymore with NKI Dgate.exe except as sleeper task because the alert task has been integrated into Dgate.exe  
 20030702: Adapted because of compression externals required by device.cpp  
 20030706: Attach VRType to PDU's for implicit little endian support  
 20050129: Adapted dummy for DumpVR

**AAAC.CXX (part of DICOM core library):**

19980327: Removed evaluation of Count without initialization in ReadDynamic  
 20001106: Use memcpy instead of ByteCopy  
 20030122: Fixed initialization of AAssociateAC  
 20050108: Fixed for linux compile

**AARQ.CXX (part of DICOM core library):**

20001106: Use memcpy instead of ByteCopy  
 20001128: Removed two warnings  
 20030122: Fixed initialization of AassociateRQ  
 20060618: Added definition of min()

**AARQ.HPP (part of DICOM core library):**

20001106: Use memcpy instead of ByteCopy

**CCTYPES.H (part of DICOM core library):**

20001107: Fixed to allow compile with BC  
 20010705: Fixed to allow compile with MSVC 6 (see note below)  
 20040111 Fix for \_\_GNUC\_\_  
 20040117 Fix for linux

**ENDIAN.CPD (part of DICOM core library):**

20001106: removed unneeded (and sometimes uncompileable)  
 XE\_UINTX::XE\_UINTX (int x)

**ENDIAN.HPD (part of DICOM core library):**

20001106: removed unneeded (and sometimes uncompileable)  
 XE\_UINTX::XE\_UINTX (int x)

**RTC.HPP (part of DICOM core library):**

19980331: Added prototype for writing binary RTCs

**TRNSYN.CXX (part of DICOM core library):**

19980409: Fixed possible transition between presence and absence  
 of TypeCodes in 'Dynamic\_ParseRawVRIntoDCM'  
 19990904: Treat type UN same as OB,OW and SQ when reading Explicit  
 files.  
 20001106: Replaced == operator by strcmp  
 20010905: Several fixes: UCDMC should NOW be able to read  
 ExplicitBigEndian files  
 20011220: Fixes in Sequence and Item delimiters  
 20030122 Fixed small leak in Dynamic\_ParseRawVRIntoDCM  
 20030205 Support new datatype 'UT' (unlimited text). Thanx to William  
 Peterson  
 20030424 Changed prototype of ParseDCMIntoRawVR. Fixed huge bug  
 in sending of ExplicitLittleEndian sequences  
 20030627 Fix for MSC 4.2  
 20030725 Keep GroupLength for group 0x00 (Radworks 6.0 was choking  
 in this)  
 20040406 Make TypeCode 'UN' if not known, and conversion to Explicit  
 is wanted  
 20050112 Fixed huge bug in Explicit\_ParseDCMIntoRawVR, causing  
 data-loss. Thanx to Goran Peros.  
 20051217 Use new VR::ReAlloc method to replace data in VR

- 20051218 Use memcopy to enter UID (extra 0 will be available: end of string)
- 20051219 Use ReAlloc instead of new BYTE[] to fill VR data
- 20051229 Moved Push in ParseRawVRIntoDCM so that not done when VR exists

#### **RTC.CXX (part of DICOM core library):**

- 19980330: Added an RTC memberfunction for loading the dicom library from memory (e.g. a resource).
- 19980331: Added function for writing binary RTCs (function was originally implemented in 'makebrtc.cxx')
- 19980414: Added RTC::GetGroupElement memberfunction, to retrieve the Group and Element numbers using a library keyword.

#### **DEIVR.HPP, DEIVR.CXX (part of DICOM core library):**

- 19990318 Added 'DICOMObject::DeleteVR'
- 20001106 Used delete [] operator for vr->Data
- 20010426 Fixed small leaks in 'DICOMObject::DeleteVR'
- 20010730 Added 'DICOMObject::ReplaceVR'
- 20010802 Added 'VR::GetSpecialValueCodeOfVR'
- 20011121 Added VR\_SPECIAL\_RGB\_TO\_MONO. Used by a conversion-tool to change ultrasound Kretz RGB images to monochrome that VariSeed (brachytherapy) understands.
- 20011121 Added VR\_SPECIAL\_RGB\_TO\_MONO\_PLUS. Same as above, but tries to preserve colored drawings.
- 20051217 Added 'VR::ReAlloc'
- 20051217 Use malloc/free instead of new char[] and delete []
- 20051229 Removed unnecessary reset() in DeleteVR

#### **SOCKET.CXX (part of DICOM core library):**

- 20010426 Added 'setsockopt' in 'Listen' and 'Open'  
Call 'shutdown' before closing a socket
- 20010720 Changed 'print' to 'fprintf(stderr,...)'
- 20050116 Adapted for LINUX compile
- 20050119 Blocked out SOCKET END ERROR message

#### **SAFEMEM.CXX (part of DICOM core library):**

- 20010720 Changed 'printf' to 'fprintf(stderr,...)'

#### **DIMSEN.CXX (part of DICOM core library):**

- 19990415 Removed static on TranslateUIDToVR
- 20020822 Use instead of DIMSEN.CPP

#### **DIMSEN.HPP (part of DICOM core library)**

20020822 Cleanup layout

**DIMSEC.CXX (part of DICOM core library):**

20030219 Removed MessageID and Priority from the 'write' functions of CStoreRSP, CFindRSP and CMoveRSP  
 20030606 Added parameter 'QueryRetrieveLevel' to CFindRSP::Write  
 20030811 Do not send DDO in CMoveRSP::Write (DicomEye and OFFIS do not like that).  
 20050129 Added Write with extra vr to CEchoRSP  
 20051222 Do not add query level if already exists

**DIMSEC.HPP (part of DICOM core library):**

20030606 Added parameter 'QueryRetrieveLevel' to CFindRSP::Write  
 20050129 Added Write with extra vr to CEchoRSP

**UNIQ.CXX (part of DICOM core library)**

19990511 Fix: All routines wrongly used '%' instead of '&'

**MAKEBRTC.CXX (part of DICOM core library)**

19990415 Note: requires changelog

**PDU.CXX (part of DICOM core library):**

19980322 Blocked one remaining printf statement "comparing ..."  
 19990202 Added PDU memberfunction 'IsAbstractSyntaxAccepted'  
 19990415 Merged both versions  
 20000322 Fix in search for PresentationContext when identical AbstractSyntaxes occur (e.g. GECT-scanner). Do not break out of the inner loop in PDU\_Service::InterrogateAAssociateAC.  
 20000322 Fix of PresentationContextID in PDV: in routines PDU\_Service::Write(DICOMObject\*, UID\*), set PresentationContextID to TempByte, not to TempByte1.  
 20000911 Removed two warnings  
 20020316 Added GetLocalAddress and GetRemoteAddress  
 20030306 Fix: Huge bug in 'InterrogateAAssociateRQ'  
 20030424 Blocked out obsolete PDU.Write(&DDO)  
 Some work on offering other TransferSyntaxes than ImplicitLittleEndian when running in SCU mode  
 (Note: when running in SCP mode, 'dgatesop.lst' is used)  
 Fix: CommandObjects are always ImplicitLittleEndian  
 20030627 Fix for MSC4.2; re-enabled obsolete write calls for test.cxx  
 20030710 Adjusted test.cxx, and disabled obsolete calls again

**PDU.HPP (part of DICOM core library):**

19990202 Added PDU memberfunction 'IsAbstractSyntaxAccepted'  
 20020316 Added GetLocalAddress and GetRemoteAddress  
 20030424 Changed prototype of ParseDCMIntoRawVR  
 20030627 Fix for MSC4.2  
 20030905 Removed spurious ;

**FILEPDU.CPP (part of DICOM core library):**

20000420 Fix in MakeChapter10: type of AffectedSOPClassUID and RequestedSOPClassUID  
 20030205 Fixed FileMetaInformationVersion for big-endian machines  
 20030424 Put the correct TransferSyntaxUID in chapter10 files  
 20041108 Fix strdup memory access problem (found using \$c drop file test mode)  
 20051229 Fixed LEAK of 68 bytes when 0002,0010 not defined  
 20060618 Added definition of \_SH\_DENYNO

**BUFFER.CXX (part of DICOM core library):**

20001106: Use memcpy instead of ByteCopy

**VERSION.H (part of DICOM core library):**

200107017 Changed ImplementationClassUID to a valid UID: the Agfa dicom validation tool protested against the original 'UID'. Changed ImplementationVersion from "0.1B/WIN32" to "1.01/WIN32"  
 20020416 Changed IMPLEMENTATION\_VERSION\_STRING to 1.3.11/WIN32  
 20021018 Changed IMPLEMENTATION\_VERSION\_STRING to 1.4.0/WIN32  
 20020208 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.1/WIN32  
 20030424 changed IMPLEMENTATION\_VERSION\_STRING to 2.0.1/WIN32  
 20030709 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.2/WIN32  
 20030815 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.3/WIN32  
 20030402 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.4/WIN32  
 20040530 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.5/WIN32  
 20040713 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.6/WIN32  
 20041101 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.7/WIN32  
 20050901 changed IMPLEMENTATION\_VERSION\_STRING to 1.4.9/WIN32

- 20060103      changed IMPLEMENTATION\_VERSION\_STRING to 1.4.10/WIN32
- 20060311      changed IMPLEMENTATION\_VERSION\_STRING to 1.4.11/WIN32
- 20060708      changed IMPLEMENTATION\_VERSION\_STRING to 1.4.12/WIN32

**FLPDU.CXX (part of DICOM core library):**

- 20050130      Allocate 1 item longer lists to allow configuration from GUI
- 20050213      Fix to allow windows created file as input under linux
- 20060618      Added definition of \_SH\_DENYNO

**FLPDU.HPP (part of DICOM core library):**

- 20050129      Made tables public for config

**VERIFY.CXX (part of DICOM core library):**

- 20050129      Added ReadRequest and WriteResponse, allows extra response vr

**VERIFY.HPP (part of DICOM core library):**

- 20050129      Added ReadRequest and WriteResponse

**QRSOP.CXX (part of DICOM core library):**

- 20020429      Fixed reporting of number of complete slices (now starts with 1); return cancel status if C\_STORE failed
- 20030606      Added parameter 'QueryRetrieveLevel' to CFindRSP::Write
- 20050401      Added ModalityWorkListQuery
- 20051222      Added pADD0 to Query::Write method - answer appended to pADD0 if set

**QRSOP.HPP (part of DICOM core library):**

- 20030606      Added member-variable 'QueryRetrieveLevel' to StandardQuery
- 20050401      Added ModalityWorkListQuery
- 20051222      Added pADD0 to Query::Write method - answer appended to pADD0 if set

**STORAGE.CXX (part of DICOM core library):**

- 20020429      check status of C-STORE RSP and return FALSE if failed
- 20030922      Added PDU\_Service to CheckObject call

**STORAGE.HPP (part of DICOM core library):**

20030922 Added PDU\_Service to CheckObject call  
 20050108 Fixed for linux compile

### **PRINTSOP.CXX (part of DICOM core library):**

20020814 Added some comments and block-out mvh's debug code  
 20020816 Fix in 'AbstractPrintManagementMeta::Write'

### **CQSERVER.CPP (Part of conquest interface DLL):**

1998xxxx Creation. This file contains DicomServer code. A  
 'DicomServer' is an application that receives images, and is  
 called a server because it 'provides' disk-space! All code is  
 reached by the routine 'ReceiveThread' at the end of this file.  
 The ReceiveThread is launched by the exported function  
 'DcmMoveHere' in CqDicom.cxx. Communication with the  
 mainthread is done by using global variables (sorry).

19990318 Added support for MultiFrame modalities  
 19990407 Swapped priority of VRs 0020-0050 and 0020-1041; now the  
 slicelocation is preferably deduced from 0020-1041.  
 19990915 FillSliceInfo now also indicates whether pixeldata are  
 'unsigned'.  
 19991028 Fix (in cases that went wrong anyhow): changed 'free' to  
 'DllFree'.  
 19991029 Added 'Signed\_compute' to convert unsigned short pixeldata  
 19991122 nki\_private\_decompress now supports Mode=2  
 20000131 Fix: Replaced an instance of free by DllFree  
 20000321 FillSliceInfo now also retrieves 'BitsStored'  
 20000405 Added CheckRangeOfCT, to Calibrated CT-values to  
 Hounsfield + 1024, and to cut the values below 0.  
 20000418 Fix: crash on (INVALID !!) Siemens demo-data on RSNA  
 1994(CR images of RXDpat1-1994). PixelRepresentation tag  
 was empty!  
 20000530 Use different pixelspacing tag for RTIMAGE  
 20010123 Moved code to GetSliceCoord; added static keywords  
 20010410 Improved communication between MainThread and  
 ServerThread  
 20010411 Do not 'sleep' the ServerThread, but let it terminate  
 20010426 Again improved communication between MainThread and  
 ServerThread  
 20010508 Replaced nki\_private\_decompress by a faster version  
 20010717 Added 'CheckRTDoseScaling'  
 20010720 Made Dummy::printf do nothing  
 20010905 Added 'CheckModalityLUT'  
 20020227 Support US pixelspacing (hiding in  
 SequenceOfUltrasoundRegions)  
 20020425 Added exported funtion 'ComputeCRC'  
 20020609 Pasted extended decompressor from NKIQRSOP.CXX

20020613 Moved MkTypedDicomObject to here  
 20020620 Guess SliceLocation in multi-frame images.  
 20021028 Support multiframe dose-grid in 'CheckRTDoseScaling', and  
 slice-positions in 'GridFrameOffsetVector'  
 NOTE: Varian multiplies and Helax divides by the  
 DoseGridScalingFactor !!!  
 20021113 Guess SliceLocation in multi-frame images (SliceThickness).  
 20021213 Adjusted field-coordinates of RTIMAGE  
 20030122 Support various Ultrasound pixel spacings  
 20030127 FillSliceInfo now also retrieves 'PhotometricInterpretation'  
 20030128 Support for 3D TimeSequences, resulting in 4D 4-space output  
 scans  
 20030213 Fixed bug in change above  
 20030624 Workaround for Varian Vision 7.1 multiframe dosegrids  
 Support for integer dosegrids and very small DoseGridScaling  
 20030904 Improved workaround for Helax DoseGridScaling  
 20041119 Added support for 4D object in slices  
 20051219 Use vr->ReAlloc  
 20060515 Also apply RescaleSlope and NEXT\_VOXEL\_DOUBLE to  
 modality PT  
 20060704 Don't apply yet...

#### **CQDICOM.CXX (part of conquest interface DLL):**

19980330 Creation  
 19980331 Added exported DcmMkBinaryLib  
 19980414 Restricted the HeaderDump to max 4096 data, and the number  
 of bytes on one line to 256.  
 19980416 Added sequence support in HeaderDump  
 19980420 Fixed last written line in multiple line sequence dump. Added  
 functions DcmFind, DcmMove and DcmMoveHere  
 19980526 Added DcmCreateBitmap  
 19980610 Changed BGR to RGB in DcmCreateBitmap. Added  
 DcmMoveHeaderHere  
 19980629 Fix: DimX and DimY were reversed. Improved efficiency  
 when loading one slice.  
 19980630 Fix: last change caused crashes  
 19980707 Removed some checks to allow non-standard Philips images.  
 Added DcmSetProgressHook  
 19980708 Added DcmReplaceInHeader, which can be used for  
 anonymization of dicom images.  
 19980709 Added C-CANCEL command object when a ProgressHook  
 stops or aborts a DcmMove operation. Added support for  
 NkiPrivateCompressed images in DcmMoveHere.  
 19980826 Added #pragma pack(1) in Field.h  
 19981105 Added DcmReadHeader  
 19981127 Added DcmGetLastXfms  
 19990108 Updated the dictionary for DICOM-RT support

- 19990114 Slices are sorted on coord. When duplicate coords exist, the last received slice eliminate previous ones. Included changed SOP-list by MvH
- 19990318 Added three xxxRetrieveNKI PresentationContextSOPs in the function DcmMoveHere
- 19990407 Swapped priority of VRs 0020-0050 and 0020-1041; now the slicelocation is preferably deduced from 0020-1041.
- 19990511 Added DcmSetLocal(char\* pszLocalAE, char\* pszLocalPort)
- 19990628 Fix: DcmCreateBitmap did not like MultiFrame dicom files
- 19990826 Added DcmSetFreeHook and DcmMoveFilesHere
- 19990906 Added DcmSetExtraParams to support (amongst others in the future) transmission of downsized Dicom images between NKI stations.
- 19990913 Private VRs of unknown type, will possibly be shown in the headerdump as character strings.
- 19990915 Fix in ParseLine of headerdump. Added support for unsigned pixeldata in DcmCreateBitmap.
- 19991019 Allow multiple slices with the same or without a coordinate, if this is the case for ALL slices (e.g. multiple scout-views in one series)
- 19991022 Changed the root of NKI-made UIDs to the official one supplied by Medical Connections(UK):  
1.2.826.0.1.3680043.2.135.1066.xxxxxxxxxxx
- 19991028 Converted unsigned short pixels to signed int pixels
- 19991122 Added DcmStoreFiles
- 20000126 Fix in WorldXfm (bug introduced on 19991019)
- 20000128 Fake slice-coords when a '3D volume' consists of e.g. multiple scout-views (Siemens MR produces such series). Prevents viewer-crash when loading a second volume into it.
- 20000321 Convert unsigned short to integer ONLY if all 16 bits of the pixeldata are used. Better contrast-stretch in DcmCreateBitmap.
- 20000327 Added C-ECHO command
- 20000405 Calibrated CT-values to Hounsfield + 1024. Cut-off below 0.
- 20000707 Added DcmSetCacheAddress
- 20000829 Added an ErrorMessage
- 20001128 Replaced 'Oh shit!' errormessage by 'Cannot find related scan'.
- 20010123 Added static keywords.  
Moved code to GetSliceCoord; this routine checks besides tags (0x0020,0x1041) and (0x0020,0x0050) also (0x0020, 0x0032). This last tag (ImagePositionPatient) had to be used for Philips MR scanners.
- 20010302 Fix: improved temporary filename
- 20010410 Improved communication between MainThread and ServerThread. Again improved temporary filename...
- 20010411 Kill ServerThread only if it is not responding
- 20010413 Fix: allways close the threadhandle
- 20010426 Again improved communication between MainThread and ServerThread
- 20010508 Adjusted call of nki\_private\_decompress to a faster version

- 20010619 Fix in GetFloatsFromKey (crashed on PatID 1234567890 NuclearMedicin testpatterns)
- 20010717 Adjusted DcmMoveHere for RTDose post-processing
- 20010802 DcmReplaceInHeader now also supports replacements inside sequences; Added export DcmVersion
- 20010808 Fix: SetStringVR appended a NULL byte to strings with uneven characters. This is correct for UIDs, all other strings should have a space appended.
- 20010824 Updated 'soplist.txt' resource to DICOM 1999 final text.
- 20010905 Fix: Headerdump was incomplete when a VR consists of more than one short or int; Start implementation of ModalityLUT
- 20011121 Replaced 'SetStringVR' by 'SetAnyTypeVR' (Used by DcmReplaceInHeader)
- 20011218 Added DcmWriteKretzFile: extracts a Kretz 3D file from a dicomfile
- 20020225 Fix for Helax-TMS: when determining XFM's and (0x20, 0x1041) and (0x20, 0x50) are both absent, use (0x20, 0x32)
- 20020403 Fixed bug when UIDs are 64 bytes long. Some code butifying.
- 20020411 Added DcmWriteVRTToFile
- 20020502 Added cacheing properties
- 20020522 Replaced ad hoc field allocation code by 'AVSdata\_alloc'
- 20020523 Do not give warning for slice-order (DCM\_E\_SLICEORDER)
- 20020609 Pass MaxCompressionMode that is set to 4
- 20020620 Adjustment to CalcXfm for multi-frame images.
- 20020814 Added two Print error-messages
- 20020930 Added MAXSLICES to optional extraparams
- 20021028 Exported GetFloatsFromKey. Try te get XFM's of multiframe objects right.
- 20021105 Get rid of scout-views when loading a volume (in 'SortSliceDDOs')
- 20021118 Fix in multiframe XFM containing 'GridFrameOffsetVector'
- 20030122 JPEG pixeldata support; Fixed memory leak
- 20030128 When SliceCoords are not provided, sort dicom-objects on imagenumber
- 20030130 Support for 3D private Kretz ultrasound
- 20030424 Changed all calls to obsolete PDU.Write(&DDO) to PDU.Write(&DDO, uid). Fix in handling of JPEG compressed images. Version to 2.0
- 20030519 Fix XFM's when ImagePositionPatient contradicts SliceLocation. Now the slicecoord in ImagePositionPatient is preferred (Marconi-fix).
- 20030523 Fix: above change frustrated coronal and sagittal MRI
- 20030716 Workaround for sloppy Adac NM multiframe reconstructions (@#\$\$%^&\*)
- 20041116 Start on time series recognition, now return unsorted
- 20041117 'proper' time series (with exact N copies of each slice with given coordinate) are sorted on derived frame# (order of image#) then coords; but still returned as 3D. MATPEL and WRLDMATC know how to make 4D data out of such image

- data (CONQUEST does not yet).  
 This option should read 4D CT (not tested) as well as 4D MRI/DTI (tested) as long as all frames are sent as one series.
- 20041119 Adjustment in CalcXfm
  - 20041119 Added support for 4D sliced object, now sent out as 4D field
  - 20041124 Merged fix ljz 20041119
  - 20041201 Improved detection of 4D data, now allow fringes, e.g., if slices at certain locations occur NMMMMKL times, N slices at start and K+L slices at end are removed. In this way, both Philips and GE DTI and perfusion data (without fringes, e.g., MMMMMM) and Siemens RCCT data is supported. Note 1: Siemens writes % of cycle in 0018,0022 as 'TP100PC5576', where 100 is the %. Not used for now, 4D data is just ordered based on slice number instead, with coordinates 0, 1, .. Note 2: some localizer series are now returned as 4D as well.
  - 20041221 Fix in 4D reader for out-of order images; first sort on image#, later in index
  - 20050301 Fix in dubious check on 'Proper4D'
  - 20050308 One more check on 'Proper4D': at least half of the slices should be Proper4D; Fix in last check
  - 20050418 Fix in WriteBmp when all pixelvalues are equal
  - 20050804 Fix in check on 'Proper4D'
  - 20050905 Added SOP 31 for query: modality worklist query
  - 20060531 Moved FreeOutputField to field.cpp and field.h
  - 20060701 Added warning on order of 4D data - MessageBox needs to be replaced

### **CQDICOM.H (part of conquest interface DLL):**

- 19980330 Creation
- 19980331 Added exported DcmMkBinaryLib
- 19980414 Restricted the HeaderDump to max 4096 data, and the number of bytes on one line to 256.
- 19980416 Added sequence support in HeaderDump
- 19980420 Fixed last written line in multiple line sequence dump  
 Added functions DcmFind, DcmMove and DcmMoveHere
- 19980526 Added DcmCreateBitmap
- 19980610 Changed BGR to RGB in DcmCreateBitmap.  
 Added DcmMoveHeaderHere
- 19980629 Fix: DimX and DimY were reversed.  
 Improved efficiency when loading one slice.
- 19980630 Fix: last change caused crashes
- 19980707 Removed some checks to allow non-standard Philips images  
 Added DcmSetProgressHook
- 19980708 Added DcmReplaceInHeader, which can be used for anonymization of dicom images.
- 19980709 Added C-CANCEL command object when a ProgressHook stops or aborts a DcmMove operation. Added support for NkiPrivateCompressed images in DcmMoveHere.

19980826 Added #pragma pack(1) in Field.h  
 19981105 Added DcmReadHeader  
 19981127 Added DcmGetLastXfms  
 19990108 Updated the dictionary for DICOM-RT support  
 19990114 Slices are sorted on coord. When duplicate coords exist, the last received slice eliminate previous ones.  
 Included changed SOP-list by MvH  
 19981127 Added DcmTree, DcmPatientList and DcmSetLocal  
 19990825 Added extended patientlist export: DcmPatientList2  
 19990826 Added DcmMoveFilesHere  
 20000824 Added DcmFileGetRtStructNames and DcmFileGetRtStruct  
 20020425 Added DcmVersion and DcmCreateRtStructFile

### **CQCREATEDCM.CPP (part of conquest interface DLL):**

20020417 Created. All created DICOM stuff should go in here  
 20020502 DcmCreateRtStructFile seems to work  
 20041119 Work on DcmCreateSliceFiles  
 20041128 Tested write new scan on grid (and properties) of existing scan:  
 needs ScanToDicom matrix to correctly compute  
 ImagePositionPatient; writes too many \\\\ in tags;  
 SliceLocation not written; Now write abs slice thickness;  
 Added missing \*10 in Z coordinate of ImagePositionPatient;  
 Added a minus to the Z coordinate of ImagePositionPatient:  
 this is a kludge that works only for scans read with CQDICOM  
 without rotations in scanner. Added creation date and time in  
 default series description  
 20041223 Added XFM parameter to DcmCreateSliceFiles  
 Added DcmCreateRtPlanFileLight  
 Fix: also incorporate ImageOrientationPatient,  
 FrameOfReference, StudyID  
 20050906 Some fixes in DcmCreateSliceFiles  
 Added 'DcmCreateRtPlanFileLight()'  
 20051018 Several fixes in DcmCreateSliceFiles:  
 - Required tags KVP and PositionReferenceIndicator were  
 missing - Element numbers of RescaleSlope and  
 RescaleIntercept were wrong; Set all MU's to 0 in  
 DcmCreateRtPlanFileLight; added OperatorsName  
 20060704 Increased stringbuffer in GetContouData() (crashed  
 ridiculously  
 detailed on ESTRO data)

### **CQGLOBAL.H (part of conquest interface DLL):**

19990318 Some cosmetics  
 19990511 Added a few warnings and prototype of MoveDDOHere  
 19990915 Added PixelRepresentation (0028,0103) in SLICE\_INFO.  
 19991028 Added prototype of Signed\_compute()  
 19991122 Added errorcode of failed C-STORE-RSP

20000317 Added BitsStored (0028,0101) in SLICE\_INFO.  
 20000405 Added CheckRangeOfCT prototypes  
 Added RescaleIntercept (0028,1052) in SLICE\_INFO.  
 Added RescaleSlope (0028,1053) in SLICE\_INFO.  
 20000530 Added ImagePlanePixelSpacing (3002,0011)  
 20000707 Added gl\_ppvCache  
 20000710 Added prototype of CacheInitFromSelectionStrings  
 20000824 Added prototype of CacheSetReferencedStruct  
 20000828 Added prototype of Dxfm\_compute  
 20000829 Added an ErrorCode  
 20010123 Added prototype of GetSliceCoord  
 20010410 Added gl\_hevEndReceive  
 20010426 Renamed gl\_hevEndReceive to gl\_hReceiveThreadIsListening  
 20010508 Changed prototype of nki\_private\_decompress()  
 20010629 Added DoseGridScaling (3004,000e) in SLICE\_INFO.  
 20010717 Added gl\_pszExtraParams  
 20010831 Added prototype of CheckModalityLUT  
 20020418 Added prototypes for cache-ing properties  
 20020424 Added declaration of field gl\_pLastProperties  
 20020613 Added prototype of MkTypedDicomObject  
 20020814 Added two Print error-codes  
 20021028 Added prototype of GetFloatsFromKey  
 20021213 Added RtImagePosition to SLICE\_INFO structure  
 20030122 Added prototype of DecompressJPEG  
 20030128 Added 'iNbTimeSequences' and szPhotometricInterpretation to  
 the SLICE\_INFO structure  
 20030129 Added prototype of READ\_KRETZ\_compute  
 20041119 Added support for 4D sliced object  
 20050203 Added prototype of CacheCleanupRtObjectFiles  
 20050906 Added prototype of CacheGetReferencedProperties

### **CQRTOBJECTS.CPP (part of conquest interface DLL):**

19990407 Created. All DICOM RT stuff should go in here  
 19990404 Added RTSTRUCT  
 19990511 Added RTPLAN. Still under construction !!!  
 19990825 Some changes in RTPLAN; still under construction  
 20000619 Added GetStructInfo to be used by TREE  
 20000707 Lots of work on RTSTRUCT and RTPLAN  
 20000828 Structure and beams has wrong XFM when patient is prone  
 20000829 Added GetRtBeamFromRtImage  
 20010302 Fix: improved temporary filename  
 20010410 Again improved temporary filename...  
 20010619 Added some comments on RTPlan organization.  
 20010717 Store szReferencedFrameOfReference in  
 STRUCT\_TREE\_INFO; To do: in 'CalcBeamXfms' the  
 collimator angle is not treated right when the patient is prone.

- 20000824 Added DcmFileGetRtStructNames and DcmFileGetRtStructFixed two small memory leaks.
- 20020225 Fixed free-ing twice in 'GetRtStruct'
- 20020502 Removed some warnings
- 20020613 Moved MkTypedDicomObject to CqServer.cpp
- 20030122 Some work on GetRtBeamFromRtImage: still under construction due to world-wide lack of good data!!!
- 20030520 In GetRtStruct, fail with DCM\_E\_INTERNAL when there is no cached underlying scan.
- 20050125 Made beam field output contain short data instead of char data  
GetRtBeam has an optional string parameter to load a specific segment (= controlpoint); Added GetPlanInfo for TREE building purposes
- 20050131 Moved MkTypedDicomObject() in GetRtBeam to StoreBeamPropertiesInCache
- 20050201 Fix: do not delete pDDO in GetRtBeam anymore
- 20050202 Fix: When settings of a controlpoint do not change, they may be defined only at controlpoint 0.
- 20050921 Change in CalcBeamXfms for FeetFirst and Prone patient-positions (This change is already in use for two months, and has been approved by Peter Remeijer)

#### **CQRTOBJECTS.H (part of conquest interface DLL):**

- 19990407 Created
- 20000619 Added prototype of GetStructInfo
- 20000707 Added more RtObjectXXX prototypes
- 20000824 Added szReferencedStruct to BEAM\_TREE\_INFO. To be used in order to get the XFM of a beam IFF RTPlanGeometry equals 'PATIENT'. In the other case (when RTPlanGeometry equals 'TREATMENT\_DEVICE'), the the XFM is defined by the 'IEC fixed coordinate system'; this case is not handled in CqDicom.
- 20000829 Added prototype of GetRtBeamFromRtImage
- 20010717 Added szReferencedFrameOfReference in STRUCT\_TREE\_INFO  
To do: in 'CalcBeamXfms' the collimator angle is not treated right when the patient is prone.

#### **CQTREE.CPP (part of conquest interface DLL):**

- 19990504 Creation: Moved Tree and PatientList from Avs\_dcm to here
- 19990511 Adjustments concerning DcmSetLocal
- 19990825 Added extended patientlist export: DcmPatientList2
- 19990826 Implemented DcmPatientList2
- 19990830 Fix: ParseSelInfo did not handle an 'extra' Key/Value pair in a selection-string.
- 19990906 Improved Alias-names of Dicom Tree Interface
- 19991019 Besides CT and MR, the images of modalities US, DR and DS belonging to the same series are grouped into a single volume.

- 19991026 Use SeriesDescription in tree if no SeriesNumber/SeriesTime available
- 19991028 MultiFrame images will be treated as '.scan' instead of '.image'.
- 19991029 Added support for multiple multi-frame images in one series  
When MovingHere only one image, the C-FIND operation is skipped. Fix: EchoNumber was discarded when retrieving header-info
- 20000126 Fix: EchoNumber was used even when value is '(empty)', only in cases where EchoNumbers were needed in other parts of the tree.
- 20000128 Fix: three memory leaks
- 20000426 Adjustment for difference in response of Borland ODBC and Microsoft SQL: an empty string-field is returned as "" and " " respectively.
- 20000707 Put structures in the tree under a scan
- 20000710 Fix: Update cache when TREE has been bypassed
- 20000717 Fix: XFMs of multiframe-scans were not returned
- 20000808: Extra check: SOPInstanceUID must be passed in selection for RT objects;
- 20000823 Fix: Crash in building of TREE when the move-response of an RT-object was OK, but no DDO was transmitted.
- 20000828 Fix: Structure and beams has wrong XFM when patient is prone
- 20000829 Added RTIMAGE properties: 'refmeam', 'refbeamwordxfm' and 'refbeamgantryxfm'
- 20010420 Added support for PatientID containing '/' or '\\'.  
20010619 Start implementation of RTDose objects.
- 20010717 When RTStructs do not reference a Series, use ReferencedFrameOfReference if possible. Caller may use 'IMAGESONLY=1' in DcmSetExtraParams when grouping of images into scans is not desired.
- 20011214 Damn! It now seems best that US images are not grouped together anymore...
- 20020403 Fixed bug when UIDs are 64 bytes long. Got rid of two #defs
- 20020501 Added cacheing properties
- 20020521 When modality equals PT, combine slices to a volume.
- 20020613 Always use SeriesDescription in tree
- 20020619 Split date parts with dots; display studymodality (0008,0061) in study alias
- 20020620 Merged 20020613 with 20020619. Do not split dates.
- 20020815 In 'ParseDicomInfo' allow also ':' as a separator
- 20021011 Fix: When bypassing the TREE, cache was not initialized when retrieving a single image or a multi-frame volume
- 20021011 Added other query modes (4..9) for DICOM\_LOAD\_PATIENTLIST (CreatePatientList)
- 20021014 Merged the two versions
- 20021028 Try to get XFM's of multiframe objects right.

- 20030128 Support for 3D TimeSequences, resulting in 4D 4-space output scans. Make check on QueryResponse case-insensitive (choked on PatientID Test vs test)
- 20030130 Support for 3D private Kretz ultrasound
- 20030213 Above change crashed when in a FIND operation there is US present, and the queried dicomserver did not supply the 'Manufacturer' key.
- 20030624 Support for multiframe dosegrids
- 20030710 Additional sorting of C-FIND result on SOPInstanceUID
- 20040525 Also send PatientID when query/retrieving RT objects
- 20050126 Made better ALIAS in TREE for RTPLAN  
Made ALIAS in TREE of a series '(empty)' if no good ALIAS can be constructed  
Implemented interface to load individual segments in a beam  
Moved DCM\_PLAN and DCM\_STRUCT typedefs to "CqRtObjects.h"
- 20050131 Check empty sequences in 'StoreBeamPropertiesInCache', and made DDO a TypedDDO
- 20050201 Handle possibility of retrieval of beam properties before retrieval of outline in ReadKeys()
- 20050203 Function GetRtDDO now caches DicomRT files. When a NEW PatientTree is constructed, these files (of a different patient) are deleted. This speeds up things enormously
- 20051018 Support for Corvus in FixControlPointProperties
- 20060103 Studydate queries on val instead of \*val\* (kodak could not handle it)
- 20060531 Added exported function 'DcmGetPlanPois'

#### **CQCACHE.CPP (part of conquest interface DLL):**

- 20000710 Added CacheInitFromSelectionStrings
- 20000808 Fix in comparison of selection with cache
- 20000824 Added ReferencedStruct to cache (used for beams)
- 20000829 Also store 'image' in cache
- 20010717 Some work on RTDose objects
- 20020418 Added cache-ing of properties
- 20040616 In CacheInit (Called from PatientTree), keep the cache if the tree is from the same patient
- 20050203 Added CacheCleanupRtObjectFiles. This is done just before a PatientTree of a different patient than last patient is being constructed
- 20050906 Added 'CacheGetReferencedProperties()'
- 20050919 Increased MAX\_SEL\_CACHE from 200 to 2000

#### **CQPRINT.CPP (part of conquest interface DLL):**

- 20020814 Added exported functions 'DcmPrintScan' and 'DcmPrintFile'; Altered 'PDU.AttachRTC' in 'PrintGrayScaleImages'; Tested with OFFIS and Mallinckrodt

- 20020816 Padded uneven string VR's with space  
Support of byte images. (RGB does not work yet)
- 20020823 DcmPrintFile accepts multiple filenames (separated by ;) and decompresses NKI data
- 20020825 Added DllProgress calls during print (used by server to ensure printing without losing socket data)
- 20051217 Use nicer method to replace compressed by uncompressed data

**ERRCODES.H (part of dgate.exe):**

- 20041221 Moved errorcode to here
- 20050901 Renamed errorcodes.h to errcodes.h

**CQJPEG8.CPP (part of conquest interface DLL and dgate.exe):**

**CQJPEG12.CPP**

**CQJPEG16.CPP**

- 20020301 Created
- 20030415 Better exception handling
- 20030417 Support for multi-frame images
- 20041221 Changed include files
- 20050215 Fixed for fragmented frames in a sequence
- 20050901 Renamed errorcodes.h to errcodes.h

**CQJPEG.CPP (part of conquest interface DLL):**

- 20030123 Created
- 20030128 Start work on RLE decompression
- 20030415 Fix in determining RLE decompressed size

**DICOMP.CXX (sample print program)**

- 20020816 Fix in (unfinished) main server code
- 20020822 Made this sample program part of code base

**TEST.CXX (sample client program)**

- 19980322: played around; added comments in query client
- 19980322: Added command line interface for c-find
- 19980323: Added command line interface for c-move
- 20000318: Added optional NKI command vr's to echoclient
- 20020315: Started on -fe: forwarding server; implemented echo, working on move and find
- 20020316: Added cstoreclient -t; load dd.txt as dicom dictionary; -fd=diagnostic mode (logs) Added IARQ; note: cast of PDU to dump() seems to crash sometimes. Forwarder works between QUIRT/conquest apps and conquest dicom server.
- 20020317: Made forwarder more general; works between EFilm and Conquest
- 20020811: Fixed forwarder such that it works for dicom-print

- Fix: Forwarder did not worked with OFFIS because OFFIS checks message command/data pdv bit 6[1] that is was not set correctly by forwarder (command/data object)
- 20020822: Made this sample program part of code base
- 20030630: Fixed crash in cast of Dump(PDU) (c.f. 20020316)  
Fixed passing of cmds to Find and Move  
Fixed continuous CechoServer  
Removed calls to obsolete PDU.Write()
- 20030721: Fixed SetStringVR (pad uneven strings with a space)  
C-Find and C-Move wildcards "\*" seem not to be valid
- 20040711: Fixed forwarder: status=0xff00 loops responses; status==0 keeps association open
- 20040712: Added auto-returner to forwarder - functions with NKI viewers (assumes viewerAE of X%ip or XX%ip).  
You need to set AE and port of return forwarder in your PACS though; see gatewayname, gatewayport, returndump and viewerport for configuration
- 20040713: Attempt to make it multithreaded; however return connection only starts once (supports single client only!)
- 20040713: Split into modes -fp: for printer; -fb: forwards and returns; -fe normal forward; -ff fixing forwards
- 20051217: Use new ReAlloc method to replace data in VR
- 20060618: Allow (and disabled) looping of c-move to test repeated c-move problem in read-ahead thread
- 20061127: Allow (and disabled) looping alternating c-move and c-find to test server

### **TOTAL.CXX (sample for making DGATE.EXE without make file)**

- 20020822 This file compiles to TOTAL.EXE = DGATE.EXE with, e.g., BC55
- 20050102 Added NOINTJPEG flag: jpeg8/12/16 sources cannot be compiled at once
- 20050107 Changed order of compile
- 20050111 Added npipe.cpp and gpps.cpp for LINUX
- 20050118 Documented how to compile under linux and with visual c++
- 20050121 Changed filename to lower case
- 20050130 Added xvgifwr.c

### **DGATESERV.DPR (part of dgateserv.exe)**

- 20000316 Created
- 20000326 Close handle on terminate  
Dgate runs via new SlaveProcess mechanism of Uservice

### **USERVICE.PAS (part of dgateserv.exe)**

- 19990316 Fixed English of some messages  
Added account and password as optional parameters for install

- 19990325 Added option to start/stop/install/uninstall on remote machine  
Works fine with start / stop / uninstall  
Remote install works except for wrong exe path  
Therefore added ExeName property and command line switch
- 19990326 Added service option: makes it a generic installer!  
Made ServiceName and ServiceDisplayName read/write  
Added AllowSlaveProcess: command line can set slave process  
Added SlaveProcess and SlaveProcessArgs: executable to start  
Fixed arguments passing when /start is followed by more /  
Fixed ServiceName: is read as first arg in DoCmdLineStart  
Note: SlaveProcess is killed when service stops

### **SERVERDRIVER.PAS (part of conquestdicomserver.exe)**

- 19980405 Created
- 19980407 Added dgatesop.lst file creation; max AE to 16 chars
- 19980407 Sorted image list on SOPINSTANC to get correct order
- 19980412 Added DuplicateHandle code; but still deadlocks
- 19980413 Threaded mode avoids TCP/IP component (seems to fix deadlock)
- 19980414 Restart after switching server mode does not always work;  
Fix application to threaded mode for now.  
Added compression configuration.
- 19980415 Some fixes for the first installation code
- 19980505 Made length of directory field in MAGDEVIC 250 chars
- 19980608 Replaced TQuirtViewer with TImage => no need to load ntpars.dll
- 19980614 Merged code with use FPiette tcp components
- 19980616 All OK with new fpiette code; actually I had to fix my own bug
- 19980617 Save as bitmap and dump header in popup menu
- 19980618 Query and Move options for CQDICOM.DLL
- 19980619 Added header lister; default MagDeviceThreshHold to 10 MB
- 19980620 MagDeviceThreshHold is now configurable
- 19980621 Renamed table to MagDevice; use full table names  
Nicely coded DBF/Access choice; but fixed to DBF  
Delete patient and refresh database menu options
- 19980622 Double click query memo to make new query  
Show on bitmap: patient is being deleted/file not found
- 19980623 Save bookmarks of tables; move to next record after delete
- 19980624 DICOM.SQL: StudyNumber (StudyID in DICOM) is now 64 long (Microsoft SQL server does not allow truncation)  
Update bitmap after loading for fast display  
Text strings in UDP input to 1024 (for long SQL errors)  
Default password and user name to 'conquest'  
PAGETIMEOUT to 600 for better database performance  
Made DataSource name more or less configurable  
Made all port numbers more or less configurable  
Installing a second server on one PC while one server is running works

- 19980702 Added KBUSED field in MAGDEVICE table
- 19980703 Some changes in static texts and hints
- 19980704 Found a handle leak in RunDgate; not fixed yet
- 19980708 Make anonymous; show progress for move
- 19980710 Added experimental archive option; fix stopcopying option
- 19980711 Fix double click query on empty form; use tray icon
- 19980713 Add Name of server in tooltip of tray icon; fix DiskFree
- 19980717 Fix crash if directory does not exist
- 19980721 Clicking tray icon restores window
- 19981219 Improved error handling display;
- 19981220 List header of undisplayable object in static  
Read and save FileNameSyntax; default=3
- 19981221 Suppress display of large files (>1 MB)
- 19981222 Use FieldByName, added combobox selectors  
Disable study navigator if only 1 available  
Moved modality from the study to the series level
- 19981229 Changed order of TableN.close to avoid side effects
- 19990104 Fixed MAGDEVICE creation under SQL server  
(KBused optional)
- 19990109 Made ImageNumber 10 bytes wide (for GE AdvantageWin)
- 19990110 Combobox1 is now patient filter and or selector  
Added access to cache and jukebox in browser but  
with limited support: up to 10 devices (one character)  
Added archiving page; fixed most handle leaks
- 19990112 Finished first archiving page; -hide command line option  
Added clear database and regen single device buttons  
Clear combobox for each page select  
NOTES: Archive page is configured by editing  
Restore original configuration or restart to load it  
Archiving allows up to 10 Jukeboxes, but only the  
selected one is used for writing. Only the drive  
with MAG0 is checked for disk space for automatic  
archiving. Only device CACHE0 is passed correctly  
to the burn program. This means: stick to 1 MAG  
device and 1 CACHE device for now.
- 19990113 Speeded archiving by selecting MAG0 if there is only 1  
Renamed entry to BurnThresholdMB, made BurnProgramList  
Note: to do - keep log file of archiving operations.  
- add RT objects to default sop file.
- 19990114 Added date and time formats for burnprograms
- 19990115 label format burnprograms; no write empty ini  
Sync magdevice0 with DataDir; %% and %p formats
- 19990315 Added EchoNumber in image table - used to separate PD,T2  
Completed dgatesop.lst with Philips, GE, RT  
Added NumberOfFrames in image table - to find multiframe  
objects
- 19990413 truncate QUERY request depending of level
- 19990510 Allow AEs starting with a digit (Siemens MRI)
- 19990527 Revision 3 of database layout (birthday, sex, bolus)

- 19990902 Added load/store of mirror devices and export converters  
 19990905 Switched word wrap off for memo's  
 Added DcmMoveFilesHere on right click of copy; but seems to crash; Problem: if we pass DcmMoveFilesHere servers AE/PORT saving slices from own server will fail. Now pass 'test;1234'
- 20000127 Hide archiving tabsheet in new install; Add NKI sops to install;  
 20000128 Added extra GE sop; compressmode 2; disabled movefiles here  
 20000316 version 1.3.5: Integrates dgate as service operation  
 New install does not start dgate right away
- 20000317 Truncate patient list if too long  
 20000318 '\$ RESTART' as console message kills and restarts server  
 '& DGATE xx' as console message runs dgate with args xx
- 20000323 Added query sop choices through level dropdown list  
 20000326 Service supported for more than one server:  
 servicename=AE; port passed as /process dgate.exe -!port  
 Removed need to enter password for SQL access  
 Save and restore user and password in dicom.ini  
 Added 'ping' option for remote check of archiving:  
 Deletes ConquestDICOMServer.Ping and makes  
 ConquestDICOMServer.response with archive status  
 Allow up to four servers at the same time, also as services  
 Note: only the first server will start correctly on boot!  
 (on boot, the /process parameter is not passed and the default IP message port will be used -!1111); Presence of file USESQLSERVER allows install on SQL server  
 Presence of file USEMSACCESS allows install using access db
- 20000328 Added tests of local server at key moments  
 added -noconfirmquit option; show VERSION in caption
- 20000402 Install service with startup at right socket  
 Read service socket from registry on startup
- 20000403 Improved socket handling; fixed space in path when not service; space in path blocks service install.  
 Now recognizes installed but not running service  
 Number of servers on one PC is now unlimited.
- 20000417 Fixed MSACCESS ODBC creation  
 20000501 ExportModalityx should be UPPER-case  
 20000528 Added "force display of large image", "remove image from database", "run external viewer" and demoviewer option  
 Removed '.' as workdir from runprogram etc (allow bat files ?)  
 Added democopy option: copy incoming to dir + CallingAE.v2
- 20000529 Merged two changes  
 20000529 Release to 1.3.6  
 20000616 Attemp to create NewInstallForm database selector  
 20000625 Added NewInstallForm database selector; default to MSACCESS  
 Added Send ... To menu items in popupmenu  
 Removed '\*' items from Dicom system selectors  
 Added Send Selected Images for more flexibility

- 20000626 Added animated display menu options
- 20000701 Added Send Selected Images selector window
- 20000701 Some adaptations of Send Selected Images;  
MaxFileNameLength  
TrimRight strings in query - trailing spaces depend on db
- 20000707 Added Edit Database by Hand menu option
- 20000808 Added ,0 code in timed archiving
- 20000915 Added ListenSocket.Addr (0,0,0,0) in multi-app mode
- 20001107 Added CheckBoxViewIncoming for demo display of  
incoming images
- 20001108 Display originating server on incoming image;  
Disable menus when the ViewIncoming option is selected
- 20001129 Added fix so that DICOM.INI may contain UNC path  
Added menu choice to change ID of selected series  
Version to 1.3.7
- 20010312 Trimmed remote IP so that hostnames can be resolved in  
CqDicom.dll
- 20010318 Trim servername and ip;  
alt-rightclick the service buttons installs service 4 times  
e.g., at ports 5678, 5679, 5680 and 5681 (all with same data)  
This may be used for efficiency and to limit the effect of  
crashes; Version to 1.3.8
- 20010327 Always pass curdir to runprogramxxx and startprogram -  
required because directoryview changes current directory!
- 20010328 Uppercase account for service; colors for archive status  
Added verify mirror disk button; burn only once per time  
Show date and time for archival steps; added KeepAlive  
Added MirrorVerifyTime (verifies whole MAG0)  
Added conquestdicomserver.log with major messages
- 20010405 Added comma-separated list option for patid in query page
- 20010406 Ctrl-dblclick adds patid to comma-separated list
- 20010406 All status memo's are now limited in length and save to  
separate log files  
Added (and disabled) simple zip code for log files per day
- 20010409 Do not log query page
- 20010409 Added Tape backup page; replace few GetCurrentDir by  
CurDir
- 20010410 Added timeouts (10s and 5 hours) to tape backup
- 20010412 Separate tape backup button - some fixes
- 20010416 Improved anonymize and change patient ID using new dgate -f  
options; Added drag and drop interface to add files to server
- 20010418 Changed description of forced backup set; refuse dropped  
directories; Version to 1.3.9
- 20010418 Update maintenance memo during drag and drop
- 20010418 Fix: timer4 was enabled if no KeepAlive specified in dicom.ini  
Hide tape backup page in new installation  
Added default install button in firstinstall
- 20010419 Added anonymize and change patient ID for study
- 20010502 Added DeleteThisStudy/Series

- 20010830 revision 4 of database definition (extended)  
Added ExportStationName in dicom.ini  
Updated dgatesop.lst to conform to DICOM 1999 final text  
Version to 1.3.10
- 20010903 Suggest .\username as account
- 20010904 Fix: Query was freed twice when a DicomMove failed
- 20011108 Added automatic zipping of log files  
Make sure that tape backup and archive pages are not shown  
Added save/restore of ExportFilter settings
- 20011109 Small fixes:  
do not write empty configuration strings (empty<>default)  
keep some settings with original case (see sorg)  
use StrToIntDef to avoid exceptions on invalid settings  
Added ZipTime as configurable
- 20011127 Added SeriesPat and ImagePat fields to DICOM.SQL  
Surpress fail message box when using SQL server  
Version to 1.3.11
- 20020402 Adapted controls.pas: exception handling in  
finddragtarget and findvclwindow
- 20020409 DB rev 6: added frame of reference UID to series
- 20020416 Store/save UIDPrefix for in dicom.ini  
When creating dicom.ini, create unique UIDPrefix:  
'1.2.826.0.1.3680043.2.135.Date.Time'  
Added configurable TestReadTime: regular check of MAG0
- 20020417 Fix: QueryResult has not necessarily 64 char  
Renamed some data structures
- 20020422 Do not save empty UIDPrefix; fix change patid for study
- 20020424 Added simple weekly checks page; mail ALL failures
- 20020426 Fix in mail sender list; use first e-mail as 'to' address
- 20020428 All recipients show in to: header  
Only serious error messages have \*\*\* in string  
Added MailCollectTime and MailWaitTime  
Avoid starting check more than once
- 20020510 Added CheckDicomSubmits (send mail when users forgot to  
send images to the PACS)
- 20020513 Checks: empty time runs all day; added log header/footer  
Updated CONTROLS.PAS: more exception handling  
Fixed reading of weeklychecks; display CD num in header  
Fix warnings and patient ID checks in CheckDicomSubmits
- 20020515 Added ImageType to database (rev 7)  
Added find missing patients button;  
allow more than one weekly check time (; separated, not  
adjacent)
- 20020515 Fix missing pats when query empty  
Added grab options to weekly checks
- 20020517 Changed StudyModality to 64 chars (e.g., fits :  
CT\MR\PT\XA\ST\MG\MS\RTIMAGE\RTDOSE\RTSTRUCT\RTPLAN\RTRECORD)
- 20020518 Fix in weeklychecks tag: too many with tag 0
- 20020519 Fix in rev 7 db definition: AcqDate is now SQL\_C\_DATE  
Added FixPhilips in DICOM.INI

- 20020520 Use DGATE.EXE for grabbing
- 20020522 Fix reading of entries with an '=' in e.g., dicom.ini
- 20020524 Fix acrnema.map problem with new install
- 20020529 Fixed duplicate mailing of messages, added WriteMemo  
Added archive.log; extra parameter for regen for DBASEII  
Removed MessageBoxes
- 20020609 Read and write FileCompressMode, default remains 2
- 20020613 Added alt-drop code: enter with new patient ID
- 20020819 Basic printer support; view incoming shows printer data
- 20020819 Process messages as files are dropped  
Print incoming imageboxes on default printer
- 20020821 Printer accepts landscape and portrait any pictures per page  
Progressbar shows printer queue activity  
Note: printer queue is single user (but may be fixed, using film#)!
- 20020823 Added print options in browser - print to local dicom server
- 20020825 Headerlister is modeless - added CTRL-A, CTRL-C, CTRL-F,  
CTRL-S, F1, F3 end ESC  
Printer has progress hook - required to avoid socket data loss  
Selection of print page format; edited info text  
Added all 1.3.11 fields to edit database by hand
- 20021015 Start deleting patient started delete "=ALL when no patient in  
list!!!!  
Protect all pop-up functions for no selection
- 20021016 Better support for copying large #patients, even if one or more  
missing  
Added denormalized database option (for DBF without ODBC)  
Removed obsolete magdevice button
- 20021017 Added "" around dropped filenames; use filter instead  
of master-detail (requires index) for built-in dbf support  
Version to 1.4.0; added dropping of directories  
Added UID counter passed to dgate to avoid UID problems
- 20021018 Fixed browser fail and missing dbase dir after non-odbc install  
Limit dbase list in browser (alternative to image) to 100 lines
- 20021020 Added Kill and Restart the Server weekly check (packs  
built-in dbf); Fix reading of database name if not default
- 20021021 Small fix in maintenance memo for very long strings
- 20021028 Also denormalized series database; default de-normalize study  
(rev 8); Show denormalized study entries in database editor
- 20021029 Fixed query keys transmittal (sent sop when not needed)
- 20021213 Added EnableReadAheadThread as configurable parameter  
Disabled GECTStorage amd GEMRStorage in dgatesop.lst
- 20030113 Version to 1.4.1; Fixed keeplive option (was never enabled)  
Added PatientQuerySortOrder and such
- 20030128 Fix update of headerlister when no image shown  
Make DBF table links case insensitive
- 20030319 Fix: ImageDB entry 'ReceivingCoil' is 16 bytes (not 12)
- 20030324 Start on 1.4.2: db rev 10: made ReceivingCoil 16 wide
- 20030402 Merged above two changes

- 20030409 Handle DicomPrint error; several path fixes in tape-handling  
 20030613 Catch WM\_QUERYENDSESSION: shutdown disables close dialog
- 20030628 Fix that more than one dropped directory will be loaded  
 20030706 Prepare for release 1.4.2; new dicom.ini; kill server  
 Compression column in acnema.map
- 20030707 Added manufacturer to denormalized db (rev 11)  
 Write registry key  
 HKEY\_LOCAL\_MACHINE\SOFTWARE\NKI AVL\Conquest\Dicomserver\SERVERNAME  
 with values: directory=path without trailing backslash and  
 laststarted=yyyymmdd. For use by Dicom-works only.  
 Note: servername changes are updated on GUI startup only.
- 20030708 Made JPEG compression configurable (affects dgatesop.lst)  
 20030709 Write version into registry  
 20030710 Install service as system account (no user required)  
 Fix attempt to mail when not wanted  
 ----- release 1.4.2 -----
- 20030717 Fix problems when registry access fails  
 20030809 Will automatically use ADO or MDBF when BDE not installed  
 Set version to 1.4.3
- 20030810 Log used DB engine; Added partial ID matching for MDBF  
 Default enable uncompressed button before install  
 Force user to push 'Save config button'  
 Added some text to install and maintenance pages  
 Do not display images when on jukebox (use force display)
- 20030819 Made max drop filename length longer (256->1024)  
 20030905 Date of zip file is one day before if zip before 8 in the morning  
 Hide external viewer menu directly after install  
 Optional configuration of SendUpperCaseAE added  
 Removed obsolete flush button  
 Do not allow install in directory with spaces in its name  
 Removed faulty extra text from install page
- 20030907 Fix ODBC generation for directory with spaces  
 Just warn against directory with spaces
- 20030909 Test write access to log files prior to startup  
 20030920 Mail messages that contain 'fail' instead of 'failed'  
 Added tape full warning (that will be mailed)  
 Added enables for timed archival (to allow retry/timer disable)  
 Changed order of burn CD message / tape backup  
 Added NextSlotToUse (slot n) next to NextCDToBurn  
 (JUKEBOX0.n); % in burn parameters %n = NextSlotToUse,  
 %c = NextCDToBurn; Manual archive buttons control  
 checkboxes as well
- 20030921 CTRL-Double click "automatic archival label" starts archival  
 CTRL-Double click "weekly checks time" starts check  
 Added NightlyCleanThreshold parameter (clean # MB at  
 01:00)
- 20040401 Added ImageID to database; version to 1.4.4  
 Show ImageID in database editor and browser
- 20040402 Allow anonymize etc on MAG0..MAG9;

- changed datasource name (now system DSN)
- 20040425 Added DoubleBackSlashToDB to dicom.ini
- 20040426 Version to 1.4.4a
- 20040528 Use built-in servertask commands for maintenance and browser
- 20040530 Browser for built-in DBASEIII driver uses extract server command; Database editor to read only for built-in DBASEIII driver; These changes allow efficient use of in-memory index for dbaseIII; OK for 10<sup>7</sup> images when patientID, studyUID or seriesUID passed in Queries; Added PackDBF and IndexDBF to dicom.ini; Reworded some in popup menu; wait for patient deletion to finish; Fix refresh for sql server
- 20040601 Added LongQueryDBF flag
- 20040605 Fix extract when no patients; kill server stops loop of server tasks; start server on activate (after windows shows)  
Pack the Database as Weekly Check Action
- 20040606 Fix in formactivate; display @ startup
- 20040610 use servertask to clear index and rebuild it in built-in dbase mode
- 20040614 small fix in keep server alive; added nightlymove option
- 20040615 small fix in nightlymove option; also reindex after regen device
- 20040713 Added FixKodak; version to 1.4.6
- 20040722 Installation defaults for FixPhilips and FixKodak are now 0
- 20040804 Added \*.lst to zipped log files; added bug report option  
Version to 1.4.7
- 20041029 Added merge and split series options;  
Process messages during long GUI actions if possible (no DB)
- 20041030 Modified GUI of merge and split, process messages
- 20041101 Check for MAG storage for split/merge  
Delete from DB does not use image (for orphaned DB)  
USEDATABASEIIIWITHOUTODBC replaced by Pos('\', Datasource)>0 while running
- 20041102 Added nj compression mode
- 20041108 Added warning when alt-dropping file(s) with \$.. as Patid (debug)
- 20041128 Fixed wording of delete messages: works on all mag devices  
Fixed problem in DeleteThisSeries, Anonymize, and change Patient ID: last series could not be modified/deleted
- 20041129 Made font size of server status window selectable; Made debug log switchable; service will continue to log to file even if user interface is closed (but with different date/time layout)  
Now can save and use acrnema.map without server restart  
Fix startup problem when disk 'c' not available
- 20041201 Backup fail 1..5 files temp logged as ALMOST OK -> continues
- 20050106 Fixed install as four services, fixed nightlymove amount  
Is now nightlymovethreshhold - free space: i.e., attempts to make nightlymovethreshhold MB free space  
Fixed nightlymove: forgot to pass ',0' for MAG0  
Also, try move even if select failed to avoid stall

- after partial failed select
- 20050109 Made backup of and warn when dicom.sql is overwritten  
Added TCPIPTimeOut, FailHoldOff, RetryDelay, QueueSize  
Version to 1.4.8
- 20050114 On startup ask to delete ExportFailures\*, CopyFailures\*
- 20050422 Added BurnTime2 (2 dvds per day) and BurnWeekend (all  
weekend through)
- 20050429 db rev 14: added worklist support
- 20050829 recurse directories when dropping files to ease load dicom CD
- 20050831 Added find modality worklist to d Gatesop.lst
- 20050901 Added clear worklist button, version to 1.4.9, WorkListMode
- 20050905 Modality worklist query, auto append worklist to dicom.sql
- 20050907 Avoid dicom.sql message in new install, v\* and s\* in  
acrnema.map
- 20050912 Small changes to dicom.ini, dicom.sql, d Gatesop.lst; added  
SQLHost. Small change to mdbf: extra refresh avoids browser  
failures
- 20051024 Version to 1.4.9a: recompiled with patched controls.pas
- 20051230 Version to 1.4.10  
Moved clear worklist button and add pack database button  
Added warning when worklist is added to dicom.sql: clear  
worklist required  
Added settings: DebugLevel, CacheVirtualData,  
LargeFileSizeKB, VirtualServerFor#  
enable study controls prior to return if same (none) image  
shown
- 20060102 Update of hints
- 20060103 1.4.10 Release
- 20060201 Added K-Pacs/EZDICOM based viewer
- 20060312 Keep case of VirtualServerFor; Message buffers from 1024 to  
8192; Open k-pacs viewer on correct series; version to 1.4.11
- 20060314 Added experimental native Mysql access; installs when  
libmysql.dll is found - uses mysql version 4.1.14
- 20060315 Keep case of FileNameSyntax
- 20060328 Updated hints and file version for release 1.4.11
- 20060618 Set default user for mySQL to root (thanks Chris Muller)  
Seems to then also work with mySQL 5.0.22, version to 1.4.12
- 20060707 Bug reported by Paolo Marchesi: save config loses DBF  
Now only set to default when previous does not exist  
Use same zipmaster as in previous versions (zipmaster\org)
- 20061101 Added SeriesDescription to query page
- 20061129 Added control for debuglevel, and allow queries on UID  
Double click queries labels to change mode
- 20061130 Added new dgate parameters; consolidated debuglevel control  
and param  
Made application forms resizable and set size constraints  
Small font control works on all status pages  
Double click image to force display it
- 20061220 Pass Tempfile to kpacs viewer form

20070123 Added processfilter to allow browsing of patients with ' in patientid  
 20070126 Importconverters stuff and ForwardAssociationRelease in dicom.ini; Version to 1.4.12b  
 20070201 Version to 1.4.12c

### **SERVERABOUT.PAS (part of conquestdicomserver.exe)**

19980405 Created  
 19980618 Added reference to Fpiette; use form also as file lister  
 19980624 Removed line about backdoor  
 19980721 Removed line about Mark Oskin going away  
 19990527 Release to 1.3.3  
 20000128 Release to 1.3.4  
 20000316 Release to 1.3.5  
 20000529 Release to 1.3.6  
 20001129 Release to 1.3.7  
 20010318 Release to 1.3.8  
 20010318 Release to 1.3.9; fixed dbaseIII text  
 20010830 Release to 1.3.10;  
 20011127 Release to 1.3.11;  
 20020816 Release to 1.3.12;  
 20020825 Made Lambert's e-mail address more prominent  
 20021018 Version to 1.4.0; added release date  
 20021020 Update release date  
 20021028 Update release date  
 20021215 Update release date  
 20030113 Version to 1.4.1; release date  
 20030128 new release date  
 20030303 new release date  
 20030710 Version to 1.4.2; release date  
 20030809 Version to 1.4.3  
 20030810 Added reference to offis, zipmaster, and mitec  
 20030922 Release date  
 20040402 Version to 1.4.4  
 20040406 Release date  
 20040426 Version to 1.4.4a; Release date  
 20040615 Version to 1.4.5; Release date  
 20040722 Version to 1.4.6; Release date  
 20040805 Version to 1.4.7; Release date  
 20041129 Release date  
 20050106 Version to 1.4.7a; Release date  
 20050109 Version to 1.4.8; Release date  
 20050303 Release date  
 20050912 Version to 1.4.9; Release date; worklist info  
 20051024 Version to 1.4.9a; Release date  
 20060103 Version to 1.4.10; Release date  
 20060314 Version to 1.4.11; Release date; new acknowledgements  
 20060402 Changed fpiette's website; Release date

20060708 Version to 1.4.12alpha; Release date  
 20061222 Version to 1.4.12; release date  
 20070126 Version to 1.4.12b; release date  
 20070201 Version to 1.4.12c; release date

### **SENDSELECTED.PAS (part of conquestdicomserver.exe)**

### **HEADERLISTER.PAS (part of conquestdicomserver.exe)**

20020825: added keyboard interface (see serverdriver.pas)

### **EDITDATABASEFORM.PAS (part of conquestdicomserver.exe)**

### **ABOUTNEW.PAS (part of conquestdicomserver.exe)**

20000625 Added NewInstallForm database selector; default to MS  
ACCESS  
 20010418 Changed text; added default install button  
 20010830 Version to 1.3.10  
 20011127 Version to 1.3.11  
 20020816 Version to 1.3.12  
 20021016 Added DBF without ODBC  
 20021017 Version to 1.4.0  
 20021018 Default to USEDBASEIIIWITHOUTODBC  
 20030324 Version to 1.4.2  
 20030810 Version to 1.4.3 - removed ODBC DBASEIII choice  
 20040102 Version to 1.4.4  
 20040426 Version to 1.4.4a  
 20040530 Version to 1.4.5  
 20040713 Version to 1.4.6  
 20041029 Version to 1.4.7  
 20050106 Version to 1.4.7a  
 20050901 Version to 1.4.9  
 20051024 Version to 1.4.9a  
 20051230 Version to 1.4.10  
 20060313 Added experimental native Mysql install when libmysql.dll is  
found  
 20060618 Version to 1.4.12  
 20070126 Version to 1.4.12b  
 20070201 Version to 1.4.12c

### **DVIEW.PAS (k-pacs viewer part of conquestdicomserver.exe)**

20000625 Added NewInstallForm database selector; default to MS  
 20060116 Adapted for Delphi 5 compatibility Do not use  
TFormatSettings; Do not use DelimitedText  
 20060116 Included NKI decompression (without CRC check)  
 20060117 Reset NKICompress flag if normal pixel data found  
 20060117 Fixed AddDelimitedText; fixed for multiframe data

- 20060117 Fix NKI compression when DCMloadMultipleFiles is true
- 20060117 Fix Get\_ZDimension when DCMloadMultipleFiles is true
- 20060117 Accept conquest .V2 files as dicom in DCMloadMultipleFiles
- 20060120 DcmFilename now accepts multiple filenames separated by "\*\*"
- 20060120 Added new dcmTool kSlice to stack trough an image
- 20060120 New global boolean gNoOffsetList to bypass gOffsetList array
- 20060121 Reimplemented tiled display (mosaic), set with procedure DCMSetMosaic
- 20060123 Restored layout to allow windiff, lossy jpeg now gives correct error
- 20060126 Added support of value representation "UT"
- 20060126 Improved scaling of text overlay and measurements
- 20060129 Added option to save image in RAW format
- 20060129 New OnMouseEnter and OnMouseLeave events and custom cursors for several gTool's
- 20060129 Added overlay text color option
- 20060129 Fixed JPEG bug in multifile mode
- 20060130 Changed mosaic slice# place
- 20060130 Fixed nki\_private\_decompress: error for large pixel values (>32768)
- 20060131 Fixed reading of ELSCINT and ACUSON images that use NKI private tag 7fdf:0010
- 20060201 Improved real-time image zooming through bypassing the SetDimension procedure
- 20060202 Fixed display of slice numbers in empty fields in multview mode, fixed mosaic mode for multiframe dicom images
- 20060204 Enabled saving to TIFF using W. Krug's Bmp2Tiff unit
- 20060205 Added Tool kShutter
- 20060223 Changed rescale method to rescale buffer directly after reading pixeldata
- 20060223 Reverse NKI test: if nki compression mode >4 it is not made by NKI
- 20060304 Fixed NKI compression of 8-bit and color images; todo: 1966 and some PT images level&window wrong
- 20060420 Added orientation indicators to text overlay
- 20060421 Implementation of TdcmOverlay record to describe custom overlay
- 20060425 Added TRuler class to show spacing
- 20060502 Implementation of basic VOI\_LUT support. Currently only 16bit VOI LUTs are supported.
- 20060607 Merged changes mvh 20060223 and 20060304
- 20060608 Need CONQUEST define to enable NKI compression, fix crash in TdView.AdjustOrientChars
- 20060609 Fixed VOI Lut crash when encoded explicit
- 20060611 Added PixelPaddingValue and PixelRepresentation to DicomData and fixed an unwanted pixel value correction if pixel padding is out of SS range
- 20060618 Merged again; added 20060223 and 20060304 changes back in

20060712 fixed wrong orientation label display when ImageOrientation and ImageOrientationPatient string is available  
20060728 Added support for non-square Pixel Aspect Ratio  
20060801 Bitmap overlay support implemented  
20060830 3D Cursor function implemented using open source vector math units  
20061107 ?  
20061220 Made compileable again in conquest: stripped html support in conquest mode  
20061220 Found endless recursion on double click: IFNDEF conquered  
20061222 Tried to restore layout

#### **UVIEWER.PAS (wraps k-pacs viewer in conquestdicomserver.exe)**

20060130 Replaced Japanese fonts (never create forms on a Japanese laptop ;->>>)  
20060304 Set limit to 2000 studies  
20060312 Slice with + and -: keep other keys for series browser  
Added OpenSeries; disallow horizontal scrollbar in stringgrid  
20060618 Removed unused variable; moved slice controls into toolbar  
20061220 Replaced viewertemp.\$\$\$ by passed tempfile  
20061222 Added some logic for better control of zoom and l&w

## APPENDIX 2. Using Conquest with MySql through ODBC (by Paolo Marcheschi, 20031110)

*NOTE: Does not apply for native MySQL driver libmysql.dll, see installation section and appendix 5.*

I believe that the association of MySql and CONQUEST server allows to get an Opensource product stable and efficient. It is possible to download mysql from the site [www.MySql.com](http://www.MySql.com), the files to download are the production files (stable release) and they are the followings:

[mysql-4.0.16-win.zip](#)  
[MyODBC-3.51.06.exe](#)  
[mysqlcc-0.9.3-win32.zip](#)

If you are not able to find exactly these releases I think that is possible to use the latest versions anyway. You have to install these files, with the setup programs that are provided inside the zip files. The default installation directory is `c:\mysql`. The first thing to be done now is to install MySql as service, open a command shell and perform the following operation::

```
C:\mysql\bin\mysqld --install
```

The service is installed with the name `MySql`, if you want to install the service as manual you have to write instead:

```
C:\mysql\bin\mysqld --install-manual
```

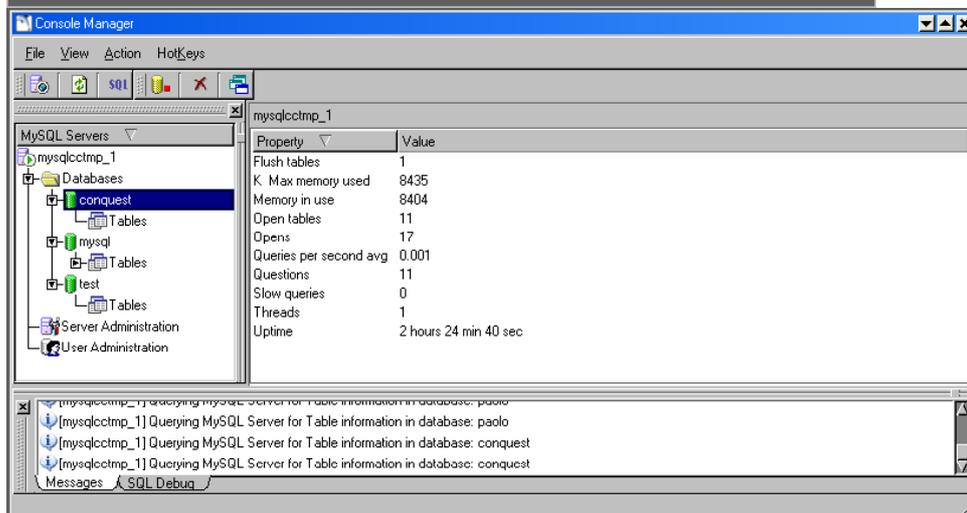
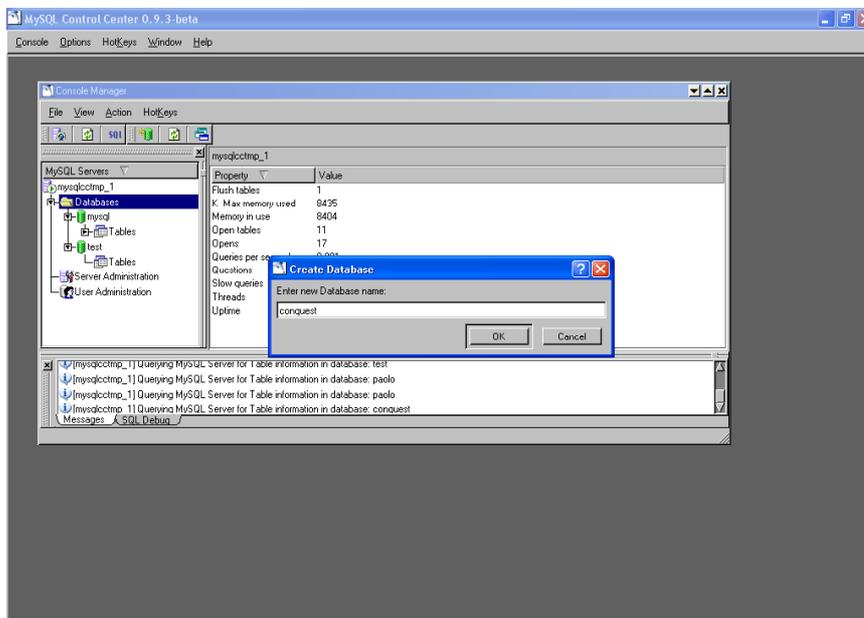
To start the RDBMS you have to type in a command shell:

```
NET START MYSQL
```

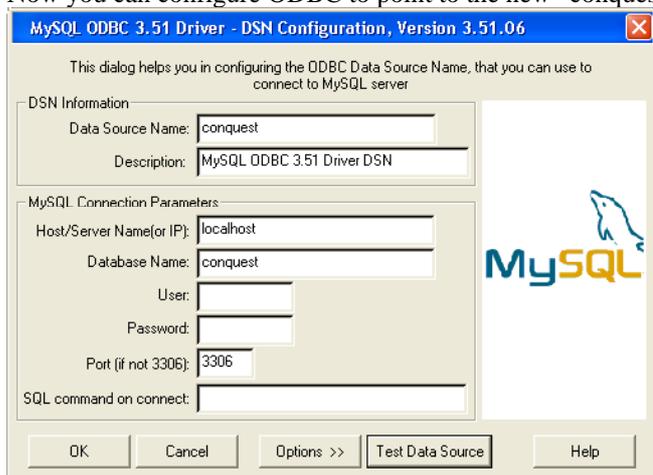
To stop the service:

```
NET STOP MYSQL
```

We create now the "conquest" database through the control center of MySql that also allows to monitor the server operations see figure 1 and 2:



Now you can configure ODBC to point to the new “conquest” database you have just created:



If everything is correctly configured, you can try the server by pressing the button "test data source." To make the CONQUEST server, aware of the new database “conquest” is necessary to write the followings voices in the file dicom.ini inside the Conquest directory:

#Name, username and password for ODBC dates source

SQLServer = conquest  
Username =  
Password =

Launch the DICOM server and do “Clear Database” from the maintenance area. In this way you can initialize the tables on the new database.

Et voilà you have done all you need.

Ciao  
Ing. Paolo Marcheschi  
Institute of Clinical Physiology CNR Pisa ITALIA.

*Notes by mvh:*

- 1) *There were small fixes in the Conquest DICOM server for MySQL – i.e., mySql works with version 1.4.4 and up only. From version 1.4.4a, you need to edit DICOM.INI by hand and set DoubleBackSlashToDB = 1 for mysql and DoubleBackSlashToDB = 0 for other sql servers*
- 2) *Very slow response has been reported when using archives approaching 1 million images with older versions of MySQL.*

## APPENDIX 3. Using Conquest on LINUX – preliminary release

Since server version 1.4.8, the server core (**dgate.exe** = **dgate** under Linux) compiles and runs on a Linux system. I have developed and tested the code on the very nice and free Knoppix 3.7 (2004-12-08-EN) release ([www.knoppix.org](http://www.knoppix.org)), which is a Debian Linux version that boots and runs from a CD and can use a memory stick or harddisk partition for user data. It also installs nicely to a harddisk of (almost) any old hardware you have.

The Linux release of the server core works default with the indexed dBaseIII driver built in into the server (no ODBC) and the internal jpeg decompression engine is not included. Piotr Filipczuk has added a PostGresSQL driver that has been reasonably tested by now (two minor flaws were fixed). A native mysql driver is now added but this has not yet been used under Linux. The graphical user interface has not been ported to Linux, but a small WEB interface is provided. In version 1.4.12, most options have been briefly tested – consider version 1.4.12 a stable release.

To use the server, one needs a valid version of the configuration files and put them in the same directory as the dgate executable. The easiest way to do this is to unpack CONQUESTLINUX1412c.ZIP with “unzip conquestlinux1412c.zip” that contains:

conquest/dgate	Server executable
conquest/dicom.ini	Server configuration (for dbase)
conquest/dicom.ini.dbase	Template configuration for built in dbase driver
conquest/dicom.ini.postgres	Template server configuration for postgres
conquest/dicom.sql	Database config (denormalized, for dbase)
conquest/dicom.sql.dbase	Template database configuration (denormalized)
conquest/dicom.sql.postgres	Template database configuration (normalized)
conquest/acrnema.map	Configuration of know DICOM providers
conquest/dgate.dic	DICOM dictionary (missing prior to 1.4.10)
conquest/dgatesop.lst	Accepted data and services
conquest/dgatesop.lst.nojpg	Template accepted data and services (no jpeg)
conquest/dgatesop.lst.withjpg	Template accepted data and services (with jpeg)
conquest/ConquestPACS.pdf	This file
conquest/maklinux	Shell script to compile and install dgate
conquest/maklinux_postgres	Idem but using Postgres as database
conquest/makttotal.bat	Used by mvh for collecting files in Linux distr.
conquest/Makefile	Sample Makefile (unused)
conquest/data/dbase/DICOMImages.DBF	Sample database
conquest/data/dbase/DICOMPpatients.DBF	
conquest/data/dbase/DICOMSeries.DBF	
conquest/data/dbase/DICOMStudies.DBF	
conquest/data/dbase/UIDMODS.DBF	
conquest/data/HEAD_EXP_00097038/	Sample images
conquest/data/HEAD_EXP_00097038/0001_002000_892665661.v2	
conquest/data/HEAD_EXP_00097038/0001_003000_892665662.v2	

Plus all the sources needed to build the server: `aaac.cxx`, `aaac.hpp`, `aarj.cxx`, `aarj.hpp`, `aarq.cxx`, `aarq.hpp`, `amap.cpp`, `array.tcc`, `array.thh`, `base.hpp`, `buffer.cxx`, `buffer.thh`, `cctypes.h`, `constant.h`,

dbsql.cpp, deivr.cxx, deivr.hpp, device.cpp, dgate.cpp, dgate.hpp, dgatefn.cpp, dicom.hpp, dimsec.cxx, dimsec.hpp, dimsens.cxx, dimsens.hpp, dprintf.cpp, dprintf.hpp, endian.cpd, endian.cxx, endian.hpd, endian.hpp, farray.thh, filepdu.cxx, flpdu.cxx, flpdu.hpp, gpps.cpp, gpps.hpp, lex.cpp, lex.hpp, loadddo.cpp, nkiqrsop.cxx, nkiqrsop.hpp, npipe.cpp, npipe.hpp, odbci.cpp, odbci.hpp, parse.cpp, pdata.cxx, pdata.hpp, pdu.cxx, pdu.hpp, queue.tcc, pqueue.thh, qrsop.cxx, qrsop.hpp, regen.cpp, rtc.cxx, rtc.hpp, safemem.h, socket.cxx, socket.hpp, storage.cxx, storage.hpp, total.cxx, trnsyn.cxx, uniq.cxx, unixsock.h, util.cxx, util.h, verify.cxx, verify.hpp, version.h, vrtosql.cpp, wintypes.hpp, xvgifwr.c

Next, make maklinux and dgate executable with “chmod 777 conquest/maklinux” and “chmod 777 conquest/dgate”.

For jpeg transfer support (requires different dgatesop.lst) the following files must be added/replaced from JPEG SUPPORT LINUX 1412.ZIP using “unzip jpeg support linux 1412.ZIP -d conquest”:

dgatesop.lst	Accepted data including jpeg transfer syntaxes
dcmcjpeg	Offis DICOM jpeg compressor
dcmcjpeg.man	
dcmdjpeg	Offis DICOM jpeg decompressor
dcmdjpeg.man	
dicom.dic	Offis dictionary (missing prior to 1.4.10)

Next, make dcm/djpeg and executable with “chmod 777 conquest/dcmdjpeg” and “chmod 777 conquest/dcmcjpeg”.

Configuration files under Windows and Linux are the same except for the use of a forward slash instead of back slash in directory paths. The following essential entries are therefore different for Linux (these are the defaults):

```
SQLServer      = ./data/dbase/
MAGDevice0    = ./data/
```

See section A.5.2 for more details about the configuration files. After copying the files, if needed, regenerate the database with “conquest/dgate -v -r” then run the server with “conquest/dgate -v” or “conquest/dgate -^serverstatus.log”. To automatically start the server at boot time create a shell script in /etc/rc5.d called Z99Conquest, that contains, e.g.,:

```
cd /home/marcel/conquest
dgate -^serverstatus.log
```

For Linux experts: options with syntax ‘dgate --command:parameters’ have been added to control a running server process for various tasks, e.g., for GUI and web access development. Use ‘dgate -?’ for some information or see below. Please keep the authors posted if you want to develop a user interface. A start has been made with a WEB based interface (see Appendix 4). Some Linux components needed for a GUI are a simple browser for small DbaseIII databases (the databases can be extracted for a single patient or queried using the server core), sockets to receive server log entries, and a minimal image viewer (the server core can convert DICOM files to gif images).

EZDicom may be a very good choice but support for NKI compression needs to be added.

To compile the server core: extract all files from CONQUESTLINUX1412c.ZIP (the same sources are in DGATE1412c.ZIP + DICOMLIB1412.ZIP but there they have - incorrectly- uppercase filenames) into a single directory. There is no good make or configure file. Instead use total.cxx (consisting of #includes of all source files) to compile all sources in one chunk as follows:

```
g++ -DUNIX -DNATIVE_ENDIAN=1 -DNOINTJPEG total.cxx -o dgate -pthread
```

Which compiles the core server executable *dgate*. The library *pthread* is used for multithreaded operation of the server and is required. This building process was tested with gcc 3.3.5. Warnings (many ‘multi-character character constant’ and one ‘fattach is not implemented and will always fail’) are produced but these do not impact server operation. For convenience shell script **maklinux** is available that compiles *dgate*, copies it to the cgi-bin directory for web access (see appendix 4), and sets up (*overwrites*) **dicom.ini** and **dicom.sql**.

Use this (or a similar) command line to compile with the PostGRES driver included:

```
g++ -I/usr/local/pgsql/include -DUNIX -DNATIVE_ENDIAN=1 -DNOINTJPEG -DPOSTGRES total.cxx -o dgate -pthread -L/usr/local/pgsql/lib -lpq
```

For convenience also a shell script **maklinux\_postgres** is available that compiles *dgate* and copies it to the cgi-bin directory for web access (see appendix 4). It also makes sure the postgres shared libraries can be found, and sets up (*overwrites*) **dicom.ini** and **dicom.sql**. The PostGRES system (I used postgresql-8.1beta1.tar.bz2) must be setup to the defaults, and a database named ‘*conquest*’ made.

For postgres to work you need to check some values in *dicom.ini* (using the default postgres account assuming password postgres, note that parameter ‘*SQLServer*’ sets the database to *conquest*). A copy from **dicom.ini.postgres** to **dicom.ini** would set the following values:

```
SQLHost = localhost
SQLServer = conquest
Username = postgres
Password = postgres
PostGRES = 1
DoubleBackSlashToDB = 1
```

It is advised to use a normalized database (as defined in **dicom.sql**) for postgres operation, e.g., by copying **dicom.sql.postgres** to **dicom.sql**.

To finish Linux server installation run “*dgate -v -r*” to regenerate the database and “*dgate -v*” to run the server (keeps window open).

The following listing shows the output of *dgate -?* (in progress) :

DGATE: UCDCM/NKI DICOM server thread and PACS utility application v1.4.10

Usage:

```
(1) DGATE <-!#|-v|-u#|-^#> Report as in dicom.ini|stdout|UDP|File(#=port)
      [-p#|-b] Set listen port|run in non-threaded debug mode
      [-i|-r|-arDEVICE] Init|Init/regenerate DB|Regen single device
      [-d|-m|-k] List (-d) devices (-m) AE map (-k) DICOM.SQL
      [-t|-o] Test console|Test database
      [-sOptions] Create ODBC data source (WIN32 only)
      [-nd|-nc#|-jd|-jc#] NKI de-/compress#|JPEG de-/compress# FILE
      [-as#N|-amFROM,TO] Select#KB to archive of MAGN|move device data
      [-au|-aeFROM,TO] Undo select for archiving|rename device
      [-av|-atDEVICE] Verify mirror disk|Test read files for DEVICE
      [-abJUKEBOX1.2,N] Make cacheset to burn JUKEBOX1,CD2 from MAGN
      [-acJUKEBOX1.2] Verify JUKEBOX1,CD2 against cacheset
      [-adJUKEBOX1.2] Verify and delete cacheset for JUKEBOX1, CD2
      [-f<p|t|s|i>ID] Delete DB for Patient, sStudy, Series, Image
      [-f<e|d|z>file] Enter/Delete DB of file, Zap server file
      [-faFILE<,ID>] Add file to server<optionally change PATID>
      [-zID] Delete (zap) patient
      [-frDEVICE,DIR] Regen single directory DIR on DEVICE
      [-f<c|k>PATID,file] Change/Kopy PATID of file (irreversible/once)
      [-f?file|-fu|-c#] get UID of file|Make new UID|UID helper(0..99)
      [-ff#] Delete old patients until #MB free
      [-gSERVER,DATE] grab images from SERVER of date not on here
      Otherwise: run as threaded server, port=1111

(2) DGATE FileMapping Run server child; shared memory has socket#

(3) DGATE --command:arguments Send command to running server in other process
      (works directly - use with care)

Delete options:
--deleteimagefile:file Delete given image file from server
--deletepatient:patid Delete given patient from server
--deletestudy:studyuid Delete given study from server
--deleteseries:seriesuid Delete given series from server
--deleteimagefromdb:file Delete given file from db only
--deletesopfromdb:pat,study,series,sop Delete specified image from db only

Dbase without ODBC options:
--packdbf: Pack dbase databases and recreate memory index
--indexdbf: Re-create memory index for dbase database
--extract:patid Extract dbase databases for single patient to X..

Modification of dicom objects:
--modifypatid:file,patid Change patid of given file
--mergestudy:uid,uid,.. Start merging studies with given studyuids
--mergestudyfile:file Use to process all files to merge
--mergeseries:uid,uid,.. Start merging series with given seriesuids
--mergeseriesfile:file Use to process all files to merge

Maintenance options:
--initializetables: Clear and create database
--initializetables:1 Clear and create database for DbaseIII via ODBC
--initializetables:2 Clear and create worklist database
--regen: Re-generate entire database
--regendevic:device Re-generate database for single device
--regendir:device,dir Re-generate database for single directory
--regenfile:file Re-enter given file in database
--addimagefile:file,patid Copy file into server, optionally with new patid
--testcompress:file Test: enter file in server with many compressions
--debuglog_on:file/port Start debug logging
--log_on:file/port Start normal logging
--debuglevel:# Set debug logging level
--makespace:# Delete old patients to make #MB space
--get_freestore:dev,fmt Report free #Mb on device
--get_param:name,fmt Read any parameter from DICOM.INI
--put_param:name,value Write any parameter to DICOM.INI
--delete_param:name Delete any parameter from DICOM.INI
--read_ini: Re-read all parameters from DICOM.INI
--get_amap:index,fmt List any entry from ACRNEMA.MAP
--put_amap:i,AE,ip,p#,cmp Write entry in memory for ACRNEMA.MAP
--delete_amap:index Delete entry in memory for ACRNEMA.MAP
--write_amap: Write ACRNEMA.MAP from memory to disk
--read_amap: Re-read ACRNEMA.MAP from disk to memory
--get_sop:index,fmt List any accepted service class UID
--put_sop:index,UID,name Write/add accepted service class UID
--delete_sop:index Delete accepted service class UID
--get_transfer:syntax List any accepted transfer syntax
--put_transfer:in,UID,nam Write/add accepted transfer syntax
```

```

--delete_transfer:index      Delete accepted transfer syntax
--get_application:idx,fmt    List any accepted application UID
--put_application:i,U,n      Write/add accepted application UID
--delete_application:inde    Delete accepted application UID
--get_localae:index,fmt     List any accepted local AE title
--put_localae:in,AE,name    Write/add accepted local AE title
--delete_localae:index      Delete accepted local AE title
--get_remoteae:index,fmt    List any accepted remote AE title
--put_remoteae:in,AE,name   Write/add accepted remote AE title
--delete_remoteae:index     Delete accepted remote AE title
--get_dic:index,fmt         List any dicom dictionary item
--get_sqldef:level,in,fmt   List any database field definition
--dump_header:filein,fileout Create header dump of file
--forward:file,mode,server  Send file with compr. mode to server
--convert_to_gif:file,size,fileout Downsize and convert to GIF
--query:table|fields|where|fmt|file Arbitrary query output to file
--query2:tab|fld|whe|fmt|max|file Same but limit output rows to max
--patientfinder:srv|str|fmt|file List patients on server
--studyfinder:srv|str|fmt|file List studies on server
--seriesfinder:srv|str|fmt|file List series on server
--serieslister:srv|pat|stu|fmt|file List series in a study
--imagelister:srv|pat|ser|fmt|file List files in a series
--addrecord:table|flds|values Append record, values must be in ''
--deleterecord:table,where Delete record from table
--grabimagesfromserver:AE,date Update this server from other
--display_status:file       Display server status
--loadhl7:file              Load HL7 data into worklist
--clonedb:AE                Clone db from server for testing
--quit:                     Stop the server

Archival options:
--renamedevice:from,to      Rename device in database
--verifymirrordisk:device   Verify mirror disk for selected device
--testimages:device         Test read all images on device
--movedatatodevice:from,to  Move data from one device to another
--selectlrforarchival:kb,device Step 1 for archival: to device.Archival
--preparebunchforburning:from,to Step 2 for archival: moves to cache
--deletebunchafterburning:deviceto Step 3 for archival: deletes from cache
--comparebunchafterburning:deviceto Part step 3 - compare jukebox to cache
--restoremagflags:         Undo archival sofar

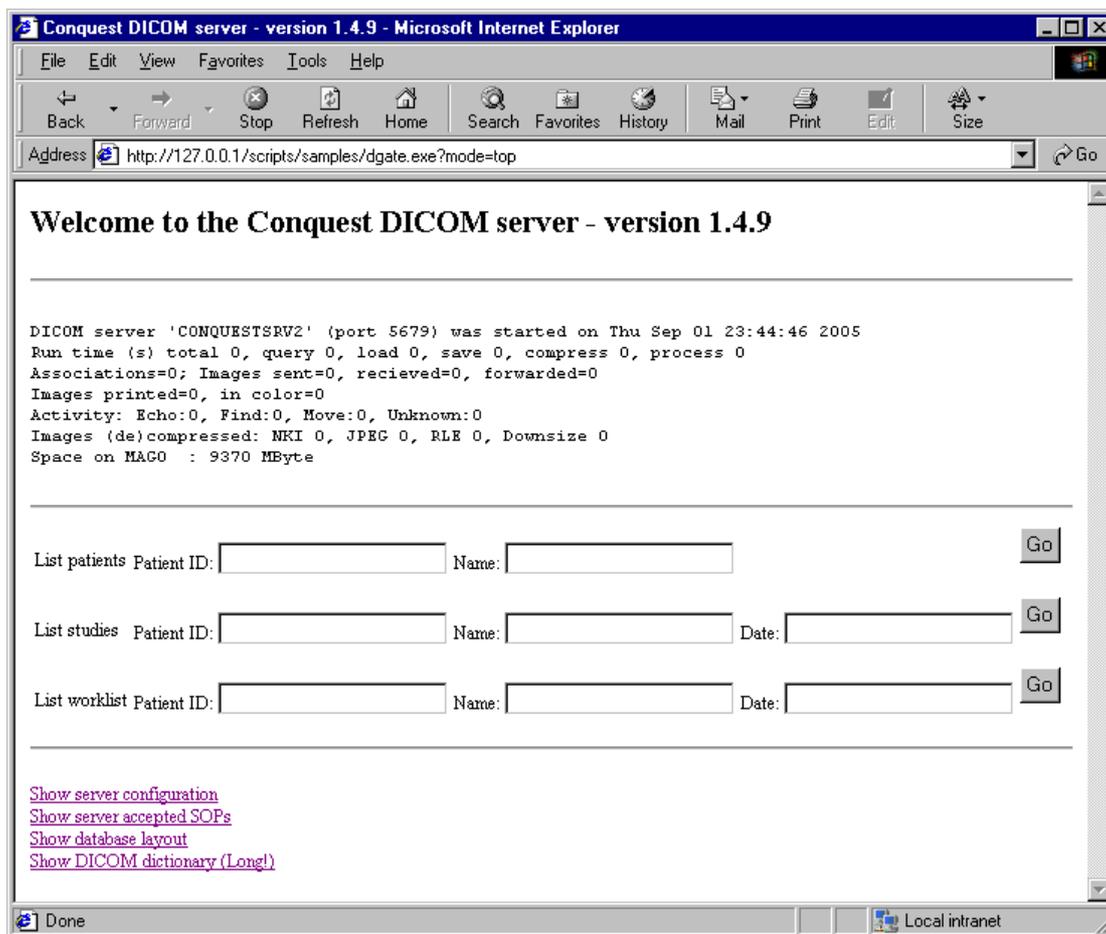
```

## APPENDIX 4. Using CONQUEST WEB server – preliminary release

Since version 1.4.8, a small WEB interface has been built in into the Conquest DICOM server. To enable it, copy **dgate.exe**, **dicom.ini** and **dicom.sql** into the cgi-bin directory of your WEB server. This has been tested with Apache servers running and Windows and Microsoft IIS under NT4. Under Linux you need the Linux version of the executable (dgate), and copy it as '**dgate.html**' (or as **dgate** but that does not work with all browsers) into the cgi-bin directory with **dicom.ini** and **dicom.sql**. Optionally set WebReadOnly to 1 in dicom.ini in cgi-bin to improve safety.

The dgate executable acts as a CGI interface (see routine DgateCgi in dgate.cpp) to a dicom server (another dgate executable) that runs elsewhere on the same computer. It uses DICOM.INI to set the IP port on which it communicates, and it uses DICOM.SQL to autoformat database pages (e.g., for the worklist). The communication goes through a private DICOM interface. This setup has the advantage that the in-memory index of the database can be reused by the WEB interface. Also, the status of the actual server can be seen from the WEB interface.

Here are some snapshots of version 1.4.9 (which are identical to 1.4.12 apart from the version number). This is the home page (for linux based servers use: <http://server/cgi-bin/dgate.html/mode=top> or <http://server/cgi-bin/dgate/mode=top>):



Server configuration (incomplete and read only for now):

Conquest DICOM server - version 1.4.9

Address: <http://127.0.0.1/scripts/samples/dgate.exe?mode=showconfig>

Welcome to the Conquest DICOM server - version 1.4.9

List of configuration parameters

File	Parameter	Value	Description
dicom.ini	MyACRNema	CONQUESTSRV2	DICOM name of server
dicom.ini	TCPPort	5679	TCP/IP port where server listens
dicom.ini	FileNameSyntax	3	Determines name for new files
dicom.ini	FixPhilips	0	Strip leading zeros from 10 digit patient ID
dicom.ini	FixKodak	0	Strip leading zeros from 8 digit patient ID
dicom.ini	IncomingCompression	un	Compression mode for incoming files
dicom.ini	ArchiveCompression	as	Compression mode for archived files
dicom.ini	MAGDevices	1	Number of storage devices
dicom.ini	MAGDevice0	F:\temp2\data\	Directory where data is stored
acrema.map	0	CONQUESTSRV2 127.0.0.1 5679 un	Known DICOM provider
acrema.map	1	V** 1234 un	Known DICOM provider
acrema.map	2	S** 5678 un	Known DICOM provider

Update

List studies (links to list series):

Conquest DICOM server - version 1.4.9

Address: <http://127.0.0.1/scripts/samples/dgate.exe?mode=queryseries&patientidmatch=&patientnamematch=HEAD&studydatematch=>

List of selected studies

Patient ID	Name	Study date	Study description	Study modality
0009703828	HEAD EXP2	19980414		CT

List series (links to two types of image list with and without icons):

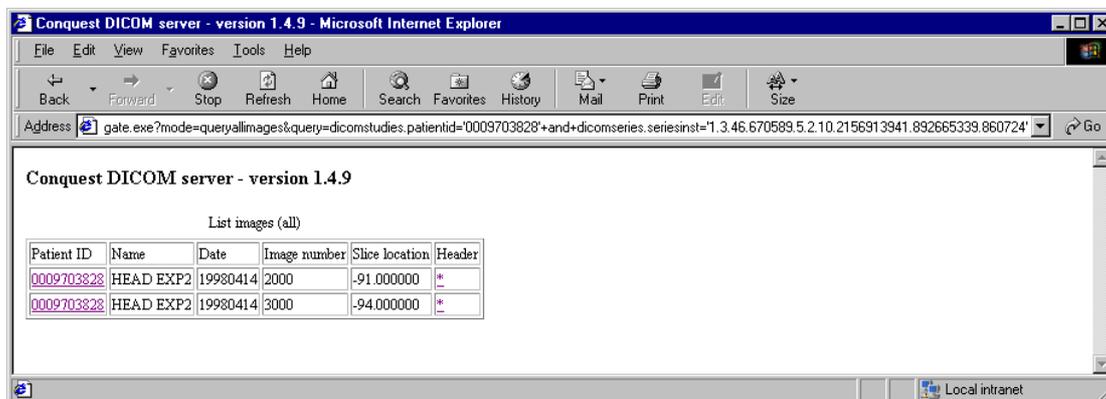
Conquest DICOM server - version 1.4.9

Address: <http://127.0.0.1/scripts/samples/dgate.exe?mode=queryseries&query=dicomstudies.patientid='0009703828'+and+dicomseries.studyinsta='1.3.46.670589.5.2.10.215691.3941.892665384.993397'>

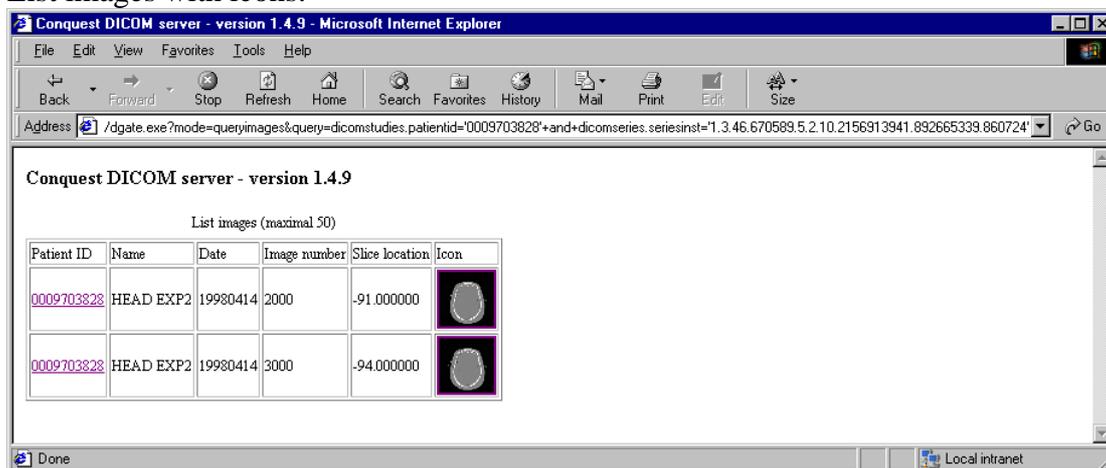
List series

Patient ID	Name	Series date	Series time	Series description	Modality
0009703828	HEAD EXP2	19980414	170346.000000		CT

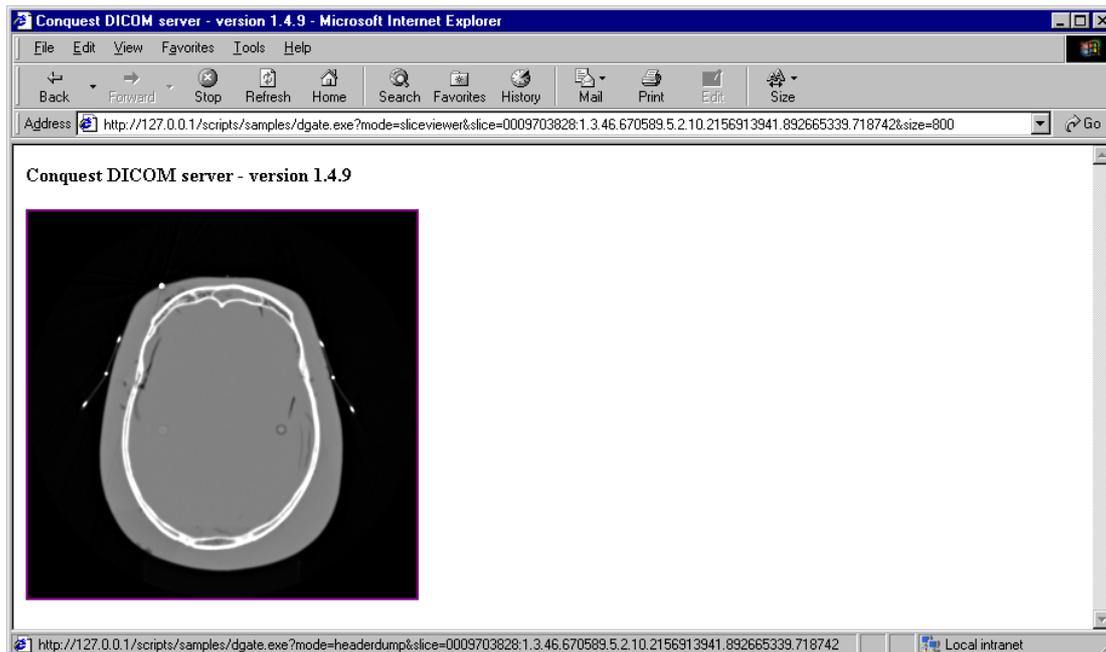
List images without icons:



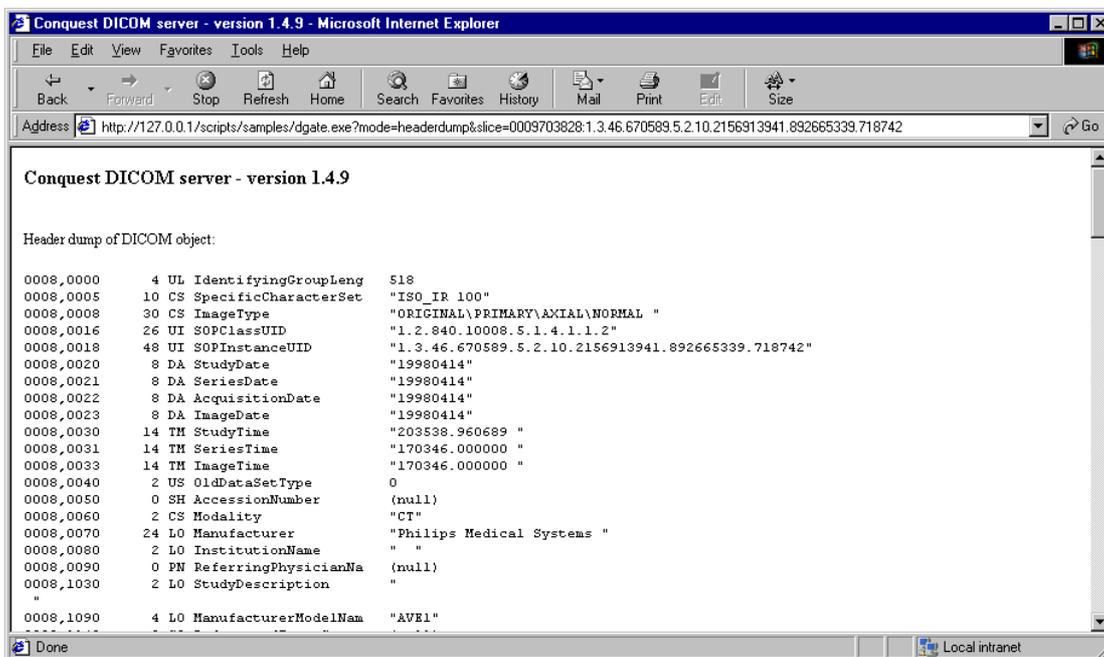
List images with icons:



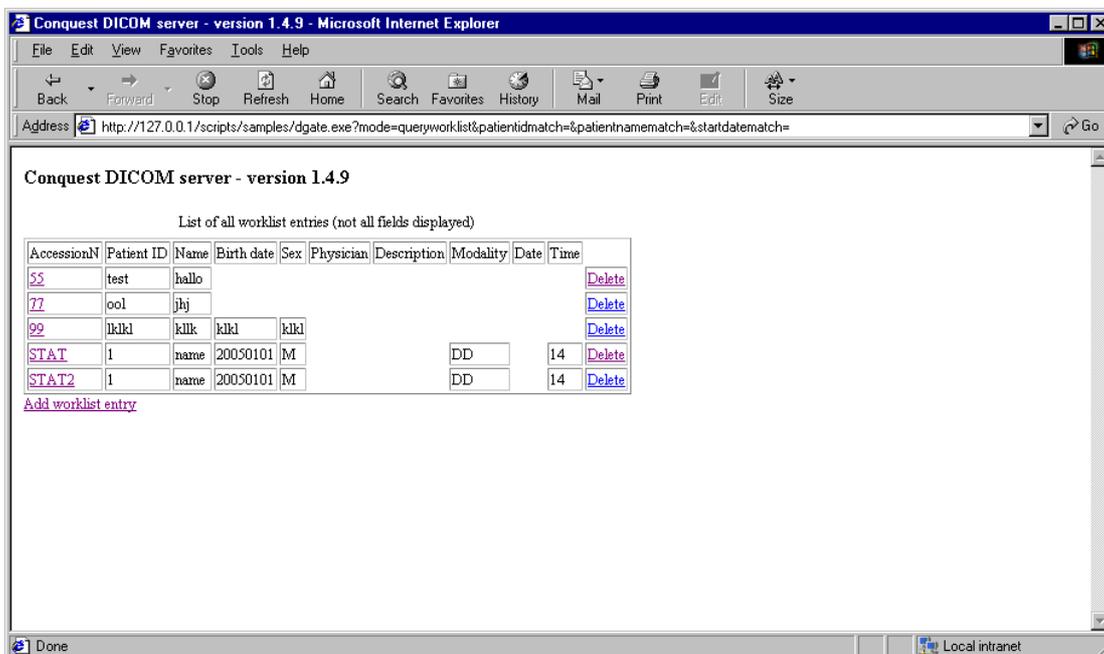
Show image:



Show header:



List worklist:



Edit worklist:

Conquest DICOM server - version 1.4.9

Edit worklist entry

Field	Value
AccessionN	STAT
PatientID	1
PatientNam	name
PatientBir	20050101
PatientSex	M
MedicalAde	
ContrastA1	
StudyInsta	
ReqPhysici	
ReqProcDes	
Modality	DD
ReqContras	
ScheduledA	AA4
StartDate	
StartTime	14
PerfPhysic	
SchedPSDes	
SchedPSID	
SchedStati	A2
SchedPSLoc	
PreMedicat	
SchedPSCom	
ReqProcID	
ReqProcPri	

Save

Note 1): some browsers will not correctly refresh dynamic pages such as the worklist table. In this case, use F5 to refresh the page manually.

Note 2): Any help with further development of WEB pages for the server would be appreciated. For instance, it has been suggested to use the ezDicom ocx as viewer in the web pages.

## APPENDIX 5. How to set up a Redundant ConQuest DICOM Server in a Two-Node Windows Cluster Environment

Alternate Titles I couldn't decide :)

ConQuest Redundancy in Eight Easy Steps

ConQuest Freedom in Eight Easy Steps

ConQuest Cluster in Eight Easy Steps

To set up ConQuest in a failover, redundant environment that will be virtually seamless to end-users who need a highly reliable system, we installed ConQuest in a Windows Clustered environment. This environment is Active/Passive meaning that only one node has control at any time of the shared drive where all the images are received. The second node sits passively waiting to be manually or automatically failed-over.

This how-to will not explain how to install and configure Windows Clustered Services. There are many documents online detailing how to set up a 2+ node Windows Cluster, and Windows Cluster fundamentals. Setup will require the expertise of a Windows server administrator.

In our case, the cluster environment already existed and we installed ConQuest as a DICOM server/listener on these existing servers. If the cluster is in place, you can set up and test all of the following in a couple hours especially if you are already familiar with ConQuest.

### SET-UP

OS: Windows 2003 Server, Clustered Environment

FileSystem: Veritas Volume MGR installed to manage SAN shares - you can use whatever you want as long as there is a shared drive available.

Nodes: Server A (192.168.1.6), Server B (192.168.1.7)

Virtual IP Address created for cluster: 192.168.1.5

Local drive letter: C:\

Clustered drive letter: G:\ drive for example represents a SAN share that is available to the active node in the cluster

DICOM SCU Device: any CT scanner, DICOM workstation, or other hospital PACS, in our environment we use TeraMedica Evercore since we require storage of DICOM-RT and DICOM-RT-ION.

### INSTRUCTIONS

- (1) Set-up two Windows 2003 servers if not already in place. Configure clustered services and a shared drive if not already in place.
- (2) Once the cluster is configured, you should have a drive letter typically mounted from a SAN that is shared to only one server node at a time. In this case, we call it G:\ drive.
- (3) Once the cluster is configured and tested for fail-over, you will have a Virtual IP address (e.g., 192.168.1.5) and two physical servers: Server A (192.168.1.6) and Server B (192.168.1.7). When you ping the Virtual IP, you are actually ping

whatever is the active node in the cluster. Once you complete all steps, when ever you send DICOM data to the Virtual IP, you are actually sending it to whichever node is active as the primary node.

(4) Install ConQuest on the active node local hard drive C:\

(5) The active node is connected to the shared, clustered drive, G:\ drive in our case. Configure ConQuest to use some G:\ path instead of C:\ path for all DICOM files.

Configure ConQuest to use the same exact AE Title and port number on both nodes. You can use the default AET/port# provided by ConQuest.

(6) Install ConQuest as an NT Server Service so that it will run 24/7 listening for incoming data. Follow the rest of the ConQuest instructions for customization, setup, etc..

(7) Failover or ask your Windows Server Admin to failover to second node, Server B. Now that Server B is the active node. repeat steps #4, #5, #6 on Server B.

(8) IMPORTANT: now configure your CT scanners, PACS, other DICOM SCU device to send ONLY to the "VIRTUAL IP" address for the Windows Cluster (e.g., 192.168.1.5). This means that no matter which node is currently active, all the files will go to the G:\ drive. Both nodes have the same port# and AET, but it won't matter since only one node is actually receiving data at a time, because only one node receives data through the virtual IP. ConQuest is technically listening actively on both nodes but it doesn't matter. All DICOM data is being sent to the virtual IP address so only the active node that is actively connected to the G:\ drive will actually receive the data. As soon as cluster is failed-over to second, passive node, then that server becomes active and starts receiving the DICOM files.

We tested this many times causing the nodes to fail-over while actively sending files before and during a fail-over. It works pretty well and usually our DICOM SCU's just attempted to resend if it failed while the nodes were in the middle of a fail-over. Your mileage may vary, but it makes your system a lot more redundant and you don't have to worry about any single server point of failure. Although this was done in a Windows Cluster, I'm sure you could create the same situation in a Linux Cluster.

Happy ConQuesting!

Kim L. Dang

## APPENDIX 6. Database details and benchmarks

The conquest DICOM server can use any ODBC database and includes a few native drivers. Since there have been a number of issues with database performance, I decided to stress test a few database solutions. Note that the server can be installed with or without BDE. This only affects the browser GUI, the server core does not use DBE at all.

The test is a set of virtual queries that will duplicate a snapshot of our hospital's Conquest research PACS (Built-in DbaseIII driver) with 4.375 million images into a test server. The records are transferred through command "dgate - clonedb:conquestsrv1" on conquestsrv2 from conquestsrv1 to conquestsrv2. This is equivalent of a regeneration of a big server (14700 patients, 36000 studies, 195000 series and 4.375 million images), but EXCLUDING the read time of the objects. Hence we purely test database write speed. The operation that is performed is that, for each patient, study, series and image, it must be found out if it already exists on the server. If not, the item is added else it is updated. The queries are special in the sense that the primary keys are DICOM UIDs, which are quite long strings.

The tests were run a 2 years old Pentium IV machine (2.4 GHz) with 1 Gbyte of RAM, without hyper-threading, running Windows XP home. Both source and destination servers run on the same machine, but in practice the source server is barely loaded.

### SQL SERVER 2000

This setup runs out of the box. First install SQL server 2000 (using all defaults, but using SQL server authentication). Create database conquest, with login conquest (important: use SQL server authentication) with password conquest. Then install a conquest server using the (local) SQL server for database. Initialize the database. Run the clonedb task to load 4.3 million images into the system.

*Write speed.* With conquest 1.4.12, the clonedb operation took 5 hours and 38 minutes (version 1.4.11 took around 9 hours due to extra queries and database connections). On average more than 200 images are loaded per second. There is no noticeable speed difference for large or small studies or early and late in the process. The database size is 3.4 GB.

*Read speed.* The database browser is fairly responsive, probably because it performs strictly only single level queries. However, directly after a regen queries in the image list on patient ID are veryyyy slow and overload the machine. After a "database maintenance plan" has run ('Reorganize data and index pages') the server becomes very responsive. So it is essential to run this task regularly (e.g., weekly) and directly after database regeneration.

SQL server cannot be used from Linux.

### MYSQL 5.0.22

I used `mysql-noinstall-5.0.22-win32.zip`. Unzip it into `c:\`. Next, copy “`libmySQL.dll`” from “`C:\mysql-5.0.22-win32\bin`” to the server directory. Run “`mysqladmin -u root create conquest`” to create the conquest database. Then install the conquest server using the Native MySQL driver option. The database username must be set to root. Create a `my.ini` (use sample given below) and run the Mysql server by starting `mysqld-nt.exe`. To install mysql as NT service (recommended), I used command `mysqld-nt --install MySql --defaults-file=C:\mysql-5.0.22-win32\my.ini`. In contrast with SQL server, the default setup (without a `my.ini`) does not work well – TUNING OF MYSQL IS MANDATORY. The default settings of MySQL result in very poor performance (initially it is fast, after 30 patients speed is down to 20 images per second, and 8 s per image was reported after 400.000 images).

As an example of tuning problems: this `my.ini` in `C:\mysql-5.0.22-win32` performs well on my old dual 800 Mhz Pentium II with Windows 2000 pro.

```
[mysqld]
default_table_type = INNODB
innodb_buffer_pool_size=100000000
innodb_flush_log_at_trx_commit=0
```

However, it works very slow on my test machine – similar as the default without `my.ini`. Actually the tests did not even complete with conquest 1.4.11 - Mysql did not handle rapid database connects/disconnects on XP (home?) well, these are now avoided on 1.4.12. The following `my.ini` works well on the test machine, and I would suggest using it as well. It is an adapted version of `my-innodb-heavy-4G.ini`:

```
[client]
#password = [your_password]
port = 3306
socket = /tmp/mysql.sock

[mysqld]
port = 3306
socket = /tmp/mysql.sock
back_log = 50
max_connections = 100
max_connect_errors = 10
table_cache = 2048
max_allowed_packet = 16M
binlog_cache_size = 1M
max_heap_table_size = 64M
sort_buffer_size = 8M
join_buffer_size = 8M
thread_cache_size = 8
thread_concurrency = 8
query_cache_size = 64M
query_cache_limit = 2M
ft_min_word_len = 4
default_table_type = INNODB
thread_stack = 192K
transaction_isolation = REPEATABLE-READ
tmp_table_size = 64M

log_slow_queries
long_query_time = 2
log_long_format

skip-bdb

# *** INNODB Specific options ***

innodb_buffer_pool_size = 100M
innodb_data_file_path = ibdata1:10M:autoextend
```

```

innodb_file_io_threads = 4
innodb_thread_concurrency = 16
innodb_flush_log_at_trx_commit = 0
innodb_log_buffer_size = 8M
innodb_log_file_size = 100M
innodb_log_files_in_group = 3
innodb_max_dirty_pages_pct = 90
innodb_lock_wait_timeout = 120

```

Note that, after a change of my.ini, the mysql daemon must be restarted to take the changes into use. Also, if the default table type is changed, e.g., from MYISAM to INNODB, the conquest database must be regenerated to create fresh tables of the new type.

*Write speed.* With this setup, and conquest 1.4.12, this clonedb operation took 5 hours and 5 minutes (version 1.4.11 crashed on the test system). On average again more than 200 images are loaded per second. Again there is no noticeable speed difference for large or small studies or early and late in the clonedb process. The database size is 3.9 GB.

*Read speed.* Is very impressive. After rebooting the PC, starting the Mysql daemon, and performing the first query, (long) lists of images for a particular patient ID appear in about 1, maximal 2 seconds. After a few queries it goes even faster.

Mysql might be used from Linux using a native driver, but this setup has not yet been tested.

### **BUILT-IN DBASE III Driver**

The built-in dBaseIII driver runs out of the box. The parameter IndexDBF in dicom.ini should, however, be initially set to about 10 times the expected number of million images to be loaded in one session. This allocates enough data to store the index buffer. Spare space is allocated when the server is restarted.

In contrast to the “real” sql servers, the DbaseIII only includes indexes on Patient ID. This index is kept in memory and generated each time the server is started. So, starting a large server takes several minutes (the source test server takes 5 minutes to start). This also means that any (image) query that spans multiple patients will be veryyyyyy slow – this should, however, not be a problem in routine use, as these queries are never used.

*Write speed.* With this setup, and conquest 1.4.12, the dbclone operation took 6 hours and 4 minutes (on version 1.4.11 this took about 24 hours due to poor optimization of some string handling). On average again almost 200 images are loaded per second. There is some speed difference between large or small studies – small patient studies load at 250 images per second, reducing to about 100 images per second for a patient containing 3000 images. Again there is no noticeable speed difference early and late in the clonedb process. The database size is 6.2 GB, which is almost completely taken up by the denormalized dicomimages table.

*Read speed.* Even querying large patients (with 2000 images) take about 1 second for a full image query from the test database of 4.374 million images. Queries that are not supported by the index (e.g., search individual images on patient name) take very long (minutes). Because the index is kept into memory, the server is very responsive once the index is done during server starting.

This driver is the default for Linux. However, it is unclear whether database files larger than 2 GB (1 million images) are supported.

## Microsoft access

The setup (on Windows XP home SP 1, with Office 2000, using access driver 4.00.6019.00), runs out of the box. Just select the access driver and install the server.

*Write speed.* With this setup, and conquest 1.4.12, the dbclone operation did not conclude. On average again about 200 images are loaded per second. However, the database size grew very quickly - reaching 2 GB at 250000 images after 30 minutes – and then new images could not be added any more.

*Read speed.* At this size, typical image queries (400 records) take 1 s or so.

This driver cannot be used on Linux.

## Postgres

This database driver has been tested on Linux only. With version 1.4.12, write speed is only about 10 images per second. Hence, this driver is not advised for normal use.

## Conclusions

For beginner users the built-in dbaseIII driver is perfect: it is the easiest to install and also very fast for common queries. More experienced users may benefit from Mysql or SQL server although both systems have performance problems under certain situations. Using Postgres and Microsoft access should be avoided. On Linux, one should use the built-in dbaseIII driver as long as the MySQL connection has not been developed.

## Appendix 7. Using Conquest as DICOM router and gateway

The Conquest DICOM server has functionality to route incoming DICOM images to other servers (DICOM router) and to forward incoming query/move requests to other servers (DICOM gateway or virtual server). The first option is often used to distribute images over multiple servers based on filters. The second option makes Conquest a perfect image cache and/or central point of access for your hospital's PACS.

Configuration of both options is through DICOM.INI. It is advised to only change DICOM.INI when the server is closed, as "save settings" in the GUI will overwrite your fresh changes. However, for making things work: most items can be changed while the server is running except *ExportConverters*.

### DICOM Routing

The following shows an example of DICOM routing. There are 3 export converters installed (out of maximal 10: *ExportConverter0..9*), with different filter options:

```

ForwardAssociationLevel      = IMAGE
ForwardAssociationCloseDelay = 5
ForwardAssociationRefreshDelay = 3600
ExportConverters             = 3

ExportModality0              = CT
ExportStationName0           = CT_SCANNER
ExportCalledAE0              = CONQUESTSRV1
ExportCallingAE0             = CONQUESTSRV2
ExportFilter0                 = Rows = 512 and Colume = 512
ExportConverter0             = forward to SERVER1

ExportModality1              = MR
ExportConverter1             = forward compressed as j2 to SERVER2

ExportModality2              = RT*
ExportConverter2             = forward to RTSERVER; forward to RTSERVER2

```

**Note that spaces around the “ = ” are obligatory!** The item *ExportConverters* determines the number of converters in use. An export converter is an external or internal program that is run for each incoming image slice of prescribed Modality, StationName, CalledAE and CallingAE (\* matches anything, this is the default value). Note that an empty string is not the same as ‘\*’, empty string will only match, e.g., empty Modality. Since version 1.4.12, it is also possible to match against, e.g., “RT\*”.

Files that match all items above are tested against an optional SQL statement in *ExportFilterN*, e.g., *ImageNumber LIKE '1%'* matches all images with an image number starting on 1. All fields in the database can be used in the SQL statement with the exception of PatientID (ImagePat may be used instead), StudyInstanceUID and SeriesInstanceUID. Since the SQL filtering is relatively slow it is advised to also/only use the hardcoded filter options. Note: When the built-in dBaseIII driver is used, filter

queries are limited to fields in the de-normalized image table, and only queries like: *ImageNumber LIKE '1%' and Modality = 'MR'* are supported. Supported fields are listed in the DICOMImages definition in dicom.sql, and only the *and* keyword is supported. Spaces should be used exactly as in the example.

The 'forward compressed as .. to' option may use any style of NKI or JPEG compression using the same values as defined for DroppedFileCompression. In the example, MR is forwarded using loss-less JPEG compression to SERVER2.

Since version 1.4.8, when an export fails, exports on that converter are blocked for 60 s (=FailHoldOff); while 100 s (=RetryDelay) after the last failure they will be automatically retried based on data stored in files like 'ExportFailures5678\_0' (where 5678=port number, 0=converter number). These files may sometimes need to be deleted (the GUI asks so at startup) to stop endless retries.

Before version 1.4.12, each image was forwarded on a new association – causing problems on some host systems. With version 1.4.12, new options have been added to change this behaviour. The flag *ForwardAssociationLevel* may have values [GLOBAL, SOPCLASS, PATIENT, STUDY, SERIES, IMAGE]. Forwarders keep the association open as long as the UID at *ForwardAssociationLevel* does not change. The default is IMAGE, creating a new association for each image as before. By changing to more global settings more images are sent per association. However, associations are always closed when a new image type [SOPCLASS] is sent that was not sent before by this converter. After *ForwardAssociationCloseDelay* seconds of inactivity (default 5), the association is closed. After *ForwardAssociationRefreshDelay* seconds of inactivity (default 3600) the list of known sopclasses is deleted. This latter option avoids having to restart conquest when other servers change their capability.

Export converters lines are executed asynchronously (they are queued in memory in a queue of *QueueSize* length) but will somewhat slow down operation of the server. If one line contains multiple commands (separated by ;) these are executed one by one in sequence. Im- and exportconverts now have a small scripting language; allowing even more flexibility in routing, see A5.2.1, page 31.

## DICOM Gateway or virtual server

DICOM gateway operation is simpler. Just add lines like these to your DICOM.INI:

```
VirtualServerFor0      = SERVER1
VirtualServerFor1      = SERVER2
```

Queries and move requests sent to the local server are forwarded to the given AE titles in VirtualServerFor0..9. The AE titles must be known in *ACRNEMA.MAP*. The client will effectively see all data of the listed servers and this one *merged* – at the cost of query speed. The merging occurs during *each* query in memory. When moves are performed, images retrieved from the listed servers are stored locally (i.e., the server functions as a DICOM cache). This option makes Conquest a perfect image cache and/or central point of access for your hospital's PACS.