

Technical Publication



DICOM CONFORMANCE STATEMENT

PatXfer 5

Document Revision 4

October 23, 2007

1 Conformance Statement Overview

This is a conformance statement for the BrainLAB software PatXfer 5. The main purpose of this software is to import and convert DICOM to the BrainLAB file formats (Chunked and xBrain).

The DICOM import part of the application is

- Browse and display of DICOM files (simple message files as well as standard DICOM files).
- Query remote DICOM archives.
- Retrieve DICOM data from archives.

SOP Classes	User Of Service (SCU)	Provider Of Service (SCP)
Verification		
Verification	Yes	Yes
Transfer		
CR Image Storage	No	Yes
CT Image Storage	No	Yes
MR Image Storage	No	Yes
Positron Emission Tomography Image Storage	No	Yes
Secondary Capture (SC) Image Storage	No	Yes
Standalone PET Curve Storage	No	Yes
X-Ray Angiographic Image Storage	No	Yes
X-Ray Radiofluoroscopic (RF) Image Storage	No	Yes
Digital X-Ray Image Storage - For Presentation	No	Yes
Digital X-Ray Image Storage - For Processing	No	Yes
Digital Mammography Image Storage - For Presentation	No	Yes
Digital Mammography Image Storage - For Processing	No	Yes
Digital Intra-oral X-Ray Image Storage - For Presentation	No	Yes
Digital Intra-oral X-Ray Image Storage - For Processing	No	Yes
Query/Retrieve		
Patient Root Query/Retrieve Information Model - FIND	Yes	No
Patient Root Query/Retrieve Information Model - MOVE	Yes	No
Study Root Query/Retrieve Information Model - FIND	Yes	No
Study Root Query/Retrieve Information Model - MOVE	Yes	No
Patient/Study Only Query/Retrieve Information Model - FIND	Yes	No
Patient/Study Only Query/Retrieve Information Model - MOVE	Yes	No

Table 1-1: Network services supported by PatXfer

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
Compact Disc – Recordable		
General Purpose CD–R	No	Yes

Table 1-2: Media Services supported by PatXfer

2 Table Of Contents

1	Conformance Statement Overview	3
2	Table Of Contents	4
3	Introduction	6
3.1	Revision History	6
3.2	Audience	6
3.3	Remarks	6
3.4	Abbreviations	7
3.5	References	7
4	Networking	8
4.1	Implementation Model	8
4.1.1	Application Data Flow Diagram	8
4.1.2	Functional Definition of Application Entity (AE)	9
4.1.3	Sequencing Of Real World Activities	10
4.2	Application Entity Specifications	11
4.2.1	PatXfer Specification	11
4.2.1.1	SOP Classes and Transfer Syntaxes	11
4.2.1.2	Association Policies	12
4.2.1.2.1	General	12
4.2.1.2.2	Number of Associations	12
4.2.1.2.3	Asynchronous Nature	13
4.2.1.2.4	Implementation Identifying Information	13
4.2.1.3	Association Initiation Policy	13
4.2.1.3.1	Activity – Find	13
4.2.1.3.2	Activity – Retrieve	14
4.2.1.4	Association Acceptance Policy	14
4.2.1.4.1	Activity – Retrieve	15
4.3	Network Interfaces	15
4.3.1	Physical Network Interface	15
4.3.2	Additional Protocols	15
4.4	Configuration	16
4.4.1	AE Title / Presentation Address Mapping	16
4.4.1.1	Local AE Titles	16
4.4.1.2	Remote AE Title/Presentation Address Mapping	16
4.4.2	Parameters	16
5	Media Interchange	17
5.1	Implementation Model	17
5.1.1	Application Data Flow Diagram	17
5.1.2	Functional Definition of Application Entity (AE)	17
5.1.3	Sequencing Of Real World Activities	17
5.1.4	File Meta Implementation Identifying Information	17
5.2	Application Entity Specifications	18
5.2.1	PatXfer Specification	18
5.2.1.1	File Meta Information For The Application Entity	18
5.2.1.2	Real-World Activities	18
5.2.1.3	Activity – Convert DICOM to BrainLAB File Formats	18
5.2.1.3.1	Media Storage Application Profiles	18
5.3	Augmented And Private Application Profiles	18

5.4 Media Configuration	19
6 Support Of Extended Character Sets	20
7 Security Profiles	21
8 Annexes	22
8.1 IOD Contents.....	22
8.1.1 Created SOP Instances.....	22
8.1.2 Usage Of Attributes From Received IOD's	22
8.2 Data Dictionary Of Private Attributes	22
8.3 Coded Terminology And Templates	22
8.4 Grayscale Image Consistency	22
8.5 Standard Extended/Specialized/Private Sop Classes	22
8.6 Private Transfer Syntaxes	22
9 Index	23
9.1 Index of Tables.....	23
9.2 Index of Figures.....	23

3 Introduction

3.1 Revision History

Document Version	Date of Issue	Author	Description
1	February 13, 2003		Initial Revision
2	May 21, 2004		Adjusted to PatXfer 5.2
3	September 14, 2005		Adjusted to DICOM PS 3.2-2004
4	October 23, 2007		

3.2 Audience

This document is intended for hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

3.3 Remarks

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality. The Conformance Statement should be read and understood in conjunction with the DICOM Standard [1]. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

- The comparison of different conformance statements is the first step towards assessing interconnectivity between BrainLAB and non–BrainLAB equipment.
- This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended. An acceptance protocol is available to validate the desired level of connectivity.
- The DICOM standard will evolve to meet the users' future requirements. BrainLAB reserves the right to make changes to its products or to discontinue its delivery.

3.4 Abbreviations

There are a variety of terms and abbreviations used in the document that are defined in the DICOM Standard. Abbreviations and terms are as follows:

AE	DICOM Application Entity
AET	Application Entity Title
CD-R	Compact Disk Recordable
FSC	File-Set Creator
FSU	File-Set Updater
FSR	File-Set Reader
IOD	(DICOM) Information Object Definition
ISO	International Standard Organization
PDU	DICOM Protocol Data Unit
Q/R	Query and Retrieve
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SOP	DICOM Service-Object Pair

3.5 References

- [1] Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-3.18 – 2004



BrainLAB uses DICOM by Merge.

4 Networking

4.1 Implementation Model

The BrainLAB PatXfer application is an implementation of:

- A Query/Retrieve SCU to query DICOM archives and to initiate a move request for the queried archive.
- A Media File Set Reader to load DICOM data from the file system.
- An application to convert DICOM image data (CT, MR, PET, XA, CR, SC) into the BrainLAB file formats.

4.1.1 Application Data Flow Diagram

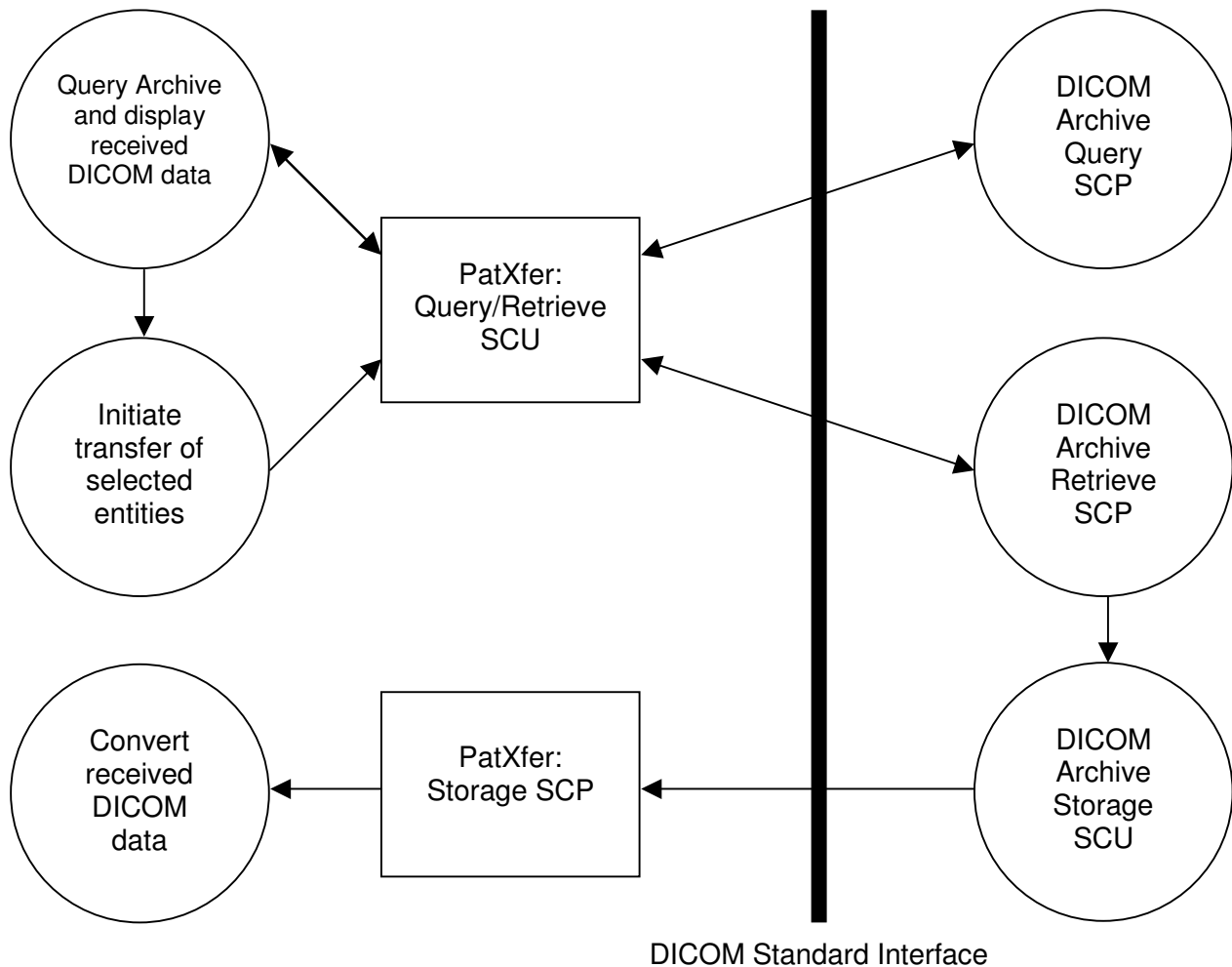


Figure 4-1: The Query/Retrieve SCU and Storage SCP

4.1.2 Functional Definition of Application Entity (AE)

Some communications and data transfer with remote AE's are accomplished utilizing the DICOM protocol over a network using the TCP/IP protocol stack.

- **Query and Retrieve:**
The user wants to find a certain dataset in a DICOM archive. PatXfer initiates an association as a Q/R SCU negotiating all models. The find request can be performed (depending on the negotiated models) on all DICOM levels (patient, study, series or instance). For a selected DICOM entity (patient, study, series or instance) a move request can be performed. The application supplies all unique keys for the requested level. The move response, indicating the storage-progress, is graphically evaluated.
- **Storage SCP:**
During a move operation a DICOM Storage SCP is invoked. PatXfer accepts an association with a Storage SCU negotiating any of the SOP Classes listed in Table 4-2. The received data is – with user interaction – converted to the BrainLAB file formats.
- **Storage SCU:**
PatXfer loads data from the BrainLAB file formats, converts it to DICOM – with user interaction – and initiates an association with a Storage SCP negotiating all SOP's listed in Table 4-2. The converted DICOM data is then sent to the remote DICOM Storage SCP.

4.1.3 Sequencing Of Real World Activities

PatXfer Query/Retrieve SCU performs a sequencing of real world activities as follows:

1. Query Archive and display received DICOM data:
 - a. Send DICOM Query/Retrieve C-FIND request.
 - b. Receive DICOM Query/Retrieve C-FIND responses.
2. User selects data to retrieve.
3. Initiate transfer of selected entities:
 - a. Start the DICOM Storage SCP
 - b. Send a DICOM Query/Retrieve C-MOVE request
 - c. Receive DICOM C-STORE requests with the requested SOP instances.
 - d. Receive DICOM Query/Retrieve C-MOVE responses
 - e. Stop the DICOM Storage SCP
4. Convert received DICOM data.

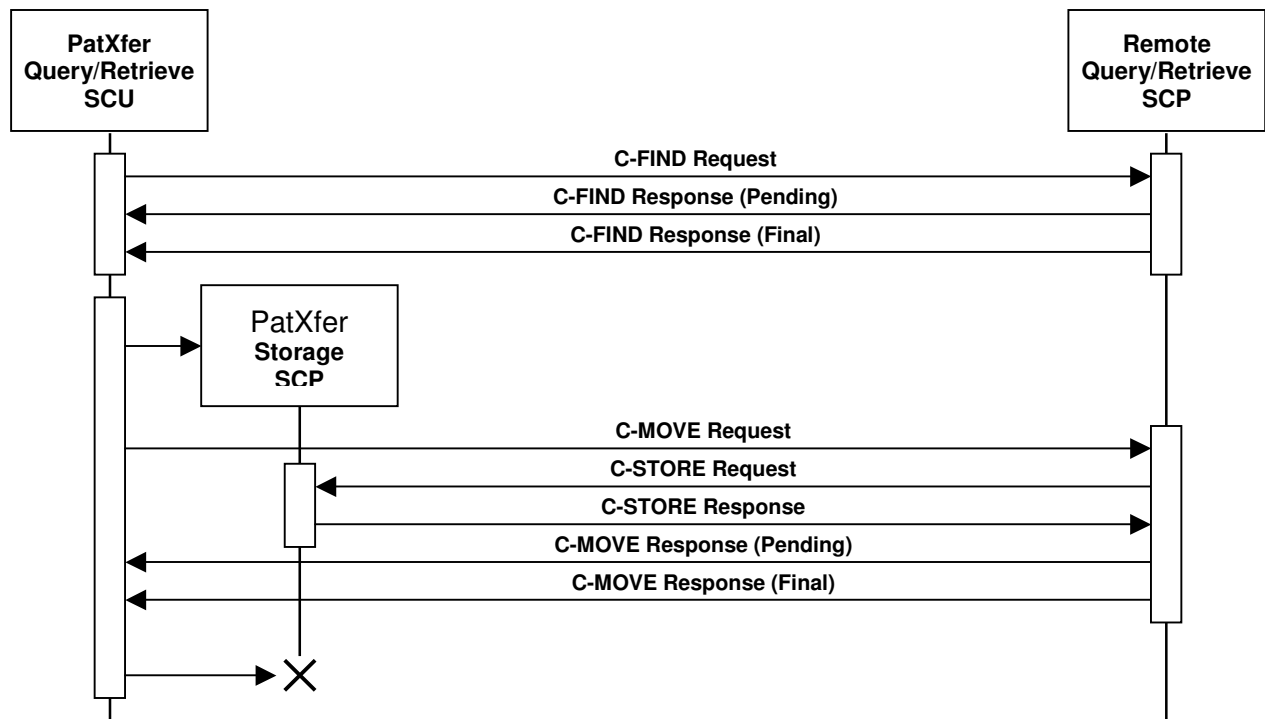


Figure 4-2: Sequence Constraints.

4.2 Application Entity Specifications

4.2.1 PatXfer Specification

4.2.1.1 SOP Classes and Transfer Syntaxes

PatXfer sends or receives a C-ECHO request in order to test the connection to a remote AE. It provides standard conformance to the following DICOM V3.0 SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes	Yes

Table 4-1: Supported Verification SOP Classes

PatXfer imports and exports DICOM data. It provides Standard Conformance to the following DICOM V3.0 SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	No	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	No	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	No	Yes
Secondary Capture (SC) Image Storage	1.2.840.10008.5.1.4.1.1.7	No	Yes
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129	No	Yes
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	No	Yes
X-Ray Radiofluoroscopic (RF) Image Storage	1.2.840.10008.5.1.4.1.1.12.2	No	Yes
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	No	Yes
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	No	Yes
Digital Mammography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	No	Yes
Digital Mammography Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	No	Yes
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	No	Yes
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	No	Yes

Table 4-2: Supported Storage SOP Classes

PatXfer is able to query a remote archive. It provides Standard Conformance to the following DICOM V3.0 SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	No
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	No
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No
Patient/Study Only Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1	Yes	No
Patient/Study Only Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2	Yes	No

Table 4-3: Supported Query/Retrieve SOP Classes

PatXfer supports the following transfer syntaxes. In an association negotiation the syntaxes are proposed in the order of appearance in the list.

Transfer Syntax Name	Transfer Syntax UID
DICOM Implicit VR Little Endian	1.2.840.10008.1.2
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1
DICOM Explicit VR Big Endian	1.2.840.10008.1.2.2
JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14)	1.2.840.10008.1.2.4.70

Table 4-4: Supported Transfer Syntaxes for Storage

Transfer Syntax Name	Transfer Syntax UID
DICOM Implicit VR Little Endian	1.2.840.10008.1.2
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1
DICOM Explicit VR Big Endian	1.2.840.10008.1.2.2

Table 4-5: Supported Transfer Syntaxes for Query/Retrieve

4.2.1.2 Association Policies

4.2.1.2.1 General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Application Context Name	1.2.840.10008.3.1.1.1
--------------------------	-----------------------

4.2.1.2.2 Number of Associations

For both association initiation and acceptance:

Maximum number of simultaneous Associations	1
---	---

4.2.1.2.3 Asynchronous Nature

The PatXfer does not support asynchronous communication (multiple outstanding transactions over a single association).

Maximum number of outstanding asynchronous transactions	1
---	---

4.2.1.2.4 Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.276.0.20.1.3
Implementation Version Name	PatXfer

4.2.1.3 Association Initiation Policy

PatXfer initiates an association in these cases:

1. **Find:** The user tries to find a specific entity in a remote DICOM archive.
2. **Retrieve:** The user wants to retrieve a specific entity from the remote DICOM archive and wants to convert it to the BrainLAB file formats.

4.2.1.3.1 Activity – Find

4.2.1.3.1.1 Description and Sequencing of Activities

A DICOM Query/Retrieve C-FIND request is performed when the user queries the remote DICOM archive for patients, studies, series or instances.

4.2.1.3.1.2 Proposed Presentation Contexts

Presentation Context Table			
Abstract Syntax	Transfer Syntax	Role	Ext. Neg.
All SCU SOP Classes defined in Table 4-1 and all FIND SCU SOP Classes as defined in Table 4-3	All Transfer Syntaxes as defined in Table 4-5	SCU	None
		SCU	None
		SCU	None

Table 4-6: Proposed Presentation Contexts for Activity Find.

4.2.1.3.1.3 SOP Specific Conformance

PatXfer provides standard conformance to the DICOM Verification Service Class and to the DICOM Query/Retrieve FIND SOP Classes. No extended negotiation is implemented.

For the patient-root and patient/study only model, the user may restrict the patient query by the following attributes:

Attribute Name	Tag
Patient's Name	(0010,0010)
Patient ID	(0010,0020)

For the study-root model, the user may restrict the patient/study query by the following attributes:

Description	Tag (hex)
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Study Date	(0008,0020)

4.2.1.3.2 Activity – Retrieve

4.2.1.3.2.1 Description and Sequencing of Activities

On user selection of a specific DICOM study or series (depends on the available SOP Class for Query/Retrieve), a move request is performed. The storage target for receiving the DICOM data (the AET with which the move-request is equipped) is the PatXfer application itself.

The Move operation only can be invoked after a Find operation. See chapter 4.1.3 for a detailed sequencing diagram.

4.2.1.3.2.2 Proposed Presentation Contexts

Presentation Context Table			
Abstract Syntax	Transfer Syntax	Role	Ext. Neg.
All SCU SOP Classes defined in Table 4-1 and all SCU MOVE SOP Classes as defined in Table 4-3	All Transfer Syntaxes as defined in Table 4-5	SCU	None
		SCU	None
		SCU	None

Table 4-7: Proposed Presentation Contexts for Activity Move.

4.2.1.3.2.3 SOP Specific Conformance

PatXfer provides standard conformance to the DICOM Verification Service Class and to the DICOM Query/Retrieve MOVE SOP Classes. No extended negotiation is implemented.

4.2.1.4 Association Acceptance Policy

PatXfer accepts an association in this case:

1. Retrieve: The user wants to retrieve a specific entity from the remote DICOM archive and wants to convert it to the BrainLAB file formats.

4.2.1.4.1 Activity – Retrieve

4.2.1.4.1.1 Associated Real-World Activity

On user selection of a specific DICOM entity a move request is performed. To receive the requested SOP instances a Storage SCP is invoked. The Storage SCP is only active during a DICOM Query/Retrieve C-MOVE request and automatically stopped after receive of the final C-MOVE response

4.2.1.4.1.2 Proposed Presentation Contexts

Presentation Context Table			
Abstract Syntax	Transfer Syntax	Role	Ext. Neg
All SOP Classes as defined in Table 4-1 and Table 4-2	All Transfer Syntaxes as defined in Table 4-4	SCU	None
		SCU	None
		SCU	None

Table 4-8: Accepted Presentation Contexts for Activity Retrieve.

4.2.1.4.1.3 SOP Specific Conformance

PatXfer provides standard conformance to the DICOM Verification Service Class and to the DICOM Storage SOP Classes. No extended negotiation is implemented.

The received DICOM SOP Instances will be converted to the BrainLAB file formats. Therefore some of the SOP specific information is lost. See chapter 8.1 for further information on exported IODs.

4.2.1.4.1.4 Presentation Context Acceptance Criterion

PatXfer accepts multiple presentation contexts containing the same abstract syntax.

4.2.1.4.1.5 Transfer Syntax Selection Policy

The first Transfer Syntax encountered in the configuration file, which matches a Transfer Syntax offered for a given Presentation Context, will be selected as the accepted Transfer Syntax for that Presentation Context.

4.3 Network Interfaces

4.3.1 Physical Network Interface

PatXfer supports the DICOM upper layer using TCP/IP. PatXfer is indifferent to the physical medium over which TCP/IP executes. It inherits this from the operating system upon which it executes.

4.3.2 Additional Protocols

The usage of DNS and DHCP is possible and is based on the network configuration of the operating system upon which PatXfer executes.

4.4 Configuration

4.4.1 AE Title / Presentation Address Mapping

Configuration of remote and local DICOM nodes can be performed with the graphical user interface of PatXfer.

PatXfer can configure several nodes representing remote QR Servers. On the corresponding settings page, application-wide global parameter and node-specific parameters can be entered.

4.4.1.1 Local AE Titles

The local AET for the Query/Retrieve SCU is an application-wide global parameter. The local AET for the Storage SCP defaults to the one of the Query/Retrieve SCU. But for each specified archive you may define an own Storage SCP AET.

The listening port is an application-wide global parameter.

Application Entity	Default AE Title	Default TCP/IP Port
PatXfer	PatXfer	104

4.4.1.2 Remote AE Title/Presentation Address Mapping

In PatXfer you can specify several archives for import. The IP address/hostname, AET and listening port may be configured for each DICOM network archive separately within the Graphical User Interface.

4.4.2 Parameters

Additional a timeout may be specified for each DICOM network archive separately.

Parameter	Configurable	Default Value
Timeout	Yes	30
Maximum PDU Size	No	28672

5 Media Interchange

PatXfer supports DICOM media interchange for import and export of DICOM data:

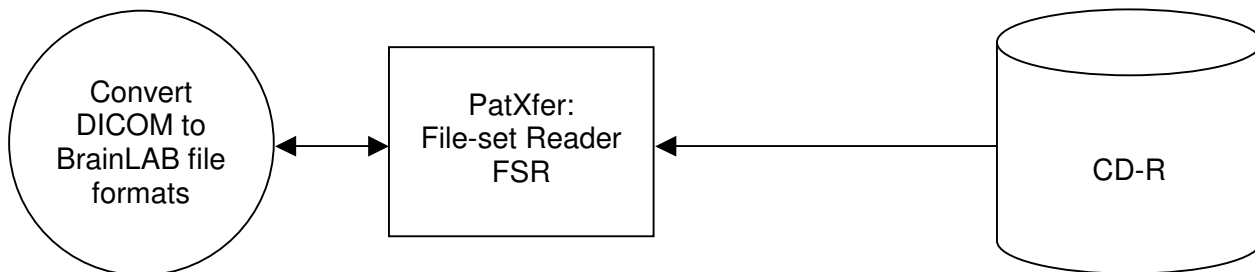
- For import PatXfer supports media interchange application profiles. To reflect this the support for the Standard General Purpose CD-R Interchange is added to provide the supported SOP Classes. Nevertheless PatXfer is able to import DICOM files even without the existence of any DICOMDIR by scanning a given file system for any kind of DICOM files.

5.1 Implementation Model

5.1.1 Application Data Flow Diagram

With PatXfer the user may browse DICOM File-sets, import selected entities and convert them to the BrainLAB file formats.

The File System Reader:



5.1.2 Functional Definition of Application Entity (AE)

Some communications and data transfer with remote AE's are accomplished utilizing the file system provided by the operating system upon which PatXfer executes.

- File Set Reader:
PatXfer loads DICOM data from the file system and converts it to the BrainLAB file formats – with user interaction. The reader supports the same SOP classes as the Storage SCP (see Table 4-2).

5.1.3 Sequencing Of Real World Activities

Not necessary.

5.1.4 File Meta Implementation Identifying Information

PatXfer provides the same information as in chapter 4.2.1.2.4.

5.2 Application Entity Specifications

5.2.1 PatXfer Specification

PatXfer supports the following Media Interchange Profiles:

AE Related Application Profiles, Real-World Activities, and Roles			
Supported APs	Real World Activity	Roles	SC Option
STD-GEN-CD	Convert DICOM to BrainLAB File Formats	FSR	Interchange

Table 5-1: Supported Media Interchange Profiles.

5.2.1.1 File Meta Information For The Application Entity

The Source Application Entity Title included in the File Meta Header is configurable. It is the same as the local AET of the network configuration (see chapter 4.4.1.1)

5.2.1.2 Real-World Activities

5.2.1.3 Activity – Convert DICOM to BrainLAB File Formats

PatXfer acts as an FSR using the Interchange option

- When requested to provide a directory listing it will read the File-set and display the DICOM-DIR directory entries for all SOP Instances in the File-set.
- When requested to load the selected entries from directory listing to convert them, only those SOP Instances are loaded that correspond to the Application Profile STD-GEN-CD.
- For the list of Application Profiles that invoke this AE see Table 5-1. The supported SOP Classes see Table 4-2.

5.2.1.3.1 Media Storage Application Profiles

PatXfer supports the STD-GEN-CD Application Profile.

5.2.1.3.1.1 Options

The Offline-Media Application Entity supports the SOP Classes and Transfer Syntaxes listed in the Table below:

SOP Classes	Transfer Syntaxes
All SOP Classes listed in Table 4-2	All Transfer Syntaxes listed in Table 4-4

See chapter 8.1.2 for further information on acceptance of SOP Instances, i.e. whether PatXfer is able to import and convert the DICOM data.

5.3 Augmented And Private Application Profiles

PatXfer does not support any augmented or private application profiles.

5.4 Media Configuration

PatXfer uses the local AET configured for the network services as source AET for the DICOM files.

6 Support Of Extended Character Sets

PatXfer supports the

- ISO_IR 100 (ISO 8859-1:1987 Latin Alphabet No. 1 supplementary set)

7 Security Profiles

No security profiles are supported.

8 Annexes

8.1 IOD Contents

8.1.1 Created SOP Instances

None supported.

8.1.2 Usage Of Attributes From Received IOD's

This section describes the requirements on the DICOM data, which shall be converted into the BrainLAB file formats. Conversion can be performed on the DICOM Images of type CT, MR, PET, CR, XA and RF.

PatXfer accepts all images of the SOP Classes in Table 4-2, which meet the following requirements:

- Only single frame images are supported.
- Images with an attribute (0028,0030) Pixel Spacing containing different values for x and y distance¹ will be rejected.

8.2 Data Dictionary Of Private Attributes

None supported.

8.3 Coded Terminology And Templates

None supported.

8.4 Grayscale Image Consistency

Not supported.

8.5 Standard Extended/Specialized/Private Sop Classes

None supported.

8.6 Private Transfer Syntaxes

None supported.

¹ To be more precise: If the difference between both values is greater than 0.001 mm!

9 Index

9.1 Index of Tables

Table 1-1: Network services supported by PatXfer	3
Table 1-2: Media Services supported by PatXfer.....	3
Table 4-1: Supported Verification SOP Classes	11
Table 4-2: Supported Storage SOP Classes	11
Table 4-3: Supported Query/Retrieve SOP Classes	12
Table 4-4: Supported Transfer Syntaxes for Storage.....	12
Table 4-5: Supported Transfer Syntaxes for Query/Retrieve	12
Table 4-6: Proposed Presentation Contexts for Activity Find.	13
Table 4-7: Proposed Presentation Contexts for Activity Move.	14
Table 4-8: Accepted Presentation Contexts for Activity Retrieve.	15
Table 5-1: Supported Media Interchange Profiles.....	18

9.2 Index of Figures

Figure 4-1: The Query/Retrieve SCU and Storage SCP	8
Figure 4-2: Sequence Constraints.	10