

Technical Publication

DICOM Conformance Statement

BrainSUITE NET 1.5

Document Revision 1

March 5, 2009

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1 Conformance Statement Overview

This is a conformance statement for the BrainLAB software BrainSUITE NET. The main purpose of this software is to import and convert DICOM data to the BrainLAB advanced file format and vice versa.

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.

The DICOM export part of the application is

- Send DICOM data to another DICOM application or archive.
- Write DICOM data to the file system (no media interchange application profile supported so far).

What is not part of BrainSUITE NET:

- There is no direct way e.g. to read DICOM files and send them to a remote system. All you can do is to import DICOM data and convert it to BrainLAB data – and therefore lose some of its information – or you can convert BrainLAB data to DICOM and export it.
- BrainSUITE NET itself has no permanent DICOM Storage SCP to receive data at any time. If you need this feature the BrainLAB Converting DICOM Service has to be installed (see [2]).

SOP Classes	User Of Service (SCU)	Provider Of Service (SCP)
Transfer		
Computed Radiography Image Storage	Yes	Yes
CT Image Storage	Yes	Yes
MR Image Storage	Yes	Yes
Secondary Capture (SC) Image Storage	Yes	Yes
Multi-frame Grayscale Byte Secondary Capture Image Storage	Yes	Yes
Multi-frame Grayscale Word Secondary Capture Image Storage	Yes	Yes
Multi-frame True Color Secondary Capture Image Storage	Yes	Yes
Standalone PET Curve Storage	No	Yes
X-Ray Angiographic Image Storage	No	Yes
X-Ray Radiofluoroscopic (RF) Image Storage	No	Yes
Nuclear Medicine Image Storage	Yes	Yes
Raw Data Storage	Yes	Yes
Positron Emission Tomography Image Storage	Yes	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 BrainSUITE NET

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 BrainSUITE NET

2 Table Of Contents

1	Conformance Statement Overview	3
2	Table Of Contents	5
3	Introduction	9
3.1	Revision History	9
3.2	Audience	9
3.3	Remarks	9
3.4	Abbreviations	10
3.5	References	10
4	Networking	11
4.1	Implementation Model	11
4.1.1	Application Data Flow Diagram	11
4.1.2	Functional Definition of Application Entity (AE)	12
4.1.3	Sequencing Of Real World Activities	13
4.2	Application Entity Specifications	14
4.2.1	BrainSUITE NET Specification	14
4.2.1.1	SOP Classes and Transfer Syntaxes	14
4.2.1.2	Association Policies	15
4.2.1.2.1	General	15
4.2.1.2.2	Number of Associations	15
4.2.1.2.3	Asynchronous Nature	15
4.2.1.2.4	Implementation Identifying Information	15
4.2.1.3	Association Initiation Policy	15
4.2.1.3.1	Activity – Find	16
4.2.1.3.2	Activity – Retrieve	16
4.2.1.3.3	Activity – Store	17
4.2.1.4	Association Acceptance Policy	17
4.2.1.4.1	Activity – Retrieve	17
4.3	Network Interfaces	18
4.3.1	Physical Network Interface	18
4.3.2	Additional Protocols	18
4.4	Configuration	18
4.4.1	AE Title / Presentation Address Mapping	18
4.4.1.1	Local AE Titles	19
4.4.1.2	Remote AE Title/Presentation Address Mapping	19
4.4.2	Parameters	19
5	Media Interchange	20
5.1	Implementation Model	20
5.1.1	Application Data Flow Diagram	20
5.1.2	Functional Definition of Application Entity (AE)	20
5.1.3	Sequencing Of Real World Activities	20
5.1.4	File Meta Implementation Identifying Information	21
5.2	Application Entity Specifications	21
5.2.1	BrainSUITE NET Specification	21
5.2.1.1	File Meta Information For The Application Entity	21
5.2.1.2	Real-World Activities	21
5.2.1.3	Activity – Convert DICOM to BrainLAB Data	21
5.2.1.3.1	Media Storage Application Profiles	21
5.3	Augmented and Private Application Profiles	22
5.4	Media Configuration	22

6	Support of Extended Character Sets	23
7	Security Profiles	24
8	Annexes	25
8.1	IOD Contents	25
8.1.1	Created SOP Instances	25
8.1.1.1	Created IODs	25
8.1.1.1.1	Computed Radiography Image Storage	25
8.1.1.1.2	Computed Tomography Image Storage	25
8.1.1.1.3	Magnetic Resonance Image Storage	26
8.1.1.1.4	Positron Emission Tomography Image Storage	26
8.1.1.1.5	Nuclear Medicine Image Storage	27
8.1.1.1.6	Multi-frame Grayscale Byte / Grayscale Word / True Color SC Image Storage	27
8.1.1.2	Created Modules	28
8.1.1.2.1	Patient	28
8.1.1.2.2	General Study	28
8.1.1.2.3	Patient Study	28
8.1.1.2.4	General Series	29
8.1.1.2.5	CR Series	29
8.1.1.2.6	PET Series	29
8.1.1.2.7	PET Isotope Image	29
8.1.1.2.8	NM/PET Patient Orientation	30
8.1.1.2.9	Frame Of Reference	30
8.1.1.2.10	General Equipment	30
8.1.1.2.11	SC Equipment	30
8.1.1.2.12	Acquisition Context	31
8.1.1.2.13	General Image	31
8.1.1.2.14	Image Plane	31
8.1.1.2.15	Image Pixel	31
8.1.1.2.16	CR Image	31
8.1.1.2.17	CT Image	32
8.1.1.2.18	MR Image	32
8.1.1.2.19	PET Image	32
8.1.1.2.20	NM Image	33
8.1.1.2.21	SC Image	33
8.1.1.2.22	NM Image Pixel	33
8.1.1.2.23	Multi-frame	33
8.1.1.2.24	NM Multi-frame	33
8.1.1.2.25	SC Multi-frame Image	33
8.1.1.2.26	SC Multi-frame Vector	34
8.1.1.2.27	NM Isotope	34
8.1.1.2.28	NM Detector	34
8.1.1.2.29	NM Reconstruction	34
8.1.1.2.30	VOI LUT	34
8.1.1.2.31	SOP Common	35
8.1.2	Usage of Attributes from Received IODs	35
8.1.2.1	Images	35
8.2	Data Dictionary of Private Attributes	36
8.2.1	Group 0009	36
8.3	Coded Terminology and Templates	36
8.4	Grayscale Image Consistency	36
8.5	Standard Extended/Specialized/Private Sop Classes	36

8.6	Private Transfer Syntaxes	36
9	Indexes	38
9.1	Index of Tables.....	38
9.2	Index of Figures.....	39

3 Introduction

3.1 Revision History

Document Version	Date of Issue	Author	Description
1	March 5, 2009		Initial release for BrainSUITE NET 1.5

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	Compact Disk
CD-R	Compact Disk Recordable
DVD	Digital Versatile Disc
FSC	File-Set Creator
FSU	File-Set Updater
FSR	File-Set Reader
HD	Hard Disk
IOD	(DICOM) Information Object Definition
ISO	International Standard Organization
MOD	Magneto Optical Disk
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
xBrain	BrainLAB advanced file format

3.5 References

- [1] Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-3.18 – 2006
- [2] DICOM Conformance Statement Converting DICOM Service 1.2, BrainLAB, March 20, 2008

4 Networking

4.1 Implementation Model

The BrainLAB BrainSUITE NET 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 a file system.
- A Storage SCU that sends DICOM data to a DICOM archive or workstation.
- An application to convert DICOM image data (X-Ray, CT, MR, PET, NM, SC) into the BrainLAB advanced file format.
- An application to convert data from the BrainLAB advanced file format into DICOM image data (X-Ray, CT, MR, PET, NM).

4.1.1 Application Data Flow Diagram

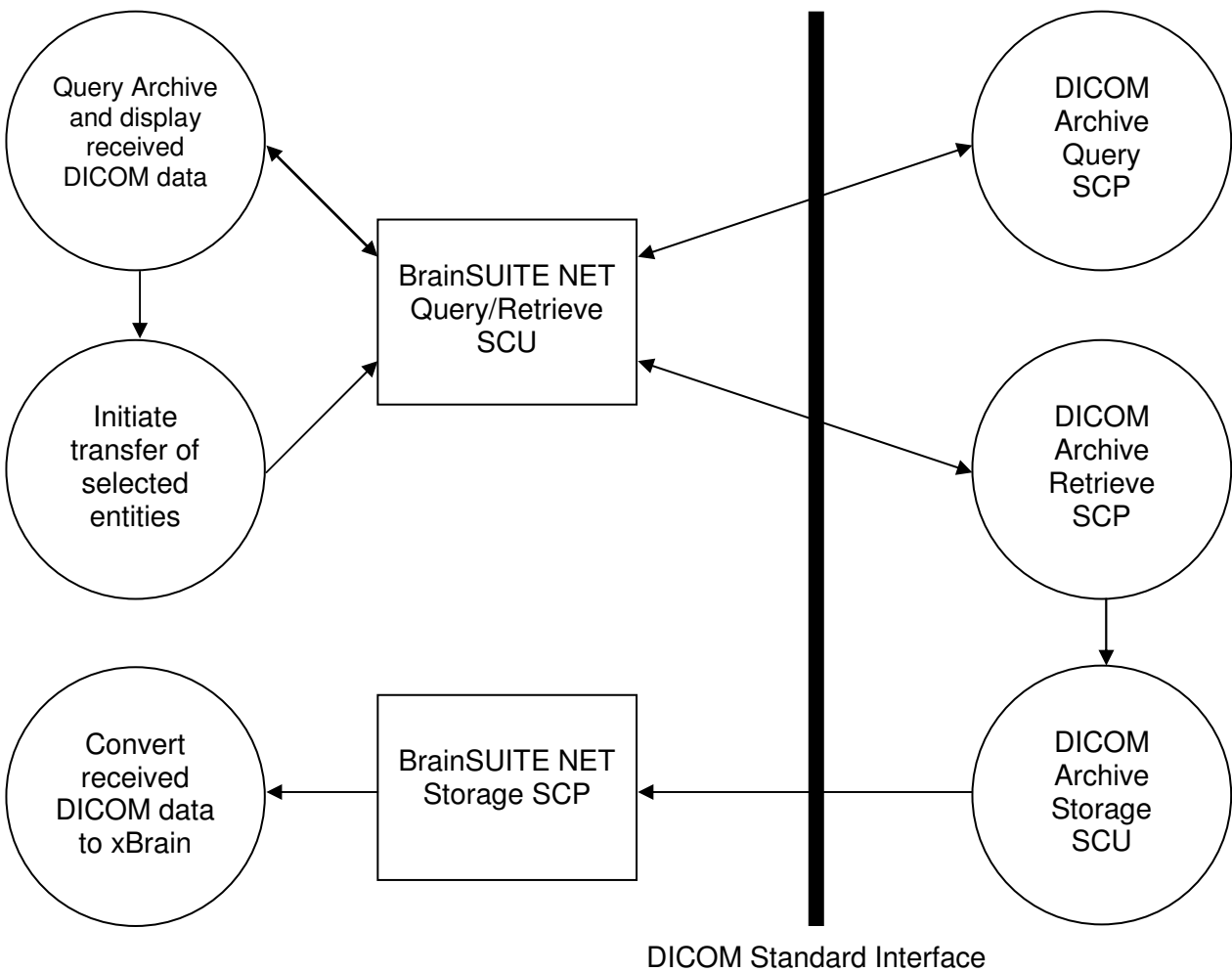


Figure 4-1: The Query/Retrieve SCU and Storage SCP application flow diagram

4.1.2 Functional Definition of Application Entity (AE)

Some communications and data transfer with remote AEs 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. BrainSUITE NET 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 SCP¹:**
During a move operation a DICOM Storage SCP is invoked. BrainSUITE NET accepts an association with a Storage SCU negotiating any of the SOP Classes listed in Table 4-3. The received data may be – with user interaction – converted to the BrainLAB advanced file format.
- **Storage SCU:**
BrainSUITE NET loads data from the BrainLAB advanced file format, converts it to DICOM – with user interaction – and initiates an association with a Storage SCP negotiating all SOPs listed in Table 4-3. The converted DICOM data is then sent to the remote DICOM Storage SCP.

¹ The Storage SCP is only available during a DICOM Query/Retrieve Move session. PatXfer itself provides no permanent Storage SCP to receive data at any time. If you need this feature the BrainLAB Converting DICOM Service has to be installed (see [2])

4.1.3 Sequencing Of Real World Activities

BrainSUITE NET 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 to BrainLAB Advanced file format.

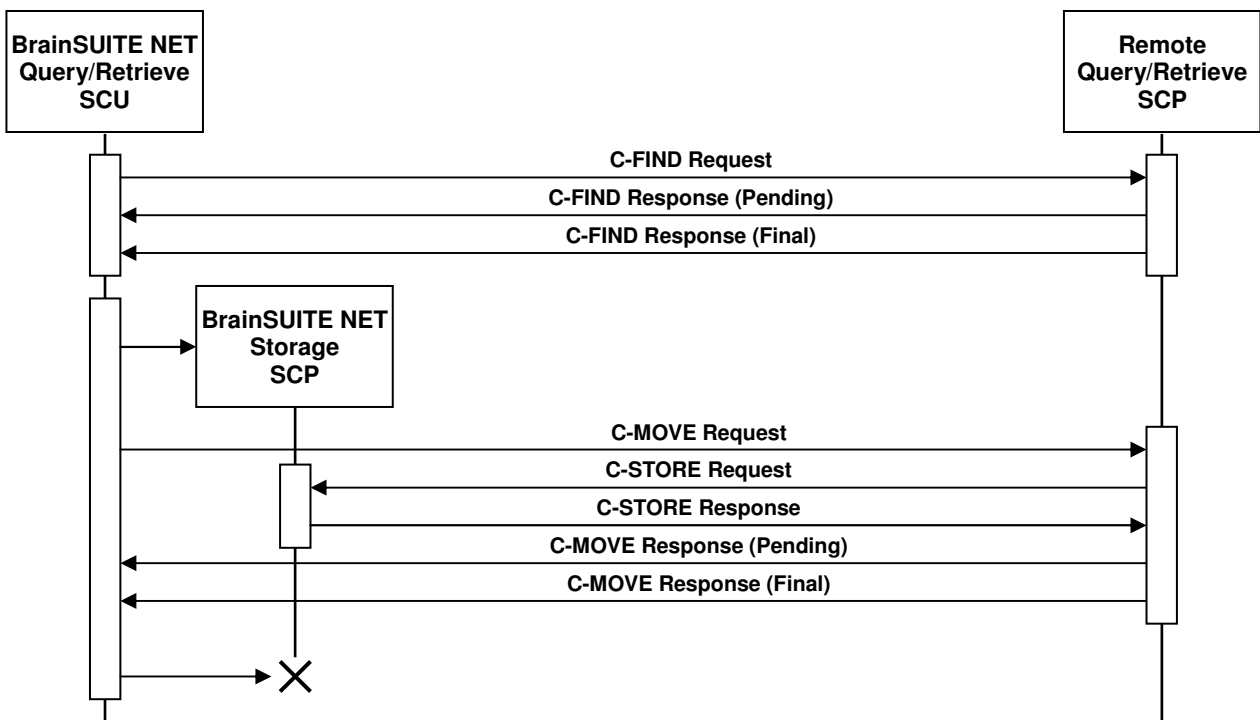


Figure 4-2: Sequencing of Query/Retrieve SCU and Storage SCP

4.2 Application Entity Specifications

4.2.1 BrainSUITE NET Specification

4.2.1.1 SOP Classes and Transfer Syntaxes

BrainSUITE NET 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

BrainSUITE NET 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 4-2: Supported Query/Retrieve SOP Classes

BrainSUITE NET imports and exports DICOM image 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	Yes	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	Yes
Secondary Capture (SC) Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	Yes
Multi-frame Grayscale Byte 2ndary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	Yes
Multi-frame Grayscale Word 2ndary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Yes	Yes
Multi-frame True Color 2ndary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	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
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	Yes
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	Yes

Table 4-3: Supported Storage SOP Classes

BrainSUITE NET 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	SCU	SCP
DICOM Implicit VR Little Endian	1.2.840.10008.1.2	Yes	Yes
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	Yes	Yes
DICOM Explicit VR Big Endian	1.2.840.10008.1.2.2	Yes	Yes
JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14)	1.2.840.10008.1.2.4.70	No	Yes

Table 4-4: Supported Transfer Syntaxes

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 BrainSUITE NET 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	1.2.276.0.20.1.1.13.1.5.0
Implementation Version Name	BrainSUITE NET15

4.2.1.3 Association Initiation Policy

BrainSUITE NET 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 advanced file format.
3. **Store:** The user loaded a dataset in the BrainLAB advanced file format and wants to convert it to the DICOM format and send it to a remote DICOM node.

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 listed in Table 4-1 and all FIND SCU SOP Classes as listed in Table 4-2	All SCU Transfer Syntaxes as listed in Table 4-4	SCU	None
		SCU	None
		SCU	None

Table 4-5: Proposed Presentation Contexts for Activity Find.

4.2.1.3.1.3 SOP Specific Conformance

BrainSUITE NET 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
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Study Date	(0008,0020)
Accession Number	(0008,0050)

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 BrainSUITE NET application itself.

The Move operation can only 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 listed in Table 4-1 and all SCU MOVE SOP Classes as listed in Table 4-2	All SCU Transfer Syntaxes as listed in Table 4-4	SCU	None
		SCU	None
		SCU	None

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

4.2.1.3.2.3 SOP Specific Conformance

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

4.2.1.3.3 Activity – Store

4.2.1.3.3.1 Associated Real-World Activity

After successful conversion of the selected BrainLAB data to DICOM a storage request is performed to send the DICOM data to a remote Storage SCP. The remote Storage SCP must be one of the AETs known by BrainSUITE NET.

4.2.1.3.3.2 Proposed Presentation Contexts

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

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

4.2.1.3.3.3 SOP Specific Conformance

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

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

4.2.1.4 Association Acceptance Policy

BrainSUITE NET 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 advanced file format.

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 SCP SOP Classes as listed in Table 4-1 and Table 4-3	All SCP Transfer Syntaxes as listed in Table 4-4	SCU	None
		SCU	None
		SCU	None

Table 4-8: Storage SCP Presentation Contexts.

4.2.1.4.1.3 SOP Specific Conformance

BrainSUITE NET 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 advanced file format. 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

BrainSUITE NET 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

BrainSUITE NET supports the DICOM upper layer using TCP/IP. BrainSUITE NET 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 BrainSUITE NET 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 BrainSUITE NET.

BrainSUITE NET can configure several nodes representing remote Q/R Servers or Storage SCPs. 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 node 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
BrainSUITE NET	PatXferQR	104

4.4.1.2 Remote AE Title/Presentation Address Mapping

In BrainSUITE NET you can specify several nodes for import and export. The IP address/hostname, AET and listening port may be configured for each DICOM network node 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

BrainSUITE NET supports DICOM media interchange for import and export of DICOM data:

- For import BrainSUITE NET 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 BrainSUITE NET is able to import DICOM files even without the existence of any DICOMDIR by scanning a given file system located on any media (e.g. HD, MOD, CD, DVD, Tapes) for any kind of DICOM files.
- For export there is no media interchange application profile supported. The files are simply stored to the file system grouped by patient without using any DICOMDIR. For export it supports the same SOP Classes like the Storage SCU (see Table 4-3 or Table 4-7).

5.1 Implementation Model

5.1.1 Application Data Flow Diagram

With BrainSUITE NET the user may browse DICOM File-sets, import selected entities and convert them to the BrainLAB advanced file format.

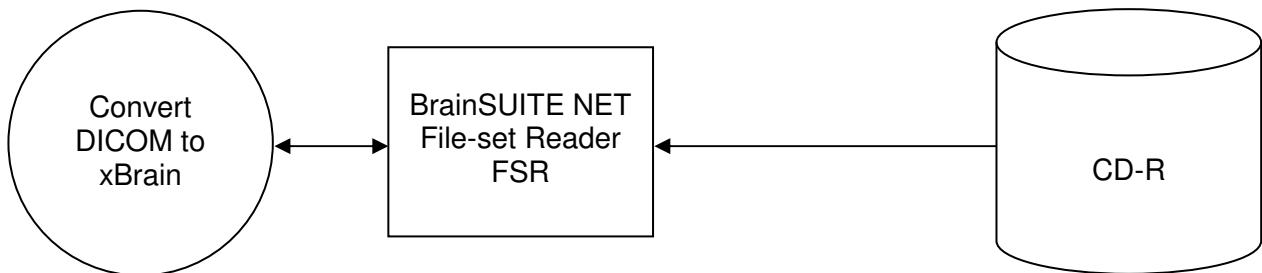


Figure 5-1: The media interchange application flow diagram

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 BrainSUITE NET executes.

- File Set Reader:
BrainSUITE NET loads DICOM data from the file system and converts it to the BrainLAB advanced file format – with user interaction. The reader supports the same SOP classes as the Storage SCP (see Table 4-3).

5.1.3 Sequencing Of Real World Activities

Not necessary.

5.1.4 File Meta Implementation Identifying Information

BrainSUITE NET provides the same information as in chapter 4.2.1.2.4.

5.2 Application Entity Specifications

5.2.1 BrainSUITE NET Specification

BrainSUITE NET 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 data	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 Data

BrainSUITE NET 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 to BrainLAB Advanced file format, 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 4-3.

5.2.1.3.1 Media Storage Application Profiles

BrainSUITE NET 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 SCP SOP Classes listed in Table 4-3	All SCP Transfer Syntaxes listed in Table 4-4

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

5.3 Augmented and Private Application Profiles

BrainSUITE NET does not support any augmented or private application profiles.

5.4 Media Configuration

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

6 Support of Extended Character Sets

BrainSUITE NET 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

The following tables use a number of abbreviations. The abbreviations used in the “Presence of Module” column are:

MNAP Module not always present
ALWAYS Module always present

8.1.1.1 Created IODs

8.1.1.1.1 Computed Radiography Image Storage

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-7	ALWAYS
Study	General Study	Table 8-8	ALWAYS
	Patient Study	Table 8-9	ALWAYS
Series	General Series	Table 8-10	ALWAYS
	CR Series	Table 8-11	ALWAYS
Frame of Reference	Frame of Reference	Table 8-15	ALWAYS
Equipment	General Equipment	Table 8-16	ALWAYS
Image	General Image	Table 8-19	ALWAYS
	Image Pixel	Table 8-21	ALWAYS
	CR Image	Table 8-22	ALWAYS
	VOI LUT	Table 8-36	MNAP
	SOP Common	Table 8-37	ALWAYS

Table 8-1: CR Image Storage IOD

8.1.1.1.2 Computed Tomography Image Storage

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-7	ALWAYS
Study	General Study	Table 8-8	ALWAYS
	Patient Study	Table 8-9	ALWAYS
Series	General Series	Table 8-10	ALWAYS
Frame of Reference	Frame of Reference	Table 8-15	ALWAYS
Equipment	General Equipment	Table 8-16	ALWAYS
Image	General Image	Table 8-19	ALWAYS
	Image Plane	Table 8-20	ALWAYS
	Image Pixel	Table 8-21	ALWAYS
	CT Image	Table 8-23	ALWAYS
	VOI LUT	Table 8-36	MNAP
	SOP Common	Table 8-37	ALWAYS

Table 8-2: CT Image Storage IOD

8.1.1.1.3 Magnetic Resonance Image Storage

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-7	ALWAYS
Study	General Study	Table 8-8	ALWAYS
	Patient Study	Table 8-9	ALWAYS
Series	General Series	Table 8-10	ALWAYS
Equipment	General Equipment	Table 8-16	ALWAYS
Image	General Image	Table 8-19	ALWAYS
	Image Plane	Table 8-20	ALWAYS
	Image Pixel	Table 8-21	ALWAYS
	MR Image	Table 8-24	ALWAYS
	VOI LUT	Table 8-36	MNAP
	SOP Common	Table 8-37	ALWAYS

Table 8-3: MR Image Storage IOD

8.1.1.1.4 Positron Emission Tomography Image Storage

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-7	ALWAYS
Study	General Study	Table 8-8	ALWAYS
	Patient Study	Table 8-9	ALWAYS
Series	General Series	Table 8-10	ALWAYS
	PET Series	Table 8-12	ALWAYS
	PET Isotope	Table 8-13	ALWAYS
Frame of Reference	Frame of Reference	Table 8-15	ALWAYS
Equipment	General Equipment	Table 8-16	ALWAYS
Image	General Image	Table 8-19	ALWAYS
	Image Plane	Table 8-20	ALWAYS
	Image Pixel	Table 8-21	ALWAYS
	PET Image	Table 8-25	ALWAYS
	VOI LUT	Table 8-36	MNAP
	SOP Common	Table 8-37	ALWAYS

Table 8-4: PET Image Storage IOD

8.1.1.1.5 Nuclear Medicine Image Storage

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-7	ALWAYS
Study	General Study	Table 8-8	ALWAYS
	Patient Study	Table 8-9	ALWAYS
Series	General Series	Table 8-10	ALWAYS
	NM/PET Patient Orientation	Table 8-14	ALWAYS
Frame of Reference	Frame of Reference	Table 8-15	ALWAYS
Equipment	General Equipment	Table 8-16	ALWAYS
Image	General Image	Table 8-19	ALWAYS
	Image Pixel	Table 8-21	ALWAYS
	NM Image Pixel	Table 8-28	ALWAYS
	Multi-frame	Table 8-29	ALWAYS
	NM Multi-frame	Table 8-30	ALWAYS
	NM Image	Table 8-26	ALWAYS
	NM Isotope	Table 8-33	ALWAYS
	NM Detector	Table 8-34	ALWAYS
	NM Reconstruction	Table 8-35	ALWAYS
	VOI LUT	Table 8-36	MNAP
SOP Common	Table 8-37	ALWAYS	

Table 8-5: NM Image Storage IOD

8.1.1.1.6 Multi-frame Grayscale Byte / Grayscale Word / True Color SC Image Storage

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-7	ALWAYS
Study	General Study	Table 8-8	ALWAYS
	Patient Study	Table 8-9	ALWAYS
Series	General Series	Table 8-10	ALWAYS
	PET Series	Table 8-12	ALWAYS
	PET Isotope	Table 8-13	ALWAYS
Equipment	General Equipment	Table 8-16	ALWAYS
	SC Equipment	Table 8-17	ALWAYS
Frame of Reference	Frame of Reference	Table 8-15	ALWAYS
Image	General Image	Table 8-19	ALWAYS
	Image Pixel	Table 8-21	ALWAYS
	Multi-frame	Table 8-29	ALWAYS
	SC Image	Table 8-27	ALWAYS
	SC Multi-frame Image	Table 8-31	ALWAYS
	SC Multi-frame Vector	Table 8-32	MNAP
	VOI LUT	Table 8-36	MNAP
	SOP Common	Table 8-37	ALWAYS

Table 8-6: PET Image Storage IOD

8.1.1.2 Created Modules

The following tables use a number of abbreviations. The abbreviations used in the “Presence” column are:

VNAP	Value not always present (attribute set to zero length if no value is present)
ANAP	Attribute not always present
ALWAYS	Attribute is always present
EMPTY	Attribute is set to zero length

The abbreviations used in the “Source” column:

USER	The attribute value source is from user input
AUTO	The attribute value is generated automatically
CONFIG	The attribute value source is a configurable parameter

8.1.1.2.1 Patient

Attribute Name	Tag	VR	Value	Presence	Source
Patient's Name	(0010,0010)	PN	From loaded data or user input	VNAP	AUTO/USER
Patient ID	(0010,0020)	LO	From loaded data or user input	VNAP	AUTO/USER
Patient's Birth Date	(0010,0030)	DA	From loaded data	VNAP	AUTO
Patient's Sex	(0010,0040)	CS	From loaded data	VNAP	AUTO

Table 8-7: Patient Module

8.1.1.2.2 General Study

Attribute Name	Tag	VR	Value	Presence	Source
Study Instance UID	(0020,000D)	UI	Generated	ALWAYS	AUTO
Study Date	(0008,0020)	DA	From loaded data	ANAP	AUTO
Referring Physician's Name	(0008,0090)	PN		EMPTY	AUTO
Study ID	(0020,0010)	SH	From loaded data	VNAP	AUTO
Accession Number	(0008,0050)	SH		EMPTY	AUTO
Study Description	(0008,1030)	LO	From loaded data	ANAP	AUTO

Table 8-8: General Study Module

8.1.1.2.3 Patient Study

Attribute Name	Tag	VR	Value	Presence	Source
Patient's Height	(0010,1020)	DS	From loaded data	ANAP	AUTO
Patient's Weight	(0010,1030)	DS	From loaded data	ANAP	AUTO

Table 8-9: Patient Study Module

8.1.1.2.4 General Series

Attribute Name	Tag	VR	Value	Presence	Source
Modality	(0008,0060)	CS	From loaded data	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	Generated	ALWAYS	AUTO
Series Number	(0020,0011)	IS	From loaded data	ALWAYS	AUTO
Series Date	(0008,0021)	DA	From loaded data	ANAP	AUTO
Series Time	(0008,0031)	TM	From loaded data	ANAP	AUTO
Series Description	(0008,103E)	LO	From loaded data	ANAP	AUTO
Patient Position	(0018,5100)	DA	If applicable: From loaded data or user	ANAP ²	AUTO/ USER

Table 8-10: General Series Module

8.1.1.2.5 CR Series

Attribute Name	Tag	VR	Value	Presence	Source
Body Part Examined	(0018,0015)	CS		EMPTY	AUTO
View Position	(0018,5101)	CS		EMPTY	AUTO

Table 8-11: CR Series Module

8.1.1.2.6 PET Series

Attribute Name	Tag	VR	Value	Presence	Source
Series Date	(0008,0021)	DA	From loaded data or current date	ALWAYS	AUTO
Series Time	(0008,0031)	TM	From loaded data or current time	ALWAYS	AUTO
Units	(0054,1001)	CS	"NONE"	ALWAYS	AUTO
Counts Source	(0054,1002)	CS	"EMISSION"	ALWAYS	AUTO
Series Type	(0054,1000)	CS	"STATIC\IMAGE"	ALWAYS	AUTO
Number of Slices	(0054,0081)	US	From loaded data	ALWAYS	AUTO
Corrected Image	(0028,0051)	CS		EMPTY	AUTO
Decay Correction	(0054,1102)	CS	"NONE"	ALWAYS	AUTO
Collimator Type	(0018,1181)	CS		EMPTY	AUTO

Table 8-12: PET Series Module

8.1.1.2.7 PET Isotope Image

Attribute Name	Tag	VR	Value	Presence	Source
Radiopharmaceutical Information Sequence	(0054,0016)	SQ		EMPTY	AUTO

Table 8-13: PET Isotope Module

² For CT and MR Image Storage this attribute exists always, else it's not present.

8.1.1.2.8 NM/PET Patient Orientation

Attribute Name	Tag	VR	Value	Presence	Source
Patient Orientation Code Sequence	(0054,0410)	SQ		VNAP	AUTO
>Code Value	(0008,0100)	SH	Context ID 19	ALWAYS	AUTO
>Coding Scheme Designator	(0008,0102)	SH	"99SDM"	ALWAYS	AUTO
>Code Meaning	(0008,0104)	LO	Context ID 19 Meaning	ALWAYS	AUTO
>Patient Orientation Modifier Code Sequence	(0054,0412)	SQ		ALWAYS	AUTO
>>Code Value	(0008,0100)	SH	Context ID 20	ALWAYS	AUTO
>>Coding Scheme Designator	(0008,0102)	SH	"99SDM"	ALWAYS	AUTO
>>Code Meaning	(0008,0104)	LO	Context ID 20 Meaning	ALWAYS	AUTO
Patient Gantry Relationship Code Sequence	(0054,0414)	SQ		VNAP	AUTO
>Code Value	(0008,0100)	SH	Context ID 21	ALWAYS	AUTO
>Coding Scheme Designator	(0008,0102)	SH	"99SDM"	ALWAYS	AUTO
>Code Meaning	(0008,0104)	LO	Context ID 21 Meaning	ALWAYS	AUTO

Table 8-14: NM/PET Patient Orientation Module

8.1.1.2.9 Frame Of Reference

Attribute Name	Tag	VR	Value	Presence	Source
Frame of Reference UID	(0020,0052)	UI	Generated	ALWAYS	AUTO
Position Reference Indicator	(0020,1040)	LO		EMPTY	AUTO

Table 8-15: Frame of Reference Module

8.1.1.2.10 General Equipment

Attribute Name	Tag	VR	Value	Presence	Source
Manufacturer	(0008,0070)	LO	"BrainLAB"	ALWAYS	AUTO
Station Name	(0008,1010)	SH	<Host Name>	ALWAYS	AUTO
Manufacturer's Model Name	(0008,1090)	LO	"BrainSUITE NET"	ALWAYS	AUTO
Software Version(s)	(0018,1020)	LO	The current BrainSUITE NET version	ALWAYS	AUTO
Private Creator Code	(0009,00xx)	LO	"BrainLAB_Conversion"	ALWAYS	AUTO
Export Platform Name	(0009,xx01)	LO	Configured Platform Name	ALWAYS	CONFIG

Table 8-16: General Equipment Module

8.1.1.2.11 SC Equipment

Attribute Name	Tag	VR	Value	Presence	Source
Conversion Type	(0008,0064)	CS	"WSD"	ALWAYS	AUTO

Table 8-17: SC Equipment Module

8.1.1.2.12 Acquisition Context

Attribute Name	Tag	VR	Value	Presence	Source
Acquisition Context Sequence	(0040,0555)	SQ		EMPTY	AUTO

Table 8-18: Acquisition Context Module

8.1.1.2.13 General Image

Attribute Name	Tag	VR	Value	Presence	Source
Instance Number	(0020,0013)	IS	From loaded data	ALWAYS	AUTO
Content Date	(0008,0023)	DA	<Current Date>	ALWAYS	AUTO
Content Time	(0008,0033)	TM	<Current Time>	ALWAYS	AUTO

Table 8-19: General Image Module

8.1.1.2.14 Image Plane

Attribute Name	Tag	VR	Value	Presence	Source
Pixel Spacing	(0028,0030)	DS	From loaded data	ALWAYS	AUTO
Image Orientation (Patient)	(0020,0037)	DS	From loaded data	ALWAYS	AUTO
Image Position (Patient)	(0020,0032)	DS	From loaded data	ALWAYS	AUTO
Slice Thickness	(0018,0050)	DS	From loaded data	ALWAYS	AUTO

Table 8-20: Image Plane Module

8.1.1.2.15 Image Pixel

Attribute Name	Tag	VR	Value	Presence	Source
Rows	(0028,0010)	IS	From loaded data	ALWAYS	AUTO
Columns	(0028,0011)	DA	From loaded data	ALWAYS	AUTO
Pixel Data	(7FE0,0010)	OB OW	From loaded data	ALWAYS	AUTO

Table 8-21: Image Pixel Module

8.1.1.2.16 CR Image

Attribute Name	Tag	VR	Value	Presence	Source
Image Type	(0008,0008)	CS	"ORIGINAL/PRIMARY"	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	US	1	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	"MONOCHROME2"	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	8 or 16	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	8 or 16	ALWAYS	AUTO
High Bit	(0028,0102)	US	7 or 15	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0000H (<i>unsigned integer</i>)	ALWAYS	AUTO

Table 8-22: CR Image Module

8.1.1.2.17 CT Image

Attribute Name	Tag	VR	Value	Presence	Source
Image Type	(0008,0008)	CS	"DERIVED\SECONDARY\AXIAL"	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	US	1	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	"MONOCHROME2"	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	16	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	16	ALWAYS	AUTO
High Bit	(0028,0102)	US	15	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0000H (<i>unsigned integer</i>)	ALWAYS	AUTO
Rescale Intercept	(0028,1052)	DS	-1024	ALWAYS	AUTO
Rescale Slope	(0028,1053)	DS	1	ALWAYS	AUTO
KVP	(0018,0060)	DS		EMPTY	AUTO
Acquisition Number	(0020,0012)	IS		EMPTY	AUTO

Table 8-23: CT Image Module

8.1.1.2.18 MR Image

Attribute Name	Tag	VR	Value	Presence	Source
Image Type	(0008,0008)	CS	"DERIVED\SECONDARY\OTHER"	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	US	1	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	"MONOCHROME2"	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	16	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	16	ALWAYS	AUTO
High Bit	(0028,0102)	US	15	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0000H (<i>unsigned integer</i>)	ALWAYS	AUTO

Table 8-24: MR Image Module

8.1.1.2.19 PET Image

Attribute Name	Tag	VR	Value	Presence	Source
Image Type	(0008,0008)	CS	"DERIVED\PRIMARY"	ALWAYS	AUTO
Samples per Pixel	(0028,0002)	US	1	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	"MONOCHROME2"	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	16	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	16	ALWAYS	AUTO
High Bit	(0028,0102)	US	15	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0000H (<i>unsigned integer</i>)	ALWAYS	AUTO
Rescale Intercept	(0028,1052)	DS	0	ALWAYS	AUTO
Rescale Slope	(0028,1053)	DS	1	ALWAYS	AUTO
Frame Reference Time	(0054,1300)	DS	0	ALWAYS	AUTO
Image Index	(0054,1330)	US	Instance Number + 1	ALWAYS	AUTO

Table 8-25: PET Image Module

8.1.1.2.20 NM Image

Attribute Name	Tag	VR	Value	Presence	Source
Image Type	(0008,0008)	CS	"DERIVED\PRIMARY\STATIC\EMISSION"	ALWAYS	AUTO
CountsAccumulated	(0018,0070)	IS		EMPTY	AUTO
ActualFrameDuration	(0018,1242)	IS	0	ALWAYS	AUTO

Table 8-26: NM Image Module

8.1.1.2.21 SC Image

Attribute Name	Tag	VR	Value	Presence	Source
Pixel Spacing	(0028,0030)	DS	From loaded data	ALWAYS	AUTO

Table 8-27: SC Image Module

8.1.1.2.22 NM Image Pixel

Attribute Name	Tag	VR	Value	Presence	Source
Samples per Pixel	(0028,0002)	US	1	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	"MONOCHROME2"	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	8 or 16	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	8 or 16	ALWAYS	AUTO
High Bit	(0028,0102)	US	7 or 15	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0000H (<i>unsigned integer</i>)	ALWAYS	AUTO
Pixel Spacing	(0028,0030)	DS	From loaded data	ALWAYS	AUTO

Table 8-28: NM Image Pixel Module

8.1.1.2.23 Multi-frame

Attribute Name	Tag	VR	Value	Presence	Source
Number Of Frames	(0028,0008)	IS	From loaded data	ALWAYS	AUTO
Frame Increment Pointer	(0028,0009)	AT	"(0054,0080)" <i>Slice Vector</i>	ALWAYS	AUTO

Table 8-29: Multi-frame Module

8.1.1.2.24 NM Multi-frame

Attribute Name	Tag	VR	Value	Presence	Source
Number Of Energy Windows	(0054,0011)	US	0	ALWAYS	AUTO
Number Of Detectors	(0054,0021)	US	1	ALWAYS	AUTO
Slice Vector	(0054,0080)	US	From loaded data	ALWAYS	AUTO
Number Of Slices	(0054,0081)	US	From loaded data	ALWAYS	AUTO

Table 8-30: NM Multi-frame Module

8.1.1.2.25 SC Multi-frame Image

Attribute Name	Tag	VR	Value	Presence	Source
Burned In Annotation	(0028,0301)	CS	"YES" / "NO"	ALWAYS	AUTO
Presentation LUT Shape	(2050,0020)	CS	"IDENTITY"	ALWAYS	AUTO

Table 8-31: SC Multi-frame Image Module

8.1.1.2.26 SC Multi-frame Vector

Attribute Name	Tag	VR	Value	Presence	Source
Frame Label Vector	(0018,2002)	SH		ANAP	AUTO

Table 8-32: SC Multi-frame Vector Module

8.1.1.2.27 NM Isotope

Attribute Name	Tag	VR	Value	Presence	Source
Energy Window Information Sequence	(0054,0012)	SQ		EMPTY	AUTO
Radiopharmaceutical Information Sequence	(0054,0016)	SQ		EMPTY	AUTO

Table 8-33: NM Isotope Module

8.1.1.2.28 NM Detector

Attribute Name	Tag	VR	Value	Presence	Source
Detector Information Sequence	(0054,0022)	SQ		ALWAYS	AUTO
>Collimator Type	(0018,1181)	CS	"NONE"	ALWAYS	AUTO
>Focal Distance	(0018,1182)	IS		EMPTY	AUTO
>Image Position Patient	(0020,0032)	DS	From loaded data	ALWAYS	AUTO
>Image Orientation Patient	(0020,0037)	DS	From loaded data	ALWAYS	AUTO

Table 8-34: NM Detector Module

8.1.1.2.29 NM Reconstruction

Attribute Name	Tag	VR	Value	Presence	Source
Spacing Between Slices	(0018,0088)	DS	From loaded data	ALWAYS	AUTO
Slice Thickness	(0018,0050)	DS	From loaded data	ALWAYS	AUTO

Table 8-35: NM Reconstruction Module

8.1.1.2.30 VOI LUT

Attribute Name	Tag	VR	Value	Presence	Source
Window Center	(0028,1050)	DS	From loaded data	ANAP	AUTO
Window Width	(0028,1051)	DS	From loaded data	ANAP	AUTO

Table 8-36: VOI LUT Module

8.1.1.2.31 SOP Common

Attribute Name	Tag	VR	Value	Presence	Source
SOP Class UID	(0008,0016)	DS	IOD specific	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	DS	Generated	ALWAYS	AUTO
Specific Character Set	(0008,0005)	CS	"ISO_IR 100"	ALWAYS	AUTO
Instance Creation Date	(0008,0012)	DA	<Current Date>	ALWAYS	AUTO
Instance Creation Time	(0008,0013)	TM	<Current Time>	ALWAYS	AUTO
Private Creator Code	(0009,00XX)	LO	"BrainLAB_Conversion"	ANAP	AUTO
Export Platform Name	(0009,XX01)	LO	Platform Name	ANAP	CONFIG

Table 8-37: SOP Common Module

8.1.2 Usage of Attributes from Received IODs

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

8.1.2.1 Images

BrainSUITE NET accepts all images of the SOP Classes in Table 4-3. Though, there are some restrictions and special conversions:

- Images with an attribute (0028,0030) Pixel Spacing containing different values for x and y distance³ will be ignored.
- MR Images containing the entry "MOSAIC" in (0008,0008) Image Type will be split into several images according to the mosaic matrix in the header. If no valid mosaic matrix can be determined the image will be left unchanged.

³ To be more precise: If the difference between both values is greater than 0.001 mm!

8.2 Data Dictionary of Private Attributes

The Private Attributes added to create SOP Instances are listed in the Table below. BrainLAB reserves blocks of private attributes in group 0009 and 0099. Further details on usage of these private attributes are contained in Section 8.1.

8.2.1 Group 0009

Tag	Attribute Name	VR	VM
(0009,xx01)	Export Platform Name	LO	1

Table 8-38: Data Dictionary Of Private Attributes For Group 0009

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.

9 Indexes

9.1 Index of Tables

Table 1-1: Network services supported by BrainSUITE NET	4
Table 1-2: Media Services supported by BrainSUITE NET	4
Table 4-1: Supported Verification SOP Classes	14
Table 4-2: Supported Query/Retrieve SOP Classes	14
Table 4-3: Supported Storage SOP Classes	14
Table 4-4: Supported Transfer Syntaxes	15
Table 4-5: Proposed Presentation Contexts for Activity Find	16
Table 4-6: Proposed Presentation Contexts for Activity Move	17
Table 4-7: Proposed Presentation Contexts for Activity Store	17
Table 4-8: Storage SCP Presentation Contexts	18
Table 5-1: Supported Media Interchange Profiles	21
Table 8-1: CR Image Storage IOD	25
Table 8-2: CT Image Storage IOD	25
Table 8-3: MR Image Storage IOD	26
Table 8-4: PET Image Storage IOD	26
Table 8-5: NM Image Storage IOD	27
Table 8-6: PET Image Storage IOD	27
Table 8-7: Patient Module	28
Table 8-8: General Study Module	28
Table 8-9: Patient Study Module	28
Table 8-10: General Series Module	29
Table 8-11: CR Series Module	29
Table 8-12: PET Series Module	29
Table 8-13: PET Isotope Module	29
Table 8-14: NM/PET Patient Orientation Module	30
Table 8-15: Frame of Reference Module	30
Table 8-16: General Equipment Module	30
Table 8-17: SC Equipment Module	30
Table 8-18: Acquisition Context Module	31
Table 8-19: General Image Module	31
Table 8-20: Image Plane Module	31
Table 8-21: Image Pixel Module	31
Table 8-22: CR Image Module	31
Table 8-23: CT Image Module	32
Table 8-24: MR Image Module	32
Table 8-25: PET Image Module	32
Table 8-26: NM Image Module	33
Table 8-27: SC Image Module	33
Table 8-28: NM Image Pixel Module	33
Table 8-29: Multi-frame Module	33
Table 8-30: NM Multi-frame Module	33
Table 8-31: SC Multi-frame Image Module	33
Table 8-32: SC Multi-frame Vector Module	34
Table 8-33: NM Isotope Module	34
Table 8-34: NM Detector Module	34
Table 8-35: NM Reconstruction Module	34
Table 8-36: VOI LUT Module	34
Table 8-37: SOP Common Module	35

Table 8-38: Data Dictionary Of Private Attributes For Group 0009 36

9.2 Index of Figures

Figure 4-1: The Query/Retrieve SCU and Storage SCP application flow diagram 11
Figure 4-3: Sequencing of Query/Retrieve SCU and Storage SCP 13
Figure 5-1: The media interchange application flow diagram..... 20