BrainLAB

Technical Publication

DICOM Conformance Statement

iPlan 3.0

Document Revision 1

November 17, 2009

1 Conformance Statement Overview

This is a conformance statement for the BrainLAB software iPlan. Its main purpose is the viewing, presentation and documentation of medical data based e.g. on CT, MR, PET, SPECT or X-ray images. It provides procedures like e.g. image fusion, atlas assisted segmentation or trajectory planning. The result is a treatment plan that can be used e.g. for stereotactic and/or image guided surgery.

The DICOM import part of the application is

- Scan and import of DICOM files (simple message files as well as standard DICOM files).
- Browse and import of DICOM File-sets.
- Query DICOM archives.
- Retrieve data from DICOM archives.

The DICOM export part of the application is

- Send screen shots as DICOM Secondary Capture to another DICOM application or archive.

What is not part of iPlan?

- iPlan 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	No	Yes
CT Image Storage	No	Yes
Enhanced CT Image Storage	No	Yes
Enhanced MR Image Storage	No	Yes
Enhanced XA Image Storage	No	Yes
Enhanced XRF Image Storage	No	Yes
MR Image Storage	No	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
Nuclear Medicine Image Storage	No	Yes
Ophthalmic Photography 16 Bit Image Storage	No	Yes
Ophthalmic Photography 8 Bit Image Storage	No	Yes
Positron Emission Tomography Image Storage	No	Yes
Secondary Capture (SC) Image Storage	No	Yes
Ultrasound Image Storage	No	Yes
Ultrasound Multi-frame Image Storage	No	Yes
Video Endoscopic Image Storage	No	Yes
Video Microscopic Image Storage	No	Yes
Video Photographic Image Storage	No	Yes
VL Endoscopic Image Storage	No	Yes
VL Microscopic Image Storage	No	Yes
VL Photographic Image Storage	No	Yes
VL Slide-Coordinates Microscopic Image Storage	No	Yes
X-Ray 3D Angiographic Image Storage	No	Yes
X-Ray 3D Craniofacial Image Storage	No	Yes
X-Ray Angiographic Image Storage	No	Yes
X-Ray Radiofluoroscopic (RF) Image Storage	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

Table 1-1: Network services supported by iPlan

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 iPlan

2 Table of Contents

3 Introduction

3.1 Revision History

Document Version	Date of Issue	Author	Description
1	November 17, 2009		Initial release for iPlan 3.0

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 ConvertingDICOMService 1.2, BrainLAB, March 20, 2008

4 Networking

4.1 Implementation Model

The BrainLAB iPlan 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 send screen shots as DICOM Secondary Capture to a DICOM archive or workstation.
- An application to import DICOM image data (X-Ray, CT, MR, PET, NM, Secondary Capture and almost all other formats containing pixel data) into the BrainLAB advanced file format.

4.1.1 Application Data Flow Diagram

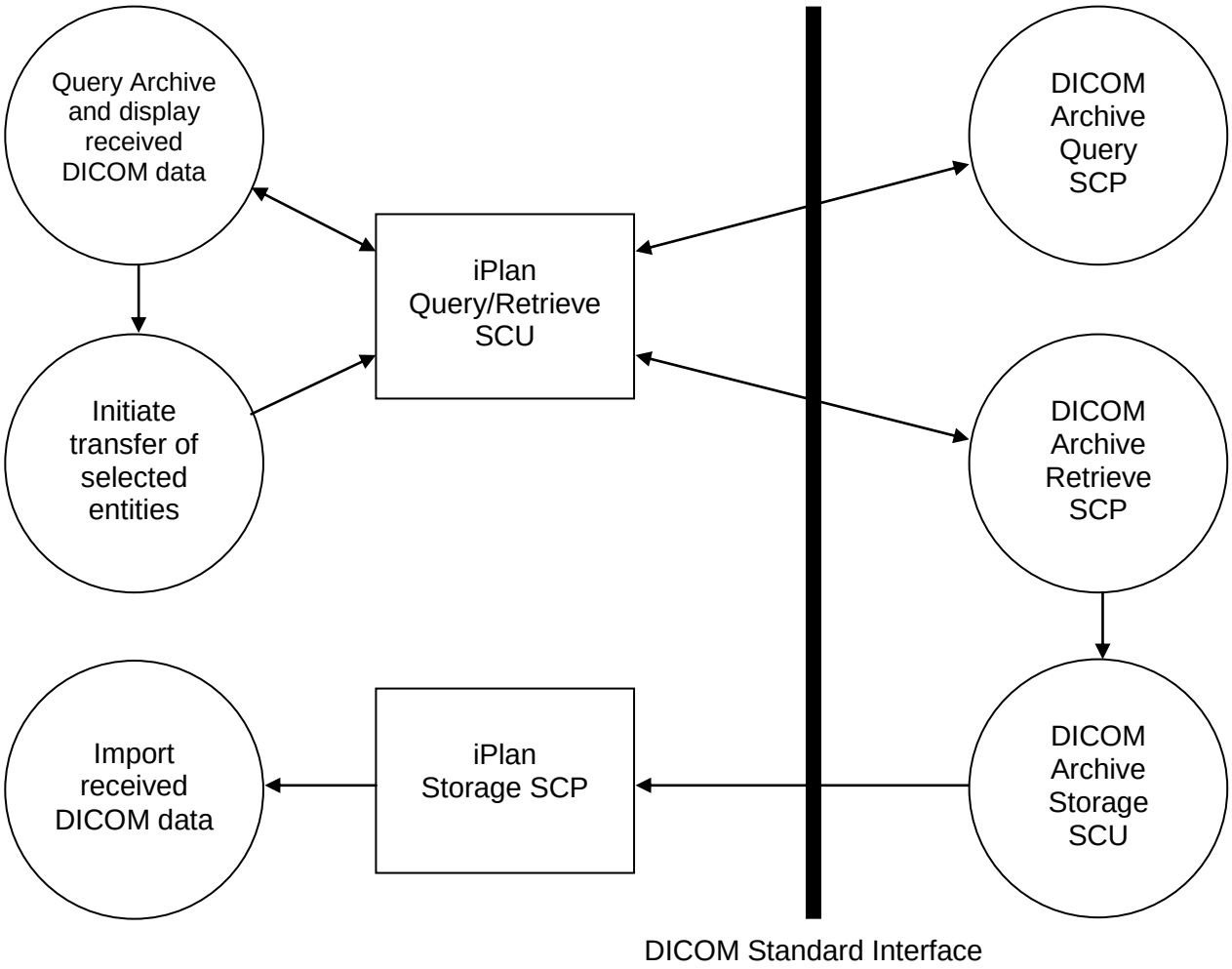

Figure 4-1: The Query/Retrieve SCU and Storage SCP application flow diagram

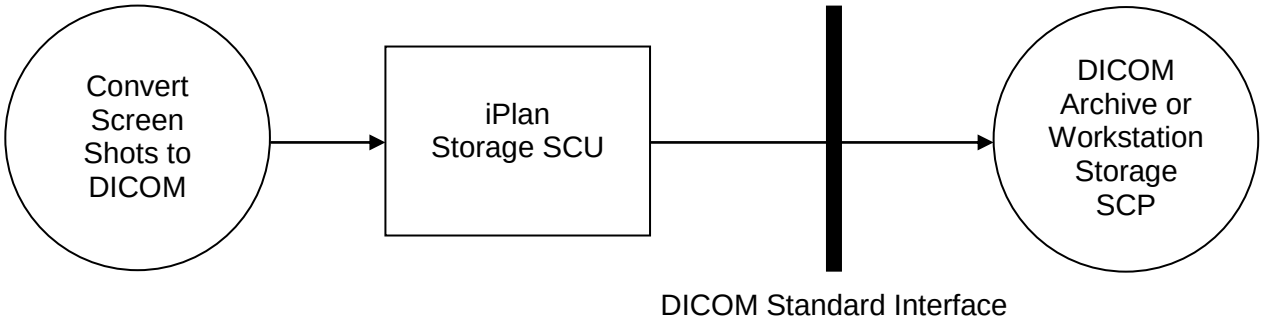

Figure 4-2: The Storage SCU application flow diagram

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. iPlan initiates an association as a DICOM Query/Retrieve SCU negotiating all models listed in Table 4-2. 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 or series) 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[1]:
  During a move operation a DICOM Storage SCP is invoked. iPlan accepts an association with a Storage SCU negotiating any of the SOP Classes listed in Table 4-3. The received data is – with user interaction – imported into iPlan.

- Storage SCU:
  iPlan converts the screen shots acquired during a planning session to DICOM Secondary Capture 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. iPlan 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

iPlan 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.

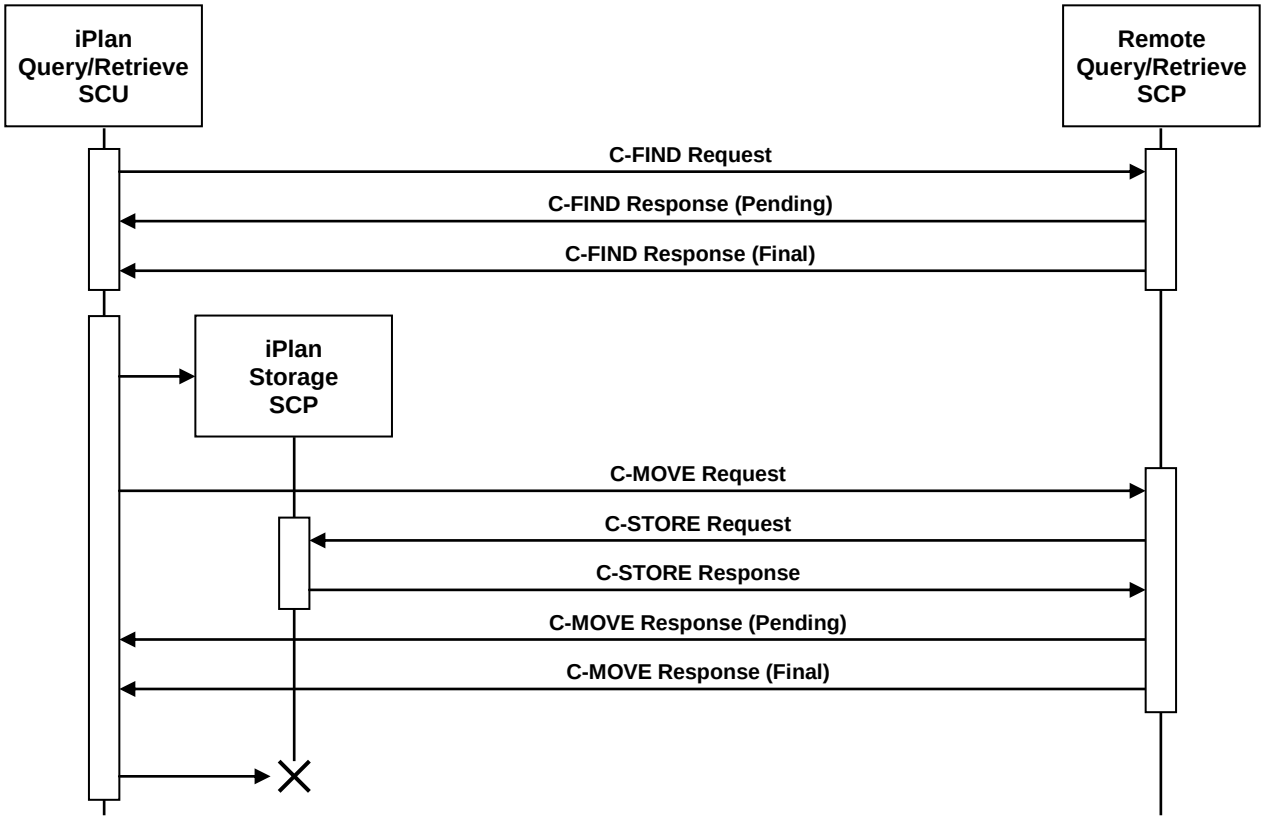

Figure 4-3: Sequencing of Query/Retrieve SCU and Storage SCP

4.2 Application Entity Specifications

4.2.1 iPlan Specification

4.2.1.1 SOP Classes and Transfer Syntaxes

iPlan 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

IPlan 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

Table 4-2: Supported Query/Retrieve SOP Classes

iPlan 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
Computed Radiography 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
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	No	Yes
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	No	Yes
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	No	Yes
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.2.1	No	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	No	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
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	No	Yes
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	No	Yes
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	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
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	No	Yes
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	No	Yes

SOP Class Name	SOP Class UID	SCU	SCP
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	No	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	No	Yes
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	No	Yes
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	No	Yes
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	No	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	No	Yes
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	No	Yes
X-Ray 3D Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.13.1.1	No	Yes
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	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

Table 4-3: Supported Storage SOP Classes

iPlan 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	Extended Negotiation
DICOM Implicit VR Little Endian	1.2.840.10008.1.2	Yes	Yes	None
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	Yes	Yes	None
DICOM Explicit VR Big Endian	1.2.840.10008.1.2.2	Yes	Yes	None
JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14)	1.2.840.10008.1.2.4.70	No	Yes	None

Table 4-4: Supported Transfer Syntaxes (association negotiation)

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

iPlan 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	1.2.276.0.20.1.1.20.3.0.0
Implementation Version Name	iPlan<*Key*>3.0

The <*Key*> part of the Implementation Version Name contains the iPlan flavour, e.g.

- "*Cranial*" for the iPlan application customized for cranial planning (→ *iPlanCranial3.0*)
- "*View*" for the iPlan viewing only application (→ *iPlanView3.0*).

These keys are only examples and there exist more!

4.2.1.3 Association Initiation Policy

iPlan 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 import it.

3. Store: The user acquired screen shots 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 or series.

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

iPlan 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 model, the user may restrict the patient level query by these attributes:

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

For the patient-root model, the user may restrict the study level query by these attributes:

Description	Tag
Study Date	(0008,0020)
Accession Number	(0008,0050)

For the study-root model, the user may restrict the study level query by these 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 one or more DICOM series, a move request is performed. The storage target for receiving the DICOM data (the AET with which the move-request is equipped) is the iPlan application itself.

The Move operation only can be invoked after a Find operation. See section 1.1.1 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

iPlan 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 screen shots 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 iPlan.

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

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

For further information see section 8.1.2 on acceptance of SOP Instances, i.e. whether iPlan is able to import and to convert the DICOM data.

4.2.1.4 Association Acceptance Policy

iPlan accepts an association in this case:

1. Retrieve: The user wants to retrieve a specific entity from the remote DICOM archive and wants to import it.

4.2.1.4.1 Activity – Retrieve

4.2.1.4.1.1 Associated Real-World Activity

On user selection of one or more DICOM series 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 (see section 1.1.1).

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

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

Some of the SOP specific information is lost during import.

4.2.1.4.1.4 Presentation Context Acceptance Criterion

iPlan 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

iPlan supports the DICOM upper layer using TCP/IP. iPlan 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 iPlan 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 iPlan.
iPlan can configure several nodes representing remote DICOM Query/Retrieve 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
iPlan	IPLAN	104

4.4.1.2 Remote AE Title/Presentation Address Mapping

In iPlan 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	64234

5 Media Interchange

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

- For import iPlan 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 iPlan 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.

5.1 Implementation Model

5.1.1 Application Data Flow Diagram

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

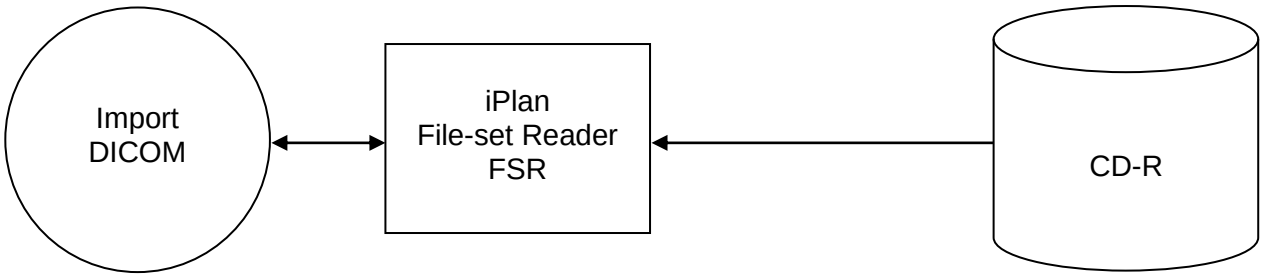

Figure 5-1: The media interchange application flow diagram

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 iPlan executes.

- File Set Reader:
  iPlan loads DICOM data from the file system and imports it – 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

iPlan provides the same information as in section 4.2.1.2.4.

5.2 Application Entity Specifications

5.2.1 iPlan Specification

iPlan 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	Import DICOM	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 section 4.4.1.1)

5.2.1.2 Real-World Activities

5.2.1.3 Activity – Import DICOM

iPlan 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 import the selected entries from directory listing, only those SOP Instances are loaded that correspond to the Application Profile STD-GEN-CD.
- For the list of Application Profiles invoking this AE see Table 5-1. The supported SOP Classes see Table 4-3.

5.2.1.3.1 Media Storage Application Profiles

iPlan supports the STD-GEN-CD Application Profile.

5.2.1.3.1.1 Options

Supported transfer syntaxes for the media profiles:

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 Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	1.2.840.10008.1.2.4.50
JPEG Extended (Process 2 & 4): Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)	1.2.840.10008.1.2.4.51
JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]): Default Transfer Syntax for Lossless JPEG Image Compression	1.2.840.10008.1.2.4.70
RLE Lossless	1.2.840.10008.1.2.5

Table 5-2: Supported Media Profile Transfer Syntaxes

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 5-2

For further information see section 8.1.2 on acceptance of SOP Instances (i.e. whether iPlan is able to import and convert the DICOM data).

5.3 Augmented and Private Application Profiles

iPlan does not support any augmented or private application profiles.

5.4 Media Configuration

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

6 Support of Extended Character Sets

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

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-2	ALWAYS
Study	General Study	Table 8-3	ALWAYS
	Patient Study	Table 8-4	ALWAYS
Series	General Series	Table 8-5	ALWAYS
Equipment	General Equipment	Table 8-7	ALWAYS
	SC Equipment	Table 8-8	ALWAYS
Frame of Reference	Frame of Reference	Table 8-6	ALWAYS
Image	General Image	Table 8-9	ALWAYS
	BrainLAB Image	Table 8-10	ALWAYS
	Image Pixel	Table 8-11	ALWAYS
	Multi-frame	Table 8-13	ALWAYS
	SC Image	Table 8-12	ALWAYS
	SC Multi-frame Image	Table 8-14	ALWAYS
	SC Multi-frame Vector	Table 8-15	MNAP
	VOI LUT	Table 8-16	MNAP
	SOP Common	Table 8-17	ALWAYS

Table 8-1: Multi-frame Grayscale Byte / Grayscale Word / True Color SC 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	AU-TO/USER
Patient ID	(0010,0020)	LO	From loaded data or user input	VNAP	AU-TO/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 8-2: 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 8-3: 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 8-4: 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 8-5: General Series Module

8.1.1.2.5 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 8-6: Frame of Reference Module

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

8.1.1.2.6 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	“iPlan”	ALWAYS	AUTO
Software Version(s)	(0018,1020)	LO	The current iPlan 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 8-7: General Equipment Module

8.1.1.2.7 SC Equipment

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

Table 8-8: SC Equipment Module

8.1.1.2.8 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 8-9: General Image Module

8.1.1.2.9 BrainLAB Image

Attribute Name	Tag	VR	Value	Presence	Source
Private Creator Code	(0099,00xx)	LO	“BrainLAB_xBrain_Plan”	ALWAYS	AUTO
Plan Export Version	(0009,xx01)	LO	“1”	ALWAYS	AUTO
Private Creator Code	(0099,00xx)	LO	“BrainLAB_xBrain_Image”	ALWAYS	AUTO
BL to DICOM Transformation	(0009,xxB0)	LO		EMPTY	AUTO
BL to DICOM Flipping	(0009,xxB1)	LO		EMPTY	AUTO

Table 8-10: BrainLAB Image Module

8.1.1.2.10 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 8-11: Image Pixel Module

8.1.1.2.11 SC Image

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

Table 8-12: SC Image Module

8.1.1.2.12 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	"(0018,2002)" *Frame Label Vector*	ALWAYS	AUTO

Table 8-13: Multi-frame Module

8.1.1.2.13 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"	ANAP	AUTO

Table 8-14: SC Multi-frame Image Module

8.1.1.2.14 SC Multi-frame Vector

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

Table 8-15: SC Multi-frame Vector Module

8.1.1.2.15 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 8-16: VOI LUT Module

8.1.1.2.16 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 8-17: SOP Common Module

8.1.2 Usage of Attributes from Received IODs

This section describes the requirements on the DICOM data, which shall be imported. 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

iPlan 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 distance[3] 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.

8.2 Data Dictionary of Private Attributes

The private attributes added to the created 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 8-18: Data Dictionary of Private Attributes for Group 0009

8.2.2 Group 0099

Tag	Attribute Name	VR	VM
(0099,xx00)	Plan Export Version	SH	1
(0099,xxB0)	BL to DICOM Transformation	IS	1
(0099,xxB1)	BL to DICOM Flipping	CS	1

Table 8-19: Data Dictionary of Private Attributes for Group 0099

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.

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

9 Indexes

9.1 Index of Tables

9.2 Index of Figures