BRAINLAB

Technical Publication

DICOM Conformance Statement

DICOM Processing Service 1.0

Document Revision 1

September 09, 2011

1 Conformance Statement Overview

This is a conformance statement for the Brainlab software DICOM Processing Service. The main purpose of this software is to automatically perform image processing tasks on DICOM images in the background, without user interaction.

Available processing tasks:
- Autonomous Segmentation Performer: provides an autonomous atlas-based segmentation on incoming CT and MR images.
- XBrainifier: provides conversion of DICOM Segmentation instances to the Brainlab Advanced File Format (xBrain).

The DICOM part of the application of
- Autonomous Segmentation Performer: receive CT or MR images and send the created Segmentation instances to the DICOM Proxy.
- XBrainifier: receive DICOM Segmentation instances.

SOP Classes	User Of Service (SCU)	Provider Of Service (SCP)
Verification		
Verification SOP Class	Yes	Yes
Transfer		
CT Image Storage	No	Yes
Enhanced CT Image Storage	No	Yes
MR Image Storage	No	Yes
Enhanced MR Image Storage	No	Yes
Segmentation Storage	Yes	Yes

Table 1-1: Network services supported by the Processing Service

The DICOM Processing Service is embedded into the Brainlab Workflow Services.

Brainlab Workflow Service	User Of Service (SCU)	Provider Of Service (SCP)
Notify	No	Yes
Request Instances	Yes	No

Table 1-2: Brainlab Workflow Services supported by the Processing Service

The Brainlab Workflow services are described in the DICOM Proxy Conformance Statement (see [2]) and are not part of this conformance statement.

2 Table of Contents

3 Introduction

3.1 Revision History

Document Version	Date of Issue	Author	Description
1	September 09, 2011		Initial release for the DICOM Processing Service 1.0

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.

- 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 DI-COM 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 DICOM Proxy 2.1, Brainlab, April 4, 2011

4 Networking

4.1 Implementation Model

The DICOM Processing Service is embedded in the Brainlab workflow infrastructure. These infrastructure is provided by the DICOM Proxy. It provides the DICOM Storage, Query/Retrieve and Worklist interfaces to communicate with the world outside. The Processing Service communicates only with the DICOM Proxy.

The Processing Service uses the following activities to interact with the DICOM Proxy:

- *Notify*
  The DICOM Proxy notifies registered applications about received DICOM instances.
- *Request Instances*
  The DICOM Proxy provides the DICOM Query/Retrieve C-GET service as SCP

Please refer to [2] for a detailed description of these activities. This DICOM Conformance Statement concentrates on the DICOM Processing Service and the kind of data it reads and creates.

The DICOM Processing Service then is an implementation of:

- Autonomous atlas-based segmentation
  - A Storage SCP to receive DICOM CT and MR instances to perform automatic segmentation of interesting structures.
  - A Storage SCU to send the resulting DICOM Segmentation Storage instances back to the DICOM Proxy.
- Conversion of DICOM Segmentation instances
  - A Storage SCP to receive DICOM Segmentation instances to convert them to the Brainlab Advanced File Format

4.1.1 Application Data Flow Diagram
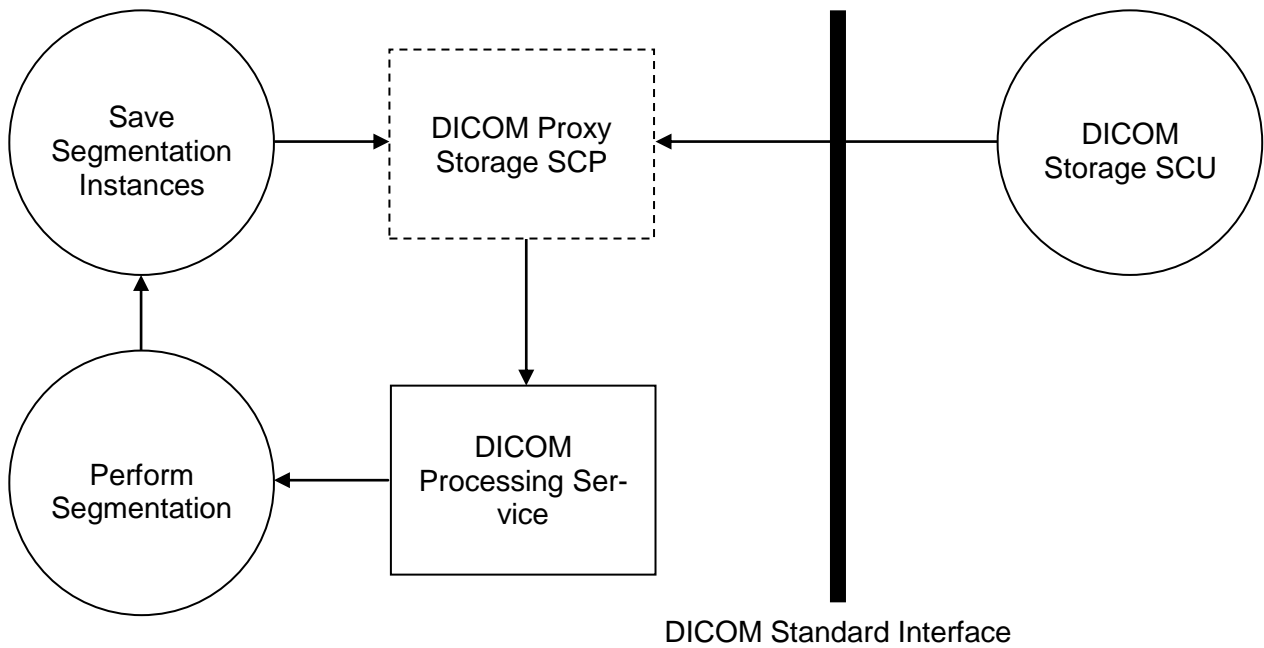
Figure 4-1: The Autonomous Segmentation Performer flow diagram
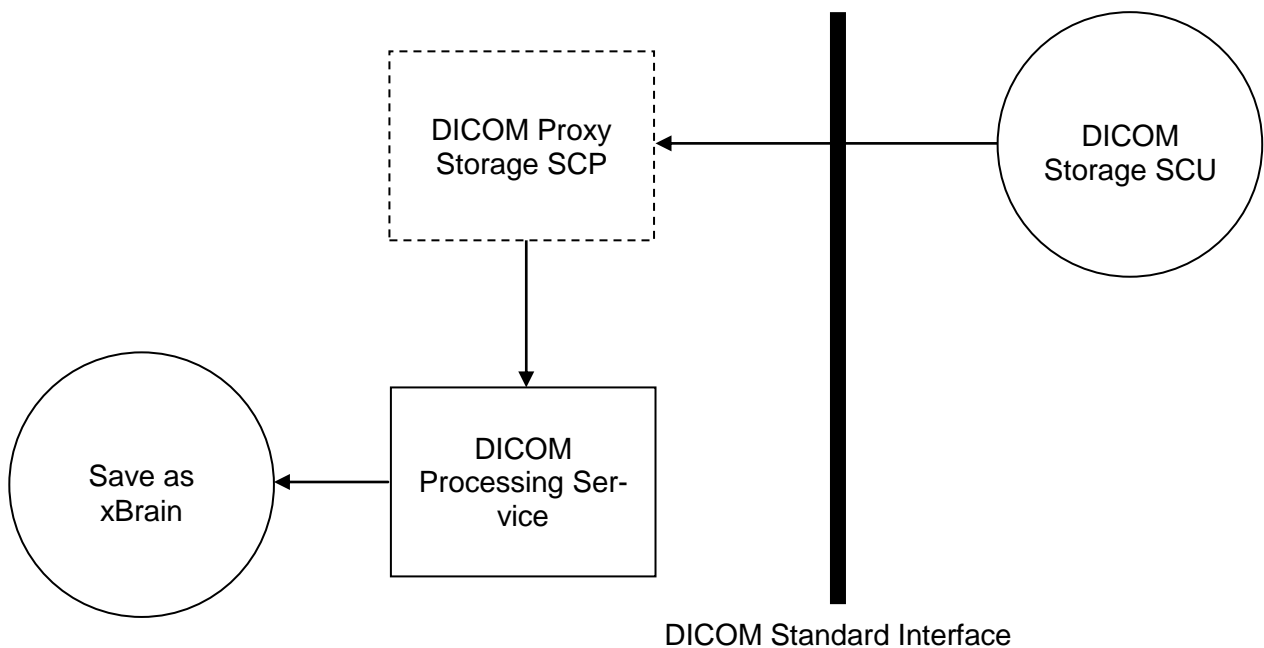
Figure 4-2: The XBrainifier flow diagram

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.

- Storage SCP:
  If the Processing Service requests instances it accepts an association from the DICOM Proxy accepting any kind of DICOM CT, MR or Segmentation instances.

- Storage SCU:
  The Processing Service performs segmentation of interesting regions in the received CT/MR instances. On segmentation progress it creates Segmentation instances which will be sent to the DICOM Proxy.

4.1.3 Sequencing Of Real World Activities
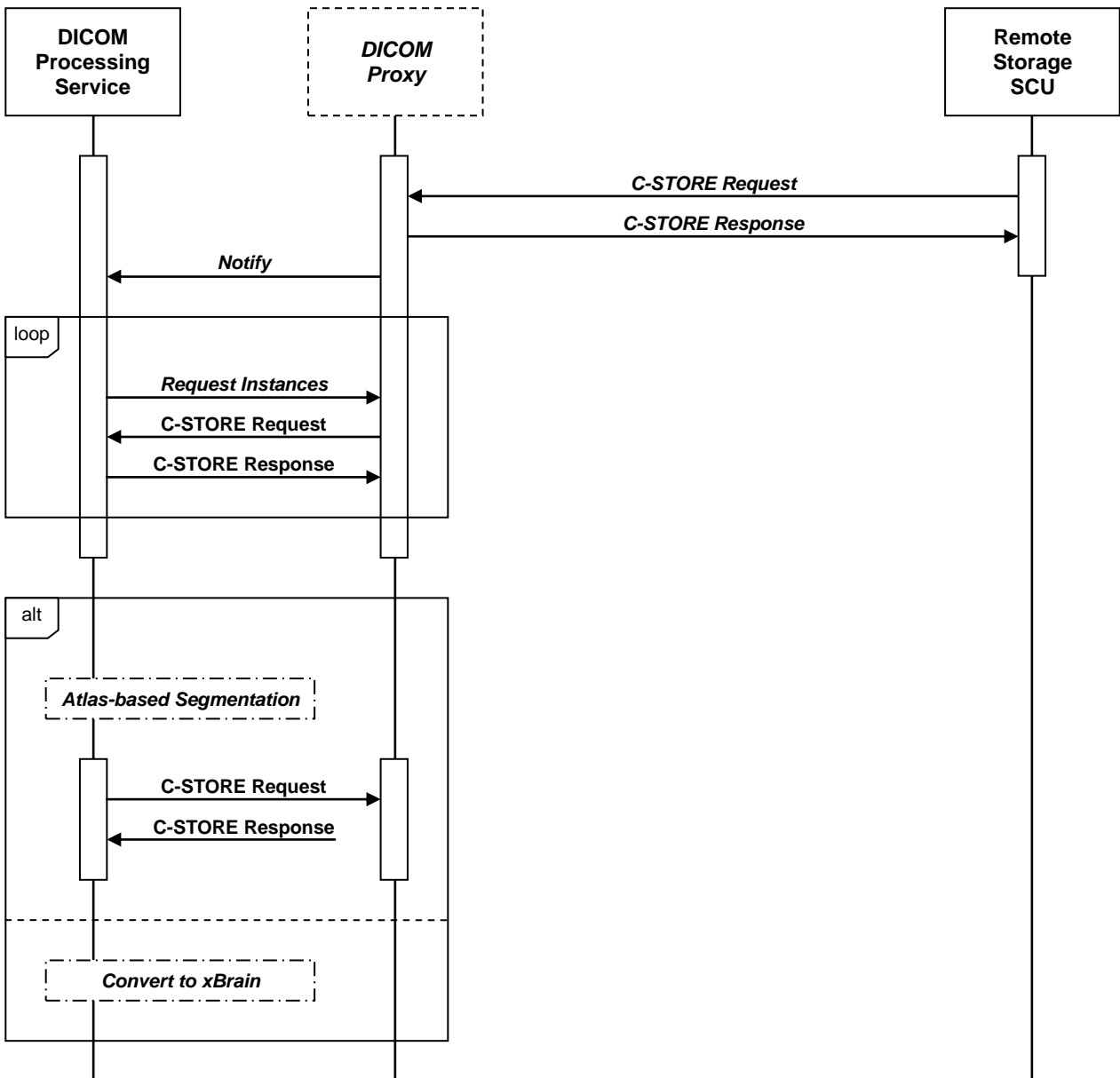
Figure 4-3: Sequencing of DICOM Processing Service and DICOM Proxy.

DICOM Processing Service is embedded in a sequencing of real world activities as follows:

1) *DICOM Proxy receives DICOM CT, MR or Segmentation instances:*
   a) *Receive DICOM Storage C-STORE requests.*
   b) *Send DICOM Storage C-STORE responses.*
2) *Notify DICOM Processing Service about received instances. In case of CT, MR or Segmentation instances DICOM Processing Service requests these instances*
   a) Receive DICOM Storage C-STORE requests with the requested instances.
   b) Send DICOM Storage C-STORE responses
3) Retrieve references from incoming Segmentation instances and request these instances
   a) Receive DICOM Storage C-STORE requests with the referenced instances.
   b) Send DICOM Storage C-STORE responses
4) Autonomous Segmentation Performer
   a) Perform segmentation of received CT/MR instances
   b) Store resulting Segmentation instances at DICOM Proxy:
      i) Send DICOM Storage C-STORE requests for each resulting Segmentation instance.
      ii) Receive DICOM Storage C-STORE responses.
5) XBrainifier
   a) Convert DICOM Segmentation instances into Brainlab Advanced File Format.

4.2 Application Entity Specifications

4.2.1 Autonomous Segmentation Performer Specification

### 4.2.1.1 SOP Classes and Transfer Syntaxes

The Processing Service 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: Segmentation Performer supported Verification SOP Classes

The Processing Service 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
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
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	No	Yes
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	No	Yes
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	Yes	No

Table 4-2: Segmentation Performer supported Storage SOP Classes

The Processing Service 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 Nego-tiation
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
RLE Lossless	1.2.840.10008.1.2.5	Yes	No	None

Table 4-3: Segmentation Performer supported Transfer Syntaxes (association negotiation)

4.2.1.2 Association Policies

4.2.1.2.1 Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.276.0.20.1.1.27.1.0.0
Implementation Version Name	AutoSegmentat1.0

4.2.1.3 Association Initiation Policy

The Processing Service initiates an association in these cases:

1. <u>Request Instances</u>: The DICOM Proxy notified the Autonomous Segmentation Performer about new instances and - in case of a CT or MR - the Autonomous Segmentation Performer requests the instances from the DICOM Proxy.
2. <u>Store</u>: The Autonomous Segmentation Performer creates DICOM Segmentation instances and wants to store them at the DICOM Proxy.

4.2.1.3.1 Activity – Request Instances

4.2.1.3.1.1 Associated Real-World Activity

The Autonomous Segmentation Performer was notified about new CT or MR instances by the DICOM Proxy. It requests the instances via the Brainlab Workflow Service "Request Instances". In the scope of this service the Segmentation Performer acts as Storage SCP on the initiated association.

4.2.1.3.1.2 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 4-2	All SCP Transfer Syntaxes as listed in Table 4-3	SCP	None
		SCP	None
		SCP	None

Table 4-4: Segmentation Performer Storage SCP Presentation Contexts.

4.2.1.3.1.3 SOP Specific Conformance

The Processing Service 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 passed to a segmentation performer which creates Segmentation instances. See section 8.1 for further information on exported Segmentation IODs.

4.2.1.3.2 Activity – Store

4.2.1.3.2.1 Associated Real-World Activity

After successful segmentation a number of storage requests are performed to send the DICOM Segmentation instances to the DICOM Proxy.

4.2.1.3.2.2 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 4-2	All SCU Transfer Syntaxes as listed in Table 4-3	SCU	None
		SCU	None
		SCU	None

Table 4-5: Segmentation Performer Proposed Presentation Contexts for Activity Store.

4.2.1.3.2.3 SOP Specific Conformance

The Processing Service 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 passed to the Autonomous Segmentation Performer which creates Segmentation instances. See section 8.1 for further information on acceptance of CT and MR IODs.

4.2.1.4 Association Acceptance Policy

The Autonomous Segmentation Performer accepts no associations beside the Brainlab Workflow Services which are not part of this conformance statement.

4.2.2 XBrainifier Specification

4.2.2.1 SOP Classes and Transfer Syntaxes

The Processing Service 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	No	Yes

Table 4-6: XBrainifier supported Verification SOP Classes

This Processing Service imports DICOM data. It provides Standard Conformance to the following DICOM V3.0 SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
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
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	No	Yes

SOP Class Name	SOP Class UID	SCU	SCP
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	No	Yes
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	No	Yes

Table 4-7:XBrainifier supported Storage SOP Classes

The Processing Service supports the following transfer syntaxes depending on the received DI-COM V3.0 SOP Classes. 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	No	Yes	None
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	No	Yes	None
DICOM Explicit VR Big Endian	1.2.840.10008.1.2.2	No	Yes	None
JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14)	1.2.840.10008.1.2.4.70	No	Yes	None
RLE Lossless	1.2.840.10008.1.2.5	No	Yes	None

Table 4-8: XBrainifier supported Transfer Syntaxes for CT and MR (association negotiation)

Transfer Syntax Name	Transfer Syntax UID	SCU	SCP	Extended Negotiation
DICOM Implicit VR Little Endian	1.2.840.10008.1.2	No	Yes	None
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	No	Yes	None
DICOM Explicit VR Big Endian	1.2.840.10008.1.2.2	No	Yes	None
RLE Lossless	1.2.840.10008.1.2.5	No	Yes	None

Table 4-9: XBrainifier supported Transfer Syntaxes for Segmentation (association negotiation)

4.2.2.1.1   Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.276.0.20.1.1.28.1.0.0
Implementation Version Name	XBrainifier-11.0

4.2.2.2   Association Initiation Policy

The Processing Service initiates an association in this case:

1. Request Instances: The DICOM Proxy notified the Processing Service about new instances and - in case of a Segmentation - the Processing Service requests the instances and the therein referenced original MR or CT instances from the DICOM Proxy.

4.2.2.2.1   Activity – Request Instances

4.2.2.2.1.1 Associated Real-World Activity

The XBrainifier was notified about new Segmentation instances by the DICOM Proxy. It requests the instances via the Brainlab Workflow Service "Request Instances". In the scope of this service the XBrainifier acts as Storage SCP on the initiated association.

4.2.2.2.1.2 Proposed Presentation Contexts

Presentation Context Table			
Abstract Syntax	Transfer Syntax	Role	Ext. Neg
CT Image Storage	All SCP Transfer Syntaxes as listed in Table 4-8	SCP	None
Enhanced CT Image Storage		SCP	None
MR Image Storage		SCP	None
Enhanced MR Image Storage		SCP	None
Segmentation Storage	All SCP Transfer Syntaxes as listed in Table 4-9	SCP	None

Table 4-10: Storage SCP Presentation Contexts.

4.2.2.2.1.3 SOP Specific Conformance

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

4.2.2.3 Association Acceptance Policy

The Autonomous Segmentation Performer accepts no associations beside the Brainlab Workflow Services which are not part of this conformance statement.

4.2.3 Processing Service Common Specifications

This section describes the common specifications for all Processing Service application entities.

4.2.3.1 Association Policies

4.2.3.1.1 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

4.2.3.1.2 Number of Associations

Maximum number of simultaneous Associations (Initiator)	1
Maximum number of simultaneous Associations (Acceptor)	1

4.2.3.1.3 Asynchronous Nature

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

4.2.3.2 Association Initiation Policy

4.2.3.2.1.1 Transfer Syntax Selection Policy

If there is a configuration which transfer syntax to prefer the first presentation state with the most preferred transfer syntax and a matching SOP Class then defines the transfer syntax. If there is no configuration the first presentation state matching the SOP Class defines the transfer syntax.

4.3 Network Interfaces

4.3.1 Physical Network Interface

The Processing Service supports the DICOM upper layer using TCP/IP. The Processing Service 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 the Processing Service executes.

4.4 Configuration

The Processing Service has no own configuration of AETs and ports. All configuration parameters are automatically assigned during the registration process at the DICOM Proxy.

5 Media Interchange

No media interchange is supported.

6 Support of Extended Character Sets

The Processing Service 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
NEVER	Module never present

8.1.1.1 Segmentation Storage

IE	Module	Reference	Presence of Module
Patient	Patient	Table 8-2	ALWAYS
	Clinical Trial Subject		NEVER
Study	General Study	Table 8-3	ALWAYS
	Patient Study	Table 8-4	MNAP
	Clinical Trial Study		NEVER
Series	General Series	Table 8-5	ALWAYS
	Segmentation Series	Table 8-6	ALWAYS
	Clinical Trial Series		NEVER
Frame of Reference	Frame of Reference	Table 8-7	ALWAYS
Equipment	General Equipment	Table 8-8	ALWAYS
	Enhanced General Equipment	Table 8-8	ALWAYS
Image	General Image	Table 8-9	ALWAYS
	Image Pixel	Table 8-10	ALWAYS
	Segmentation Image	Table 8-11	ALWAYS
	Multi-frame Functional Groups	Table 8-12	ALWAYS
	Multi-frame Dimension	Table 8-20	ALWAYS
	Specimen		NEVER
	Common Instance Reference	Table 8-21	ALWAYS
	SOP Common	Table 8-22	ALWAYS
	Frame Extraction		NEVER

Table 8-1: Segmentation 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	VNAP	AUTO
Patient ID	(0010,0020)	LO	From loaded data	VNAP	AUTO
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
Series Instance UID	(0020,000E)	UI	Generated	ALWAYS	AUTO
Series Date	(0008,0021)	DA	Generated: <CurrentDate>	ALWAYS	AUTO
Series Time	(0008,0031)	TM	Generated: <CurrentTime>	ALWAYS	AUTO
Series Description	(0008,103E)	LO	Generated	ALWAYS	AUTO

Patient Position	(0018,5100)	CS		NEVER	

Table 8-5: General Series Module

8.1.1.2.5 Segmentation Series Module

Attribute Name	Tag	VR	Value	Presence	Source
Modality	(0008,0060)	CS	"SEG"	ALWAYS	AUTO
Series Number	(0020,000E)	UI	Generated	ALWAYS	AUTO
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ		NEVER	

Table 8-6: Segmentation Series Module

8.1.1.2.6 Frame Of Reference

Attribute Name	Tag	VR	Value	Presence	Source
Frame of Reference UID	(0020,0052)	UI	From loaded data or - if not available - generated	ALWAYS	AUTO
Position Reference Indicator	(0020,1040)	LO		EMPTY	AUTO

Table 8-7: Frame of Reference Module

8.1.1.2.7 (Enhanced) General Equipment

Attribute Name	Tag	VR	Value	Presence	Source
Manufacturer	(0008,0070)	LO	"Brainlab"	ALWAYS	AUTO
Manufacturer's Model Name	(0008,1090)	LO	<ApplicationName>	ALWAYS	AUTO
Device Serial Number	(0008,1000)	SH	"0"	ALWAYS	AUTO
Software Versions	(0018,1020)	LO	"1.0.0"	ALWAYS	AUTO

Table 8-8: (Enhanced) General Equipment Module

8.1.1.2.8 General Image

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

Table 8-9: General Image Module

8.1.1.2.9 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	Generated	ALWAYS	AUTO

Table 8-10: Image Pixel Module

8.1.1.2.10 Segmentation Image

Attribute Name	Tag	VR	Value	Presence	Source
Image Type	(0008, 0008)	CS	"DERIVED\PRIMARY"	ALWAYS	AUTO

Content Label	(0070,0080)	CS	"SEG"	ALWAYS	AUTO
Content Description	(0070,0081)	LO	"Segmentation Objects"	ALWAYS	AUTO
Alternate Content Description Sequence	(0070,0081)	SQ		NEVER	
Content Creator's Name	(0070,0084)	PN		EMPTY	
Samples Per Pixel	(0028,0002)	US	"1"	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	"MONOCHROME2"	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	"0"	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	"1" if Segmentation Type (0062, 0001) is "BINARY", "8" else	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	"1" if Segmentation Type (0062, 0001) is "BINARY", "8" else	ALWAYS	AUTO
High Bit	(0028,0102)	US	"0" if Segmentation Type (0062, 0001) is "BINARY", "7" else	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	CS	"00"	ALWAYS	AUTO
Segmentation Type	(0062,0001)	CS	"BINARY", "FRACTIONAL"	ALWAYS	AUTO
Segmentation Fractional Type	(0062,0010)	CS	Not present if Segmentation Type (0062,0001) is "BINARY", else value is "PROBABILITY"	ANAP	AUTO
Maximum Fractional Value	(0062,000E)	US	Not present if Segmentation Type (0062,0001) is "BINARY", else value is "255"	ANAP	AUTO
Segment Sequence	(0062,0002)	SQ		ALWAYS	AUTO
>Segment Number	(0062,0004)	US	Generated	ALWAYS	AUTO
>Segment Label	(0062,0005)	LO	Generated	ALWAYS	AUTO
>Segment Description	(0062,0006)	ST	Generated	ALWAYS	AUTO
>Segment Algorithm Type	(0062,0008)	CS	"AUTOMATIC"	ALWAYS	AUTO
>Segment Algorithm Name	(0062,0009)	LO	"AtlasSegmentation"	ALWAYS	AUTO
>Anatomic Region Sequence	(0008,2218)	SQ		ALWAYS	AUTO
>>*Include 'Code Sequence Macro' PS 3.3 Table 8.8-1*			Baseline CID 4031	ALWAYS	AUTO
>Segmented Property Category Code Sequence	(0062,0003)	SQ		ALWAYS	AUTO
>>*Include 'Code Sequence Macro' PS 3.3 Table 8.8-1*			Baseline CID 7150	ALWAYS	AUTO
>Segmented Property Type Code Sequence	(0062, 000F)	SQ		ALWAYS	AUTO
>>*Include 'Code Sequence Macro' PS 3.3 Table 8.8-1*			Baseline CID 7151 (see section 8.3.1 for details)	ALWAYS	AUTO
>Recommended Display CIELab Value	(0062,000D)	US	Generated	ALWAYS	AUTO

Table 8-11: Segmentation Image Module

8.1.1.2.11 Segmentation Multi-frame Functional Groups

Functional Group Macros	Belongs to Functional Group	Reference	Presence of Module
Pixel Measures	Shared	Table 8-13	ALWAYS
Plane Position (Patient)	Per-Frame	Table 8-14	ALWAYS
Plane Orientation (Patient)	Shared	Table 8-15	ALWAYS

Functional Group Macros	Belongs to Functional Group	Reference	Presence of Module
Derivation Image	Per-Frame	Table 8-16	ALWAYS
Frame Content Macro	Per-Frame	Table 8-17	ALWAYS
Segmentation	Per-Frame	Table 8-18	ALWAYS

Table 8-12: Segmentation Multi-frame Functional Groups

Attribute Name	Tag	VR	Value	Presence	Source
Pixel Measures Sequence	(0028,9110)	SQ		ALWAYS	AUTO
>Pixel Spacing	(0028,0030)	DS	From loaded data	ALWAYS	AUTO
>Slice Thickness	(0018,0050)	DS	From loaded data	ALWAYS	AUTO

Table 8-13: Pixel Measures Macro

Attribute Name	Tag	VR	Value	Presence	Source
Plane Position Sequence	(0020,9113)	SQ		ALWAYS	AUTO
>Image Position (Patient)	(0020,0032)	DS	From loaded data	ALWAYS	AUTO

Table 8-14: Plane Position (Patient) Macro

Attribute Name	Tag	VR	Value	Presence	Source
Plane Orientation Sequence	(0020,9116)	SQ		ALWAYS	AUTO
>Image Orientation (Patient)	(0020,0037)	DS	From loaded data	ALWAYS	AUTO

Table 8-15: Plane Orientation (Patient) Macro

Attribute Name	Tag	VR	Value	Presence	Source
Derivation Image Sequence	(0008, 9124)	SQ		ALWAYS	AUTO
>Derivation Description	(0008, 2111)	ST	"Segmentation"	ALWAYS	AUTO
>Derivation Code Sequence	(0008, 9215)	SQ		ALWAYS	AUTO
>>Code Value	(0008, 0100)	SH	"1130762"	ALWAYS	AUTO
>>Coding Scheme Designator	(0008, 0102)	SH	"DCM"	ALWAYS	AUTO
>>Code Meaning	(0008, 0104)	LO	"Segmentation"	ALWAYS	AUTO
>Source Image Sequence	(0008, 2112)	SQ		ALWAYS	AUTO
>>*Include 'Image SOP Instance Reference Macro' Table 10-3*				ALWAYS	AUTO
>>Purpose of Reference Code Sequence	(0040,A170)	SQ		ALWAYS	AUTO
>>>Code Value	(0008, 0100)	SH	"121322"	ALWAYS	AUTO
>>>Coding Scheme Designator	(0008, 0102)	SH	"DCM"	ALWAYS	AUTO
>>>Code Meaning	(0008, 0104)	LO	"Source Image for Image Processing Operation"	ALWAYS	AUTO

Table 8-16: Derivation Image Macro

Attribute Name	Tag	VR	Value	Presence	Source
Frame Content Sequence	(0020, 9111)	SQ		ALWAYS	AUTO
>Dimension Index Values	(0020, 9157)	UL	Generated	ALWAYS	AUTO

Table 8-17: Frame Content Macro

Attribute Name	Tag	VR	Value	Presence	Source
Segment Identification Sequence	(0062,000A)	SQ		ALWAYS	AUTO
>Referenced Segment Number	(0062,000B)	IS	Generated	ALWAYS	AUTO

Table 8-18: Segmentation Macro

8.1.1.2.12 Multi-frame

Attribute Name	Tag	VR	Value	Presence	Source
Number Of Frames	(0028,0008)	IS	Generated	ALWAYS	AUTO

Table 8-19: Multi-frame Module

8.1.1.2.13 Multi-frame Dimension

Attribute Name	Tag	VR	Value	Presence	Source
Dimension Organization Sequence	(0020,9921)	SQ	1 item	ALWAYS	AUTO
>Dimension Organization UID	(0020, 9164)	UI	Generated	ALWAYS	AUTO
Dimension Organization Type	(0020, 9311)	CS	3D	ALWAYS	AUTO
Dimension Index Sequence	(0020, 9222)	SQ	2 items	ALWAYS	AUTO
>[1] Dimension Index Pointer	(0020, 9165	AT	(0062, 0004) Segment Number	ALWAYS	AUTO
>[1] Functional Group Pointer	(0020, 9167)	AT	(0062,0002) Segment Sequence	ALWAYS	AUTO
>[1] Dimension Organization UID	(0020, 9164)	UI	From Dimension Organization Sequence (see above)	ALWAYS	AUTO
>[2] Dimension Index Pointer	(0020, 9165	AT	(0020, 0032) Image Position Patient	ALWAYS	AUTO
>[2] Functional Group Pointer	(0020, 9167)	AT	(0020,9113) Plane Position Sequence	ALWAYS	AUTO
>[2] Dimension Organization UID	(0020, 9164)	UI	From Dimension Organization Sequence (see above)	ALWAYS	AUTO

Table 8-20: Multi-frame Dimension Module

8.1.1.2.14 Common Instance Reference

Attribute Name	Tag	VR	Value	Presence	Source
Referenced Series Sequence	(0008,1115)	SQ		ALWAYS	AUTO
>Series Instance UID	(0020, 000E)	UI	From referenced series	ALWAYS	AUTO
>Referenced Instance Sequence	(0008, 114A)	SQ		ALWAYS	AUTO
>>Referenced SOP Class UID	(0008, 1150)	UI	From referenced instance	ALWAYS	AUTO
>>Referenced SOP Instance UID	(0008, 1155)	UI	From referenced instance	ALWAYS	AUTO

Table 8-21: Common Instance Reference Module

8.1.1.2.15 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	Generated: <CurrentDate>	ALWAYS	AUTO
Instance Creation Time	(0008,0013)	TM	Generated: <CurrentTime>	ALWAYS	AUTO

Table 8-22: SOP Common Module

8.1.2 Usage of Attributes from Received IODs

This section describes the requirements on the DICOM data, which shall be segmented. Segmentation can be performed on the DICOM Images of type CT and MR.

8.1.2.1   Images

The Processing Service accepts all images of the SOP Classes in Table 4-2. Though, there are some restrictions:

- Images with an attribute (0028,0030) Pixel Spacing containing different values for x and y distance[1] will be ignored.

8.1.2.2   Segmentation Storage Instances

- Segmentation Storage instances with Segmentation Type (0060,3020) "BINARY" are not supported if the value of the Columns attribute (0028, 0011) is not a multiple of 8.

8.1.3 Attribute Mapping

Not applicable.

8.1.4 Coerced/Modified fields

No coercion is performed.

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

8.2 Data Dictionary of Private Attributes

None.

8.3 Coded Terminology and Templates

8.3.1 CID 7151 Segmentation Property Types

The Context Group CID 7151 is extended by Brainlab specific codes. The value for Code Meaning will be displayed for all code sequences. No local lexicon is provided to look up alternative code meanings.

8.4 Grayscale Image Consistency

Not supported.

8.5 Standard Extended/Specialized/Private Sop Classes

None.

8.6 Private Transfer Syntaxes

None.

9 Indexes

9.1 Index of Tables

9.2 Index of Figures