BRAINLAB

DICOM Conformance Statement

ExacTrac Dynamic

Document Revision 3

October 11, 2023

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1 Conformance Statement Overview

This is a Conformance Statement for the Brainlab ExacTrac Dynamic system. This system – dependent from purchased licenses and configuration – consists of several applications and performers.

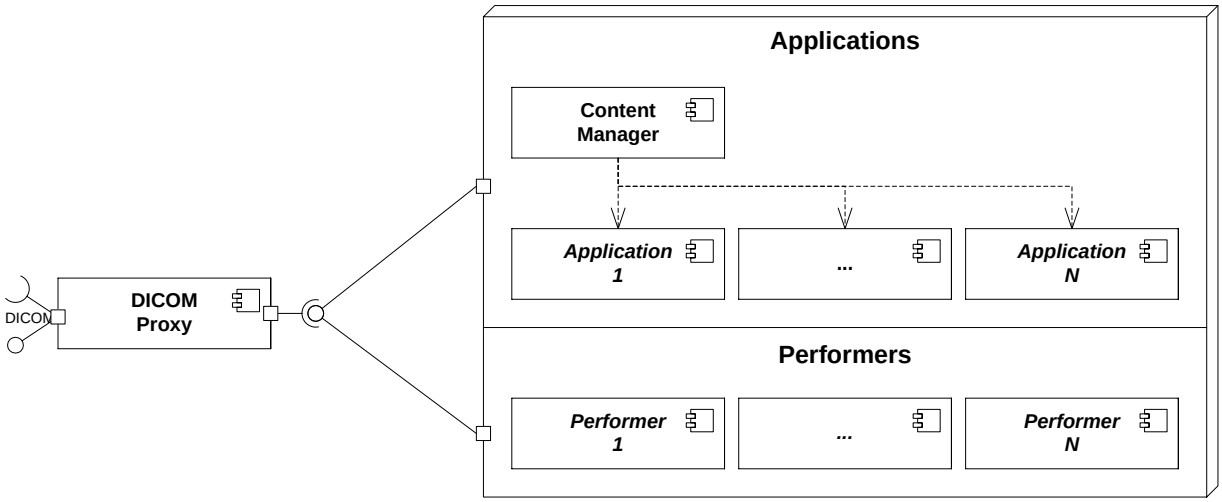

Figure 1-1: Overview of a Brainlab system running applications and performers

The Brainlab system is based on the following common management applications:

Management Application	Description
Content Manager	Manages applications on Brainlab systems. It allows a user to create and read screenshots. See [1] for the Conformance Statement.
DICOM Proxy	The interface between the Brainlab system and the outside DICOM world. No application or performer communicates directly with any remote DICOM node, but all communication will be done through the DICOM Proxy. If necessary the DICOM Proxy adjusts the DICOM communication to the capabilities and known specialties of the remote DICOM nodes. The DICOM Proxy itself (see [2] for the Conformance Statement) as well as the internal communication between the DICOM Proxy and the applications and performers is not part of this Conformance Statement.

Table 1-1: Common Management Applications

Applications have a user interface. The following applications are documented in this Conformance Statement:

Application	Description
ExacTrac Dynamic Treatment	Application for positioning and monitoring patient during the radiotherapy treatment.
ExacTrac Dynamic Preparation	Application for preparing patients for the ExacTrac Dynamic Treatment Application.

Table 1-2: Applications

The following additional applications and performers are included in the ExacTrac Dynamic system but will not be documented here. See [1, 3] for the Conformance Statement.

Application	Description
Patient Selection	Allows the user to browse, load or save data in/to DICOM archives or on/to media (e.g., CD-ROM).

Performer	Description
DICOM RT Import	Conversion of DICOM RT Structure Set, DICOM RT Plan and DICOM RT Dose to internal format.

The table below addresses all supported network services used by the different ExacTrac Dynamic application entities. For other applications, refer to [1, 3]. For the SOP Classes in the Transfer section SCU and SCP have special meanings. Entities consuming data (e.g., for displaying images) are marked as SCP. Applications producing data (e.g., like spatial registrations) are marked as SCU. All created data will be initially stored to the DICOM Proxy, which then is responsible to forward created data to configured remote DICOM nodes.

Symbol:	Meaning:
■	User of Service (SCU)
◆	Provider of Service (SCP)
✹	Both (SCU/SCP)

SOP Classes	ExacTrac Dynamic Treatment	ExacTrac Dynamic Preparation
Transfer		
CT Image Storage	◆	◆
Key Object Selection Document Storage	◆	◆
Raw Data Storage	✹	✹
Segmentation Storage	◆	◆
RT Image Storage	■	■
Spatial Registration Storage	■	■
Query/Retrieve		
Patient Root Query/Retrieve Information Model - FIND	■	■
Study Root Query/Retrieve Information Model - FIND	■	■
Study Root Query/Retrieve Information Model - GET	■	■

Table 1-3: Supported network services

The next table addresses all supported Media Storage Application Profiles used by the different application entities.

Symbol: Meaning:

- ■ Read Files (FSR)
- ◆ Write Files (FSC or FSU)
- ⬢ Both (FSR/FSC or FSU)

Media Storage Application Profile	ExacTrac Dynamic Treatment	ExacTrac Dynamic Preparation
Brainlab General Purpose Media Interchange	◆	◆

Table 1-4: Supported media profiles

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3 Introduction

3.1 Revision History

Document Revision	Date of Issue	Author	Description

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 [4]. 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 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
RT	Radiotherapy
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SOP	DICOM Service-Object Pair

3.5 References

[1] Brainlab AG, "DICOM Conformance Statement Surgery 7.0," 2018. [Online]. Available: https://www.brainlab.com/wp-content/uploads/2018/05/DICOM-Conformance-Statement-Surgery-Rev7.pdf.

[2] Brainlab AG, "DICOM Conformance Statement DICOM Proxy 5.0," 2023. [Online]. Available: https://www.brainlab.com/wp-content/uploads/2023/01/dicom-conformance-statement-dicom-proxy-5.0.pdf.

[3] Brainlab AG, "DICOM Conformance Statement RT Elements 4.0," 2022. [Online]. Available: https://www.brainlab.com/wp-content/uploads/2022/07/dicom-conformancestatement-rtelements-rev8.pdf.

[4] D. S. Committee, "Digital Imaging and Communications in Medicine (DICOM) 3.1, Rev. 2023d," Medical Imaging & Technology Alliance (MITA), 2023. [Online]. Available: http://www.dicomstandard.org/current/.

4 Networking

4.1 Implementation Model

4.1.1 Application Data Flow Diagram

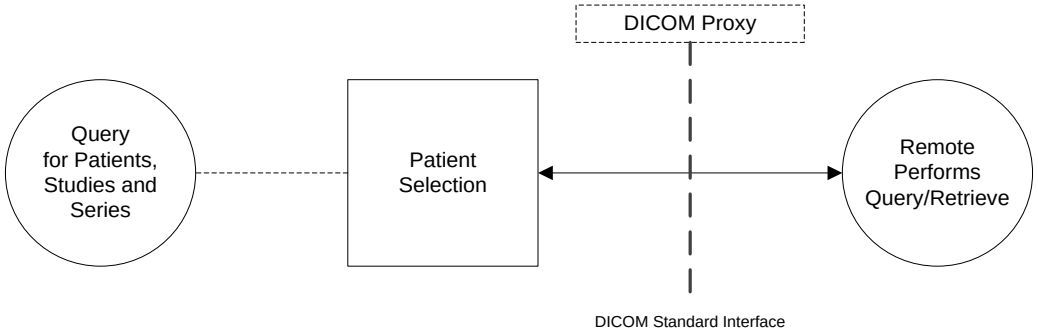

Figure 4-1: Patient Selection Application Data Flow Diagram

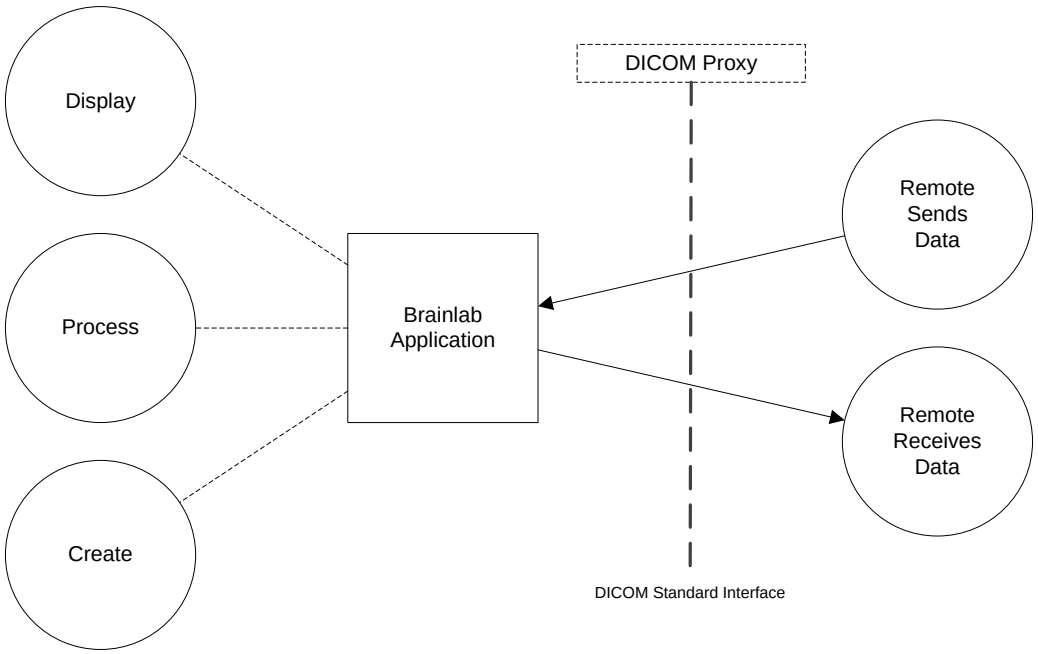

Figure 4-2: General Application Data Flow Diagram

4.1.2 Functional Definition of Application Entity (AE)

All communication is done through the DICOM Proxy. If there is an appropriate configuration for a remote node any DICOM command or message may be forwarded to the configured remote node. In this case the DICOM Proxy may act as protocol converter, i.e., it converts DICOM commands and messages in a DICOM format the remote node understands.

If there is no remote node configured the data will be retrieved from and stored in the local storage of the DICOM Proxy.

4.1.2.1 Applications

4.1.2.2 Management Applications

- **Content Manager**
  It allows the user to create screenshots. It stores them via the DICOM Storage Service Class as DICOM Secondary Capture.

4.1.2.3 Applications

- **ExacTrac Dynamic Treatment**
  ExacTrac Dynamic Treatment is an application for positioning and monitoring patient during the radiotherapy treatment. It requests DICOM image, Segmentation, Key Object Selection and Raw Data instances received via the DICOM Storage Service Class. It creates RT Image, Registration, Key Object Selection and Raw Data instances. RT Image and Registration instances are sent to a defined target system.

- **ExacTrac Preparation**
  ExacTrac Dynamic Preparation is an application for preparing patients for the ExacTrac Dynamic Treatment Application. It requests DICOM image, Segmentation, Key Object Selection and Raw Data instances received via the DICOM Storage Service Class. It creates Key Object Selection and Raw Data instances. Previously created RT Image and Registration instances are sent to a defined target system during export. Archives and deletes patient data belonging to a patient.

For the following Applications, refer to [1, 3]:
- **Patient Selection**

For the following Performers, refer to [3]:
- **DICOM RT Import**

4.1.3 Sequencing Of Real World Activities

4.1.3.1 Standard Interactive Use Case

In the standard use case the user pushes the planning data from the Treatment Management System to the DICOM Proxy (1). Then the RT Import Performer is activated (1), loads the received data (2), converts it to the internal data representation and stores the results back to the

DICOM Proxy (3). Afterwards, the application is started and requests the data (5). The data produced by the application is stored to the DICOM Proxy (6) and the RT Image and Registration instances are forwarded to the Treatment Management System (7).

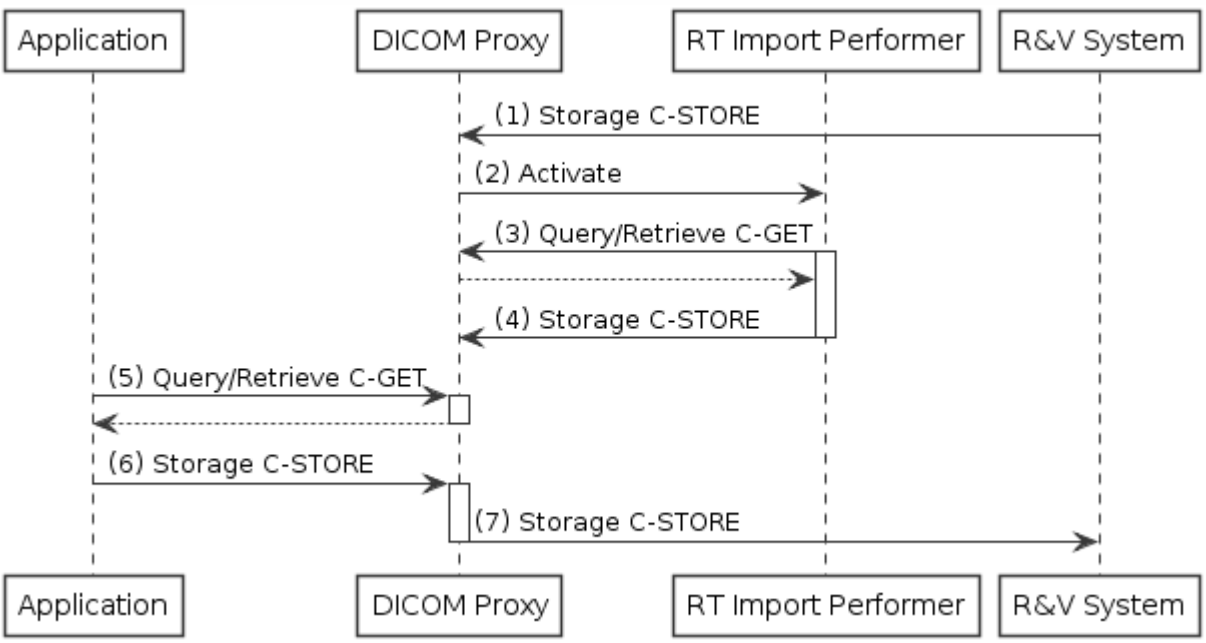

Figure 4-3: Simplified sequencing of the standard interactive use case.

4.1.3.2 Performer

For the general information about performer workflow see [3].

4.2 Application Entity Specifications

4.2.1 Common Specifications

See [3].

4.2.2 ExacTrac Dynamic Treatment Application Specification

ExacTrac Dynamic Treatment is an application for positioning and monitoring patient during a radiotherapy treatment session. It requests DICOM image, Segmentation, Key Object Selection and Raw Data instances received via the DICOM Storage Service Class. It creates RT Image, Registration, Key Object Selection and Raw Data instances. RT Image and Registration instances are sent to a defined target system.

4.2.2.1 SOP Classes and Transfer Syntaxes

ExacTrac Positioning & Monitoring Application accepts the following SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
Storage			
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	No
Volumetric Other			
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	No	Yes
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1	Yes	No
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	Yes
Other			
Key Object Selection Document Storage	1.2.840.10008.5.1.4.1.1.88.59	Yes	Yes
Query/Retrieve			
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	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 – GET	1.2.840.10008.5.1.4.1.2.2.3	Yes	No

Table 4-1: ExacTrac Dynamic Treatment Application supported SOP Classes

4.2.2.2 Association Policies

4.2.2.2.1 Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.276.0.20.1.1.114.<version>
Implementation Version Name	ETXD_ExacTracDynamic<version>

Current possible versions are: <version> = 1.0, 1.1, 2.0

4.2.2.3 Association Initiation Policy

The ExacTrac Dynamic Treatment Application initiates an association in these cases:

Find Patients
Initiated to find all available patients

Find Studies, Series and Instances
Initiated to find related studies, series and instances

Get Studies, Series and Instances
Initiated to retrieve related studies, series and instances

Save Instances
Initiated to store preparation and treatment data

4.2.2.3.1 Activity – Find Patients

See Common Specifications, section 4.2.1.3.1 in [3].

4.2.2.3.2 Activity – Find Studies, Series and Instances

See Common Specifications, section 4.2.1.3.1 in [3].

4.2.2.3.3 Activity – Get Studies, Series and Instances

See Common Specifications, section 4.2.1.3.2 in [3] restricted to Study Root Query/Retrieve Information Model – GET and to all SCP Storage SOP Classes and SOP Class UIDs as listed in Table 4-1.

4.2.2.3.4 Activity – Save Instances

4.2.2.3.4.1 Description and Sequencing of Activities

New instances will be created

- If the user closes a treatment session. This will be stored as Key Object Selection Documents and Raw Data.
- If the user finalizes a fusion. It will be stored as Raw Data, RT Image and Spatial Registration instances.
- If the patients position provided as thermal and depth information needs to be stored. It will be stored as Raw Data.

4.2.2.3.4.2 Proposed Presentation Contexts

Presentation Context Table			
Abstract Syntax	**Transfer Syntax**	**Role**	**Ext. Neg**
All **SCU** Storage SOP Classes and SOP Class UIDs as listed in Table 4-1	See Table 4-2 for the SOP Class / Transfer Syntax mapping	SCU	None

Table 4-2: ExacTrac Dynamic Treatment Application proposed Presentation Contexts – Save Instances

4.2.2.3.4.3 SOP Specific Conformance

The ExacTrac Dynamic Treatment Application provides standard conformance to the DICOM Storage SOP Classes.

4.2.3 ExacTrac Dynamic Preparation Application Specification

ExacTrac Dynamic Preparation is an application for preparing patients for the ExacTrac Dynamic Treatment Application. It requests DICOM image, Segmentation, Key Object Selection and Raw Data instances received via the DICOM Storage Service Class. It creates RT Image, Registration, Key Object Selection and Raw Data instances. Previously created RT Image and Registration instances are sent to a defined target system during export. Archives and deletes patient data belonging to a patient.

4.2.3.1 SOP Classes and Transfer Syntaxes

The ExacTrac Dynamic Preparation Application accepts the following SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
Storage			
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	No
Volumetric Other			
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	No	Yes
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1	Yes	No
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	Yes	Yes
Other			
Key Object Selection Document Storage	1.2.840.10008.5.1.4.1.1.88.59	Yes	Yes
Query/Retrieve			
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	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 – GET	1.2.840.10008.5.1.4.1.2.2.3	Yes	No

Table 4-3: ExacTrac Dynamic Preparation Application supported SOP Classes

4.2.3.2 Association Policies

4.2.3.2.1 Implementation Identifying Information

The implementation information for this Application Entity is:

Implementation Class UID	1.2.276.0.20.1.1.113.<version>
Implementation Version Name	ETXD_Preparation<version>

Current possible versions are: <version> = 1.0, 1.1, 2.0

4.2.3.3 Association Initiation Policy

The ExacTrac Dynamic Preparation initiates an association in these cases:

Find Patients
Initiated to find all available patients

Find Studies, Series and Instances
Initiated to find related studies, series and instances

Get Studies, Series and Instances

Initiated to retrieve related studies, series and instances

Save Instances

The user (re-)prepared a radiotherapy treatment plan for treatment with ExacTrac Dynamic Treatment Application.

4.2.3.3.1 Activity – Find Patients

See Common Specifications, section 4.2.1.3.1 in [3].

4.2.3.3.2 Activity – Find Studies, Series and Instances

See Common Specifications, section 4.2.1.3.1 in [3].

4.2.3.3.3 Activity – Get Studies, Series and Instances

See Common Specifications, section 4.2.1.3.2 in [3], restricted to Study Root Query/Retrieve Information Model – GET and to all SCP Storage SOP Classes and SOP Class UIDs as listed in Table 4-3.

4.2.3.3.4 Activity – Save Instances

4.2.3.3.4.1 Description and Sequencing of Activities

New instances will be created if the user

- finalizes preparation. This will be stored as Key Object Selection Documents and Raw Data instances.
- triggers forwarding of previously created RT Image and Spatial Registration instances. This action will be stored using Key Object Selection Documents and Raw Data instances.

4.2.3.3.4.2 Proposed Presentation Contexts

Presentation Context Table			
Abstract Syntax	**Transfer Syntax**	**Role**	**Ext. Neg**
All **SCU** Storage SOP Classes and SOP Class UIDs as listed in Table 4-3	See Table 4-2 for the SOP Class / Transfer Syntax mapping	SCU	None

Table 4-4: ExacTrac Dynamic Preparation Application proposed Presentation Contexts – Save Instances

4.2.3.3.4.3 SOP Specific Conformance

The ExacTrac Dynamic Preparation provides standard conformance to the DICOM Storage SOP Classes.

4.3 Network Interfaces

4.3.1 Physical Network Interface

The applications support the DICOM upper layer using TCP/IP and are indifferent to the physical medium over which TCP/IP executes. The applications and performers inherit this from the operating system upon which they are executed.

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 applications and performers execute.

4.4 Configuration

4.4.1 AE Title

See [2, 3].

5 Media Interchange

5.1 Implementation Model

See [3].

5.2 AE Specifications

5.2.1 Common Export Specifications

See [3].

5.3 Augmented and Private Application Profiles

5.3.1 Augmented Application Profiles

None.

5.3.2 Private Application Profiles

5.3.2.1 Brainlab Export Profiles

5.3.2.1.1 Profile Identification

This section defines an Application Profile Class potentially inclusive of all defined Media Storage SOP Classes. This class is intended to be used for the export of Composite SOP Instances via the file system. Objects from multiple modalities may be included on the same media.

Application Profile	Identifier	Description
Brainlab ExacTrac Export	BL-EXPORT-EXACTRAC	Handles export of produced RT Images and Spatial Registrations.

Table 5-1: Brainlab BL-EXPORT Profiles.

5.3.2.1.2 Clinical Context

This Application Profile facilitates the export of any DICOM Composite Instance to any non-Brainlab system expecting DICOM media files as input.

5.3.2.1.2.1 Roles and Service Class Options

This Application Profile uses the Media Storage Service Class defined in PS3.4.

The Application Entity shall support the role of the File Set Creator (FSC) as defined in [4] PS 3.10.

5.3.2.1.2.1.1 File Set Creator

The application entity acting as a File-Set Creator generates a File Set under a BL-EXPORT-Application Profile. The File Set Creator doesn't generate a DICOMDIR file.

For each export the File Set Creator shall create a unique directory beneath the export destination which then contains all exported DICOM media files.

5.3.2.1.3 BL-EXPORT Profiles

5.3.2.1.3.1 SOP Classes and Transfer Syntaxes

This Application Profile is based on the Media Storage Service Class (see [4] PS 3.4).

IOD	SOP Class UID	Transfer Syntax	Profiles	FSC
RT Image Storage	11.2.840.10008.5.1.4.1.1.481.1	See Table 4-2 in [3] for the SOP Class / Transfer Syntax mapping	BL-EXPORT-EXACTRAC	Mandatory
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1		BL-EXPORT-EXACTRAC	Optional

Table 5-2: BL-EXACTRAC-EXPORT SOP Classes and Transfer Syntaxes.

Note: For the Composite Instance Storage at least one of FSC, FSR or FSU must be supported to fulfill this profile.

5.3.2.1.4 Physical Medium and Medium Format

BL-PRV-GEN requires either the PC File System (see [4] PS 3.12, Annex A) or the ZIP File Media (see [4] PS 3.12, Annex V).

Furthermore this profile supports all media like CD, DVD, USB, CF, MMC or SD which seamlessly integrates into the OS file system for reading, writing and updating. It also supports filenames not fulfilling the 8 + 3 rule of the above mentioned PC File System.

5.3.2.1.5 Directory Information in DICOMDIR

Conformant Application Entities may include in the DICOMDIR File the Basic Directory IOD containing Directory Records at the Patient and the subsidiary Study and Series levels, appropriate to the SOP Classes in the File Set.

All DICOM files in the File Set incorporating SOP Instances defined for the specific Application Profile shall be referenced by Directory Records.

All implementations shall include the DICOM Media Storage Directory in the DICOMDIR file. There shall be exactly one or no DICOMDIR file per File Set. The DICOMDIR file shall be in the root directory of the medium.

The Patient ID at the patient level shall be unique for each patient directory record in one File Set.

If there is no DICOMDIR this profile allows recursive scanning of file systems for DICOM instances.

Whether the DICOMDIR is supported and how a file system scan is performed needs to be described in the Conformance Statement.

5.3.2.1.6 Additional Keys

File Set Creators and Updaters are required to generate the mandatory elements specified in [4] PS 3.3.

5.3.2.1.7 Other Parameters

Not applicable.

5.3.2.1.8 Security Parameters

Not applicable.

6 Support of Character Sets

The applications and performers in common support the following character sets:

ISO_IR 100 (ISO 8859-1; Latin Alphabet No. 1: Western European)

Character Sets	ExacTrac Dynamic Treatment	ExacTrac Dynamic Prepa-ration
ISO_IR 100	●	●

Table 6-1: Application and performer specific supported character sets

For supported character sets of other applications, refer to [1], [2] and [3].

7 Security Profiles

7.1 Security Profiles

None supported

7.2 Association Level Security

None supported.

7.3 Application Level Security

None supported

8 Annexes

8.1 IOD Contents

8.1.1 Supported SOP Instances

8.1.1.1 Secondary Capture Image

See [1].

8.1.1.2 Standard RT Structure Set

See [3].

8.1.1.3 Standard RT Plan

See [3].

8.1.1.4 Spatial Registration

IE	Module	Reference	Support
Patient	Patient	8.1.2.1.1	
	Clinical Trial Subject		Not supported
Study	General Study	8.1.2.1.2	
	Patient Study	8.1.2.1.3	
	Clinical Trial Study		Not supported
Series	General Series	8.1.2.1.4	
	Clinical Trial Series		Not supported
	Spatial Registration Series	8.1.2.1.5	
Frame of Reference	Frame of Reference	8.1.2.1.6	
Equipment	General Equipment	8.1.2.1.7	
Spatial Registration	Spatial Registration	8.1.2.3.1	
	Common Instance Reference	8.1.2.2.2	
	SOP Common	8.1.2.2.1	

Table 8-1: Spatial Registration IOD

8.1.1.5 RT Image

IE	Module	Reference	Support
Patient	Patient	8.1.2.1.1	
	Clinical Trial Subject		Not supported
Study	General Study	8.1.2.1.2	
	Patient Study	8.1.2.1.3	
	Clinical Trial Study		Not supported
Series	RT Series	8.1.2.3	
	Clinical Trial Series		Not supported
Frame of Reference	Frame of Reference	8.1.2.1.6	
Equipment	General Equipment	8.1.2.1.7	
Image	General Image	8.1.2.1.8	

IE	Module	Reference	Support
	Image Pixel	8.1.2.1.9	
	Contrast/Bolus		Not supported
	Cine		Not supported
	Multi-frame		Not supported
	Device		Not supported
	RT Image	8.1.2.4.18.1.2.2.1	
	Modality LUT		Not supported
	VOI LUT	8.1.2.5.1	Optional
	Approval		Not supported
	SOP Common	8.1.2.2.1	
	Common Instance Reference	8.1.2.2.2	
	Frame Extraction		Not supported

Table 8-2: RT Image Storage IOD

8.1.1.6 Segmentation

See [1].

8.1.1.7 Surface Segmentation

See [1].

8.1.1.8 Raw Data

See [1].

8.1.2 Supported Modules

8.1.2.1 Common Composite Image Modules

8.1.2.1.1 Patient

Attribute Name	Tag	VR	Import	Export
Patient's Name	(0010,0010)	PN	Used to identify the patient (see 8.1.3.4)	
Patient ID	(0010,0020)	LO	Used to identify the patient (see 8.1.3.4)	
Patient's Birth Date	(0010,0030)	DA	Used to identify the patient (see 8.1.3.4)	
Patient's Sex	(0010,0040)	CS		

Table 8-3: Patient Module

8.1.2.1.2 General Study

Attribute Name	Tag	VR	Import	Exported
Study Instance UID	(0020,000D)	UI		
Study Date	(0008,0020)	DA		Generated for new studies with <CurrentDate>; otherwise as imported
Referring Physician's Name	(0008,0090)	PN		EMPTY for new studies; otherwise as imported

Study ID	(0020,0010)	SH		
Accession Number	(0008,0050)	SH		EMPTY for new studies; otherwise as imported
Study Description	(0008,1030)	LO		Generated for new studies; otherwise as imported

Table 8-4: General Study Module

8.1.2.1.3 Patient Study

Attribute Name	Tag	VR	Import	Exported
Patient's Height	(0010,1020)	DS		
Patient's Weight	(0010,1030)	DS		

Table 8-5: Patient Study Module

8.1.2.1.4 General Series

Attribute Name	Tag	VR	Import	Export
Modality	(0008,0060)	CS		
Series Instance UID	(0020,000E)	UI		Generated for new series; otherwise as imported
Series Number	(0020,0011)	IS		Generated for new series; otherwise as imported
Series Date	(0008,0021)	DA		Generated with <Creation Date> for new series; otherwise as imported
Series Time	(0008,0031)	TM		Generated with <Creation Time> for new series; otherwise as imported
Series Description	(0008,103E)	LO		Generated for new series; otherwise as imported
Patient Position	(0018,5100)	DA		Written for any Image IOD if data originated from either one of CT, MR, XA or CR regarding the attribute (0008, 0060) Modality.

Table 8-6: General Series Module

8.1.2.1.5 Spatial Registration Series

Attribute Name	Tag	VR	Import	Export
Modality	(0008,0060)	CS	Must be "REG"	"REG"

8.1.2.1.6 Frame Of Reference

Attribute Name	Tag	VR	Import	Export
Frame of Reference UID	(0020,0052)	UI		

Table 8-7: Frame of Reference Module

Note: See section 8.1.3.5 for the usage of the Frame of Reference in Brainlab applications and performers.

8.1.2.1.7 (Enhanced) General Equipment

Attribute Name	Tag	VR	Import	Export
Manufacturer	(0008,0070)	LO		“Brainlab”
Manufacturer's Model Name	(0008,1090)	LO		<ApplicationName>
Device Serial Number	(0008,1000)	SH		<HostID> or <Serial Number>
Software Version(s)	(0018,1020)	LO		<ApplicationVersion>

Table 8-8: (Enhanced) General Equipment Module

8.1.2.1.8 General Image

Attribute Name	Tag	VR	Import	Export
Instance Number	(0020,0013)	IS		0
Patient Orientation	(0020,0020)	LO		Not supported.
Content Date	(0008,0023)	DA		<Current Date>
Content Time	(0008,0033)	TM		<Current Time>
Acquisition Date	(0008,0022)	DA		Provided only for X-Ray images
Acquisition Time	(0008,0032)	TM		Provided only for X-Ray images
Referenced Image Sequence	(0008,1140)	SQ		Provided only for stereoscopic images
>Referenced SOP Class UID	(0008,1150)	UI		
>Referenced SOP Instance UID	(0008,1155)	UI		
>Registration Type Code Sequence	(0070,030D)	SQ		
>>Code Value	(0008,0100)	SH		“121315”
>>Coding Scheme Designator	(0008,0102)	SH		“DCM”
>>Code Meaning	Code Meaning	LO		“Other image of stereoscopic pair”

Table 8-9: General Image Module

8.1.2.1.9 Image Pixel

Attribute Name	Tag	VR	Import	Export
Samples per Pixel	(0028,0002)	US		1
Photometric Interpretation	(0028,0004)	CS		“MONOCHROME2”
Rows	(0028,0010)	IS		
Columns	(0028,0011)	DA		
Bits Allocated	(0028,0100)	US		16
Bits Stored	(0028,0101)	US		16
High Bit	(0028,0102)	US		15
Pixel Representation	(0028,0103)	US		0
Pixel Aspect Ratio	(0028,0034)	US		Not supported
Pixel Data	(7FE0,0010)	OW		

Table 8-10: Image Pixel Module

8.1.2.2 General Modules

8.1.2.2.1 SOP Common Module

Attribute Name	Tag	VR	Import	Export
SOP Class UID	(0008,0016)	DS		IOD specific
SOP Instance UID	(0008,0018)	DS		Generated
Specific Character Set	(0008,0005)	CS		“ISO_IR 100”
Instance Creation Date	(0008,0012)	DA		<Current Date>
Instance Creation Time	(0008,0013)	TM		<Current Time>

Table 8-11: SOP Common Module

8.1.2.2.2 Common Instance Reference Module

Attribute Name	Tag	VR	Import	Export
Referenced Series Sequence	(0008,1115)	SQ		
>Series Instance UID	(0020,000E)	UI		
>Referenced Instance Sequence	(0008,114A)	SQ		
>>Referenced SOP Class UID	(0008,1150)	UI		
>>Referenced SOP Instance UID	(0008,1155)	UI		
Studies Containing Other Referenced Instances Sequence	(0008,1200)	SQ		
>Study Instance UID	(0020,000D)	UI		
>Referenced Series Sequence	(0008,1115)	SQ		
>>Series Instance UID	(0020,000E)	UI		
>>Referenced Instance Sequence	(0008,114A)	SQ		
>>>Referenced SOP Class UID	(0008,1150)	UI		
>>>Referenced SOP Instance UID	(0008,1155)	UI		

Table 8-12: Common Instance Reference Module

8.1.2.3 Spatial Registration Modules

Table 8-13: RT Series Module

8.1.2.3.1 Spatial Registration Module

Attribute Name	Tag	VR	Import	Export
Content Date	(0008,0023)	DA		<Current Date>
Content Time	(0008,0033)	TM		<Current Time>
Instance Number	(0020,0013)	IS		1
Content Label	(0070,0080)	CS		EXACTRAC_REG
Content Description	(0070,0081)	LO		Registration of Planning FOR to Treatment FOR
Alternate Content Description Sequence	(0070,0087)	SQ		Not supported.

Content Creator's Name	(0070,0084)	PN		“”
Registration Sequence	(0070,0308)	SQ		Two items is supported.
>Frame of Reference UID	(0020,0052)	UI		See [1]
>Referenced Image Sequence	(0008,1140)	SQ		
>Matrix Registration Sequence	(0070,0309)	SQ		
>>Frame of Reference Transformation Comment	(3006,00C8)	LO		“IDENTITY” or “SOURCE”
>>Registration Type Code Sequence	(0070,030D)	SQ		
>>>Code Value	(0008,0100)	SH		“125024”
>>>Coding Scheme Designator	(0008,0102)	SH		“DCM”
>>>Code Meaning	Code Meaning	LO		“Image Content-based Alignment”
>>Matrix Sequence	(0070,030A)	SQ		
>>>Frame of Reference Transformation Matrix	(3006,00C6)	DS		Identity matrix
>>>Frame of Reference Transformation Matrix Type	(0070,030C)	CS		“RIGID”

Table 8-14: Spatial Registration Module

8.1.2.4 RT Modules

8.1.2.4.1 RT Image

Attribute Name	Tag	VR	Import	Export
RT Image Label	(3002,0002)	SH		
RT Image Name	(3002,0003)	LO		
RT Image Description	(3002,0004)	ST		
Image Type	(0008,0008)	CS		See [2].
Conversion Type	(0008,0064)	CS		Not supported.
Reported Values Origin	(3002,000A)	CS		“ACTUAL”, provided only for X-Ray images.
RT Image Plane	(3002,000C)	CS		"NORMAL"
X-Ray Image Receptor Translation	(3002,000D)	DS		
X-Ray Image Receptor Angle	(3002,000E)	DS		
RT Image Orientation	(3002,0010)			
Image Plane Pixel Spacing	(3002,0011)	DS		
RT Image Position	(3002,0012)	DS		
Radiation Machine Name	(3002,0020)	SH		“ExacTrac Xray”
Primary Dosimeter Unit	(300A,00B3)	CS		“”
Radiation Machine SAD	(3002,0022)	DS		

[1] One of the two elements of the Registration Sequence references the Frame of Reference UID of the patient at scanning time as defined in the reference CT data set. The other referenced Frame of Reference describes the patient’s Frame of Reference during the imaging procedure at the time of treatment delivery.

[2] Pre-positioning DRR images has type: DERIVED/SECONDARY/DRR; Post-positioning DRR images has type: DERIVED/SECONDARY/DRR/TREATMENT_POS or DERIVED/SECONDARY/DRR/TREATMENT_POSITION depending on the export platform setting; X-ray images have the type: ORIGINAL/PRIMARY/RADIOGRAPH or ORIGINAL/PRIMARY/PORTAL.

Radiation Machine SSD	(3002,0024)			
RT Image SID	(3002,0026)	DS		
Source to Reference Object Distance	(3002,0028)			
Referenced RT Plan Sequence	(300C,0002)	SQ		
>Referenced SOP Class UID	(0008,1150)	UI		
>Referenced SOP Instance UID	(0008,1155)	UI		
Referenced Beam Number	(300C,0006)	IS		See [3].
Exposure Sequence	(3002,0030)	SQ		Provided only for X-Ray images.
>KVP	(0018,0060)	DS		
>X-Ray Tube Current	(0018,1151)	IS		
>Exposure Time	(0018,1150)	IS		
>Meterset Exposure	(3002,0032)	DS		Not supported.
>Number of Blocks	(300A,00F0)	IS		0
Gantry Angle	(300A,011E)	DS		
Gantry Pitch Angle	(300A,014A)	FL		
Patient Support Angle	(300A,0122)	DS		Provided only for X-Ray images.
Table Top Pitch Angle	(300A,0140)	FL		Provided only for X-Ray images and only present if known.
Table Top Roll Angle	(300A,0144)	FL		Provided only for X-Ray images and only present if known.
Table Top Vertical Position	(300A,0128)	DS		Provided only for X-Ray images.
Table Top Longitudinal Position	(300A,0129)	DS		Provided only for X-Ray images.
Table Top Lateral Position	(300A,012A)	DS		Provided only for X-Ray images.
Isocenter Position	(300A,012C)	DS		
Patient Position	(0018,5100)	CS		One of the values: “HFP”, “HFS”, “FFP”, “FFS”

Table 8-15: RT Image Module

8.1.2.5 Look Up Tables and Presentation States

8.1.2.5.1 VOI LUT

Attribute Name	Tag	VR	Import	Export
Window Center	(0028,1050)	DS		
Window Width	(0028,1051)	DS		

Table 8-16: VOI LUT Module

[3] Provided depending of the export platform setting. By default not provided.

8.1.3 Usage of Attributes from Received IODs

8.1.3.1 CT Image Storage / Enhanced CT Image Storage

In addition to all restrictions imposed by the RT Import Performer [3] ExacTrac Dynamic imposes following restrictions on the set of CT Images.
(0018,5100) Patient Position contains either “HFS”, “HFP”, “FFS” or “FPP”.
Distance between images in the set shall be maximum 5mm.
All images representing the patient anatomy shall be parallel and equidistant.

8.1.3.2 RT Plan Storage

In addition to all restrictions imposed by the RT Import Performer [3] ExacTrac Dynamic imposes following restrictions on RT Plan Storage.
Patient Position (0018,5100) contains either “HFS”, “HFP”, “FFS” or “FPP”. Prone/Supine part shall match to the patient position of all CT images, which represent the patient anatomy.
Beam Sequence (300A,00B0):

Contains at least one item with Treatment Delivery Type (300A,00CE) with value “TREATMENT” or equivalent[4].

All items of the sequence contain a non-empty Isocenter Position (300A,012C) attribute and all values of all items shall be equal[5].

All referenced treatment beams in the Fraction Group Sequence (300A,0070) shall contain the Beam Meterset (300A,0086) attribute.

8.1.3.3 Segmentation IODs

See [3].

8.1.3.4 Patient Identification

See [3].

8.1.3.5 Frame of Reference and Image References

See [3].

8.1.4 Attribute Mapping

No attribute mapping is performed.

8.1.5 Coerced/Modified fields

No coercion is performed.

[4] Additional non-standard Treatment Delivery Types can be configured to be interpreted as “TREATMENT”.
[5] Precision of comparison is configurable.

8.2 Data Dictionary of Private Attributes

Not supported.

8.3 Coded Terminology and Templates

See [1].

8.4 Grayscale Image Consistency

Not supported.

8.5 Standard Extended/Specialized/Private SOP Classes

None

8.6 Private Transfer Syntaxes

None.

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