HL7 Conformance Statement

syngo.via VB80A

SIEMENS Healthineers

1 Introduction

1.1 Purpose

This document gives a compact view of the HL7 interface provided by ***syngo*.via**. The HL7 interface of ***syngo*.via** is based on the requirements and suggestions of the IHE Framework [1], in regard to supported message types. Hint: Messages, that do not 100% comply to the definition of IHE, but contain the minimum required information as per definition of ***syngo*.via**, are nevertheless processed. Please refer to the chapter Required Attributes for the list of mandatory information.

1.2 Audience

This document is intended for hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working knowledge of HL7 and IHE.

1.3 Definitions, Terms and Abbreviations

Definitions, terms, and abbreviations used in this document are defined within the different parts of the DICOM standard.

1.3.1 Abbreviations

Additional Abbreviations and terms are as follows:

CDA	Common Document Architecture
EVN	Event Type
FHIR	Fast Healthcare Interoperability Resources
HL7	Health Level Seven
IHE	Integrating the Healthcare Enterprise
IS	Information System
ISR	Imaging Service Request
MRG	Merge Patient Information
MSH	Message Header
OBX	Observation Result
OBR	Observation Request Segment
OEM	Original Equipment Manufacturer
PID	Patient Identification
PV1	Patient Visit
PV2	Patient Visit – Additional Information
RIS	Radiology Information System
RP	Requested Procedure
SINR	Simple Image and Numeric Report
SPS	Scheduled Procedure Step
TX	Text data
TXS	Text data start

TXE	Text data end
V2	Health Level Seven Version 2
XML	Extended Markup Language

1.3.2 Definition and Terms

- **HL7**: It is a standard for information exchange between medical applications. It is an abbreviation for "Health Level Seven", 7th OSI layer protocol for the health environment. (OSI = Open Systems Interconnect, a model to describe defined layers in a network operating system). The HL7 protocol defines the format and the content of the messages that applications must pass to one another under various conditions (e.g. to pass the message between applications / systems that a patient has been admitted to a hospital).
- **IHE**: Integrating the Healthcare Enterprise is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care.
- **ISR**: An Imaging Service Request includes pertinent specific and general information. Each instance of an Imaging Service Request carries the information common to one or more Requested Procedures requested at the same moment. For further information please refer to [3].
- **RP**: A Requested Procedure is an instance of a Procedure of a given Procedure Type. An instance of a Requested Procedure includes all of the items of information that are specified by an instance of a Procedure Plan that is selected for the Requested Procedure by the imaging service provider. For further information please refer to [3].
- **SPS**: A Modality Scheduled Procedure Step is an arbitrarily defined scheduled unit of service, that is specified by the Procedure Plan for a Requested Procedure. A Modality Scheduled Procedure Step prescribes the Protocol which may be identified by one or more protocol codes. A Modality Scheduled Procedure Step involves equipment (e.g. imaging Modality equipment, anesthesia equipment, surgical equipment, transportation equipment), human resources, consumable supplies, location, and time (e.g. start time, stop time, duration). For further information please refer to [3].
- **HL7 Version 2**: HL7's Version 2.x (V2) messaging standard is the workhorse of electronic data exchange in the clinical domain and arguably the most widely implemented standard for healthcare in the world. This messaging standard allows the exchange of clinical data between systems. It is designed to support a central patient care system as well as a more distributed environment where data resides in departmental systems.
- **FHIR**: is a standard describing data formats and elements (known as "resources") and an application programming interface (API) for exchanging electronic health records (EHR). For further information please refer to [4].

1.4 Reference

[1] IHE Radiology Framework, Vol. I – IV, http://www.ihe.net/Technical_Frameworks

[2] HL7 Standard, chapter 2 "Control", http://www.hl7.org/

[3] Communications in Medicine (DICOM) Standard, National Electrical Manufacturers Association, Rosslyn, VA, USA (available free at https://www.dicomstandard.org)

[4] FHIR Standard, http://fhir.org/

2 General Information

Siemens Healthineers offers advanced RIS, PACS, and Processing features for all imaging needs in radiology and cardiology.
syngo.via, on which this Conformance Statement focuses, provides a set of interfaces for tight integration with radiology information systems.

- An OEM interface is used to realize frontend integration (remote image callup).
- For backend communication there is a bi-directional interface available, where the HL7 interface comprises the RIS to ***syngo.via*** communication parts. Furthermore ***syngo.via*** is informed about new procedures via DICOM Modality Worklist service.

3 Overview

syngo.via supports the following features in regards to the HL7 communication:

- Patient Update / Merge (ADT^A08, ADT^A40 or ADT^A34)
- Report Export (ORU^R01)
- Report Import (ORU^R01) for the option ***syngo.via*** WebReport

For the definiton of these interfaces, IHE was used as a basis, therefore ***syngo.via*** expects the Patient Update or Merge messages from the Information System to be compliant to IHE semantics. The structure of the Report Export message ***syngo.via*** is sending out is geared to those definitions as well. The structure of the Report Import message is aligned with the SINR profile, but other forms are also supported.
For an overview about all supported IHE actors/profiles, please take a look at the IHE Integration Statement published at https://www.siemens-healthineers.com/services/it-standards/ihe-integrating-the-healthcare-enterprise.

4 HL7 Configuration

Generally, ***syngo.via*** will expect HL7 version 2.5.1 as this version is required by IHE Radiology Framework. But messages based on version 2.4 and 2.5 will also be processed.

4.1 Minimal Lower Layer Message Transport Protocol (MLLP)

The ***syngo.via*** HL7/XML interface uses HL7's Minimal Lower Layer Protocol (MLLP) protocol over TCP/IP to receive and send messages. Briefly, message body is encoded using transaction framing with 0xB start and 0x1C+0xD end.

Table 1: Encoding message using MLLP

TXS	TX Body											TXE	
0xB	A	B	C	D	E	...						0x1C	0xD

Such encoded transactions are then sent to (or received from) a TCP/IP port at the ***syngo.via*** HL7/XML interface.

4.2 Sending Messages to the Product

MLLP encoded HL7 messages have to be sent to the port 9973 at the ***syngo.via*** HL7/XML interface. No additional configuration needs to be done on the ***syngo.via*** HL7/XML interface if the port 9973 is used. Note that the TCP/IP connection is permanent, and the interface port is blocked as long as the IS is connected to it (dedicated connection).

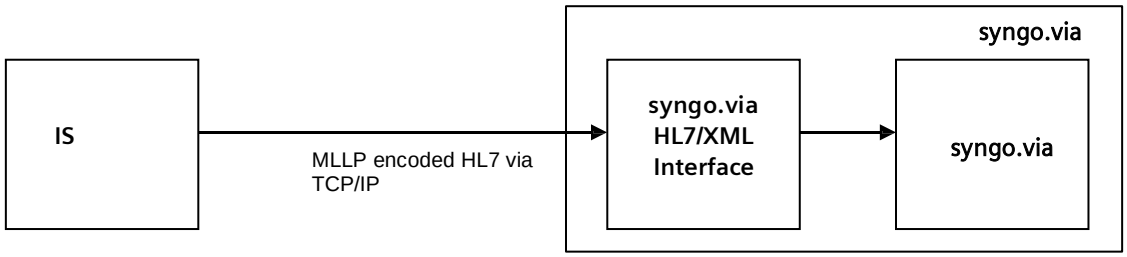

Figure 1: Sending HL7 to *syngo.via* HL7/XML interface

4.3 Sending Messages out of the Product

MLLP encoded HL7 messages are sent to the receiving port of the Information System. This port needs to be configured within the ***syngo.via*** HL7/XML interface. Additionally to the Port configuration the IP address of the receiving system needs to be set on the ***syngo.via*** HL7/XML interface. Note that the TCP/IP connection is permanent and the interface port is blocked as long as the IS is connected to it (dedicated connection).

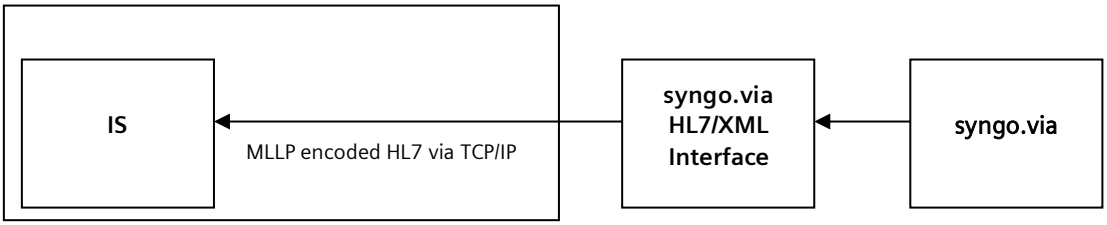

Figure 2: Sending HL7 out of *syngo*.via

4.4 Patient ID Matching

If objects are either created or updated at the RIS, ***syngo.via*** tries to find a matching existing patient and Requested Procedure (RP). If it finds either of that, it performs an update rather than creating a new record.
To match a patient, a configurable combination of the following fields is used.

- Patient ID (PID-3.1) (mandatory)
- Assigning Authority (PID-3.4)
- Patient Name (PID-5)
- Patient Date of Birth (PID-7)

The patient is by default identified through Patient ID and Assigning Authority/Issuer of Patient ID. If the latter is not set and no default value is set for Assigning Authority/Issuer of Patient ID, the above mentioned configuration is applied for patient identification.

4.5 Supported Character Sets

UTF-8 is the de-facto standard encoding for v2 messages in North America, in Europe it's ISO 8859-1 (Latin-1). UTF-8 is the commonly used encoding for UNICODE. Note that UNICODE is an example of a character set, it is not a character encoding. Use "UNICODE UTF-8" in the field MSH.18 and you're all set.

4.6 Security and Authentication

FHIRcast uses TLS authentication and security, which has to be configured.

5 HL7 Version 2 (V2)

This chapter describes the details of the communication supported on V2 by ***syngo.via***.

5.1 Versions Supported

syngo.via supports HL7 version 2.5. All received messages are handled as version 2.5-formatted messages and all the messages are sent in 2.5. format.

5.2 Implementation Details

Generally syngo.via will expect HL7 version 2.5 as this version is required by IHE Radiology Framework. But messages based on version 2.4 will also be processed.

5.2.1 Supported Messages

The table below provides an overview about all HL7 messages that are supported by ***syngo.via*** as receiving application.

Table 2: Overview of Supported HL7 messages

Message	Description	Segment Grouping
Inbound Messages		
ADT^A08	Patient Update	MSH, EVN, PID, [MRG], [PV1]
ADT^A40	Patient Merge	MSH, EVN, PID, [MRG], [PV1]
ADT^A34	Patient Merge – Patient ID only	MSH, EVN, PID, [MRG], [PV1]
ORU^R01	Unsolicited Transmission of an observation to be transferred to ***syngo.via*** WebReport	MSH, PID, OBR, {OBX}, [PV1]
Outbound Messages		
ORU^R01	Unsolicited Transmission of an observation	MSH, PID, OBR, {OBX}

ACK/NACK Behavior

If a message is sent to **syngo.via** which is not supported or a mandatory attribute is missing (e.g. Patient Name), **syngo.via** nevertheless replies with an HL7 ACK in order to avoid blocking the connection. The message is stored within the backlog of the HL7 gateway. (see Table 12: Required Fields for ADT messages and Table 13: Required Fields for ORU messages for a list of required attributes which are expected by **syngo.via**).

5.2.1.1 Inbound Messages

5.2.1.1.1 Patient Update / Merge

The Patient Information Update and Patient Merge messages trigger changes to patient information, including demographics, patient identification, patient location/class changes, and patient merges. These changes may occur at any time for a patient record. These messages are used for both inpatients (i.e., those who are assigned a bed at the facility) and outpatients (i.e., those who are not assigned a bed at the facility) if the patient has been previously registered.

5.2.1.1.2 Patient Information Update – ADT^A08

Changes to patient demographics and account information (e.g. change in patient name, patient address, etc.) triggers an ADT^A08 Update Patient message.
The table below indicates the message semantics of the ADT^A08 message:

Table 3: Message semantics of ADT^A08 according to IHE

Segment	Segment Name	Chapter in HL7
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3
[{OBX}]	Observation/results	7
[{AL1}]	Allergy	3

syngo.via tries to find the patient and

- erases values of attributes where the message contains a null value (two adjacent quotation marks “”)
- ignores empty attributes
- updates the below specified attributes (with a non-null value)

Table 4: Attributes to be updated by a received ADT^A08 message

Attribute	DICOM Tag Number	Part of DICOM Module	DICOM Value Representation	HL7
Patients Name*	(0010,0010)	Patient Identification / Patient	PN	ADT PID: 5
Patients Sex	(0010,0040)		CS	ADT PID: 8
Patients BirthDate	(0010,0030)		DA	ADT PID: 7
Patients BirthTime	(0010,0032)		TM	ADT PID: 7
Other Patient Names	(0010,1001)		PN (VM 1-n)	ADT PID: 9
Ethnic Group	(0010,2160)		SH	ADT PID: 10
Allergies	(0010,2110)	Patient Medical	LO	ADT AL1: 3

* Patient Name is expected in DICOM format.

If the patient is not found, ***syngo.via*** stores the update information. Imaging data which enters the system afterwards and matches the patient demographics within the update message, gets updated while receiving/importing.

Note: this patient update message can be used to update only non-key attributes. To change a key attribute, a "Patient Merge – ADT^A40" or a "Patient Merge (Patient ID Only) – ADT^A34" message has to be issued by the sending application.

5.2.1.1.3 Patient Merge – ADT^A40

A Patient Merge triggered by an ADT^A40 message indicates that a merge has been done at the internal identifier level. That is, PID-3-patient ID identifier has been merged with MRG-1 Patient ID.
Note: Be aware that the RIS has to send all the attributes which are configured in ***syngo.via*** to identify a patient in order to merge the patient.
The table below indicates the message semantics of the ADT^A40 message:

Table 5: Message Semantics of MSG1^EVN002

Segment	Segment Name	Chapter in HL7
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
MRG	Merge Information	3
[PV1]	Patient Visit	3

There are two use cases for the patient merge message:

- Merging two patient object branches into a single one
  In this case the PID and MRG segments represent two existing patients in the database. After finding the target patient and merge patient (MRG segment), all RPs from the merge patient are moved to the target patient. See Table 6: Attributes which get updated during Patient Merge for an explanation which attributes are changed in this case.
- Update patient's key attributes
  the target patient (PID segment) is not found. Only the merge patient (MRG segment) exists. A new patient is created with the key attributes from PID segment and all other fields are populated from the existing merge patient in database. All RPs from the merge patient are moved to the new patient. See Table 6: Attributes which get updated during Patient Merge for an explanation which Patient's key attributes are changed in this case.

Patients get identified by a configurable combination of fields. The MRG segment only provides the patient name and patient id. Therefore, the ***syngo.via*** can only process the message in case the merge patient gets identified unambiguously using these fields.

If the patient with the correct patient identification already exists, ***syngo.via*** copies the following attributes from that patient:

Table 6: Attributes which get updated during Patient Merge (patient identification found)

Attribute	DICOM Tag Number	Part of DICOM Module	DICOM Value Representation	HL7
Patients Name	(0010,0010)	Patient Identification / Patient	PN	ADT PID: 5
Patients ID	(0010,0020)		LO	ADT PID: 3
Issuer Of Patient ID	(0010,0021)		LO	ADT PID: 3
Other Patient IDs	(0010,1000)		LO (VM 1-n)	ADT PID: 3
Other Patient Names	(0010,1001)		PN (VM 1-n)	ADT PID: 9
Patient Birth Date	(0010,0030)		DA	ADT PID: 7
Patient Birth Time	(0010,0032)		TM	ADT PID: 7
Patients Sex	(0010,0040)		CS	ADT PID: 8
Ethnic Group	(0010,2160)		SH	ADT PID: 10

If the patient with the correct patient identification does not exist, ***syngo.via*** modifies only the patient identification attributes:

Table 7: Attributes which get updated based on Patient Merge (patient identification not found)

Attribute	DICOM Tag Number	Part of DICOM Module	DICOM Value Representation	HL7
Patients Name	(0010,0010)	Patient Identification / Patient	PN	ADT PID: 5
Patients ID	(0010,0020)		LO	ADT PID: 3
Issuer Of Patient ID	(0010,0021)		LO	ADT PID: 3

5.2.1.1.4 Patient Merge (Patient ID Only) – ADT^A34

Although IHE specifies, that the ADT^A40 message shall be used for Patient Merge messages, several older systems still use the ADT^A34 ("Merge patient information - patient ID only") message for this purpose.
The difference between the ADT^A40 and the older ADT^A34 is, that the A40 deals with the Patient Identifier List, whereas the ADT^A34 only supports the Patient ID.
syngo.via also supports the ADT^A34 message in order to enhance the interoperability to older RIS as those systems more often support the retired ADT^A34 and do not support the ADT^A40.
The table below indicates the message semantics of the ADT^A34 message:

Table 8: Message semantics of ADT^A34

Segment	Segment Name	Chapter in HL7
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
[PD1]	Patient Additional Demographic	3
MRG	Merge Information	3

Hint: ***syngo.via*** treats and analyzes the ADT^A34 in the same way as the ADT^A40.

5.2.1.1.5 Report Import

The ORU message is used for receiving results from other systems and forwarding these results to ***syngo.via*** WebReport. With the OBX and the OBR segments, one can construct almost any clinical report as a three-level hierarchy, with the Patient Context within the PID segment at the upper level, an order record within the OBR segment at the next level and one or more observation records within the OBX at the bottom.

5.2.1.1.5.1 Unsolicited Report – ORU^R01

Table 9: General message semantics of ORU^R01 (tags in use)

Segment	Segment Name	Segment used within *syngo.via* ORU msg	Chapter in HL7
MSH	Message Header	Yes	2
PID	Patient Identification	Yes	2
OBR	Observations Report ID	Yes	7
OBX	Observation/Result	Yes	7

The other segments are not used in the ORU messages by ***syngo.via***.

Identifying Information

The table below indicates the message mapping between DICOM and HL7 of the ORU^R01 message:

Table 10: Attributes to be updated by a received ADT^A08 message

Attribute	DICOM Tag Numbe	Part of DICOM Module	DICOM Value Representation	HL7
Patients Name*	(0010,0010)	Patient Identification / Patient	PN	ORU PID:5
Patient ID	(0010,0020)		LO	ORU PID:3
Patients BirthDate	(0010,0030)		DA	ORU PID:7
Patients Sex	(0010,0040)		CS	ORU PID:8
Accession Number	(0008,0050)	Imaging Service Request	SH	ORU OBR:3
Procedure Description	(0032,1060)	Requested Procedure Module	LO	ORU OBR:4

Result Status

The result status (OBR-25) field is aggregated across all available OBX-11 fields. In case multiple OBX-11 fields are available, all of those need to be filled with

- F (meaning: "Final: The report has been finalized in the IS)

in order for the report to be treated as finalized by ***syngo.via*** WebReport.

Report Content

The report in plain text format is conveyed within the OBX2-5 Observation Value.
Information about the observation date will be read from OBR-7 Observation Date/Time. It is assumed that this value correlates with the DICOM Study Date (0008,0020). The report date will be read from OBR-22 Results rpt/status chng - date/time. The Reason for Study will be read from OBR-31.2 and the reading radiologist will be taken from OBR-32 Prinicipal Result Interpreter.

5.2.1.2 Outbound Messages

5.2.1.2.1 Report Export

The ORU message is used for transmitting results to other systems. With the OBX and the OBR segments, one can construct almost any clinical report as a three-level hierarchy, with the Patient Context within the PID segment at the upper level, an order record within the OBR segment at the next level and one or more observation records within the OBX at the bottom. The message is encoded using the UTF8 encoding.

5.2.1.2.1.1 Unsolicited Report – ORU^R01

Table 11: Message Semantics of ORU^R01

Segment	Segment Name	Segment used within syngo.via ORU msg	Chapter in HL7
MSH	Message Header	Yes	2
{ [PID	Patient Identification	Yes	3
[PD1]	Additional Demographics	No	3
[{NK1}]	Next of Kin/Associated Parties	No	3
[{NTE}]	Notes and Comments	No	2
[PV1	Patient Visit	No	3
[PV2]]]	Patient Visit – Additional Info	No	3
{[ORC]	Order common	No	4
OBR	Observations Report ID	Yes	7
{[NTE]}	Notes and comments	No	2
[CTD]	Contact Data	No	11
{ [OBX]	Observation/Result	Yes	7
{[NTE]}}	Notes and comments	No	2
[{FT1}]	Financial Transaction	No	6
{[CTI]}}}	Clinical Trial Identification	No	7
[DSC]	Continuation Pointer	No	2

Observation value encoding into HL7

The ***syngo.via*** Report is generated in an XML format prior to being sent to the internal HL7 engine.

For the report in plain text (OBX2-5) the tabs are converted to spaces (0x20) and the linefeed character (0x0A) is replaced with a value of \.br\ by the internal HL7 engine to indicate new lines within the formatted report for the HL7 output.

For the CDA report the study related DICOM attributes are available in the Body section of the CDA within the "DICOM Object Catalog".

Result Status

The result status (OBR-25) attribute is filled with

- P (meaning: "Preliminary: A verified early result is available, final results not yet obtained)

For compatibility reasons the information is also transferred in OBX1-11.

Report Content

The message contains:

- the report in plain text format is conveyed within the OBX2-5 Observation Value
- the report in PDF format is encoded as Base64 string within the OBX3-5 Observation Value
- the structured finding and study information in CDA format is sent within the OBX4-5 Observation Value

5.3 HL7 User Defined Tables

There are no User Defined Tables in the current implementation.

5.4 Examples

Example Report Import

MSH|^~\&|RAD|BMH|||301203140327||ORU^R01|RMS|P|2.3.1|<x0D>

PID|1||000999888777|001010126512|LASTNAME1 MIDDLENAM^FIRST^^^|<x0D>

OBR||00003^001|36494140|ULT4476814 ^OB LIMITED FOR VIABL SNGL OR MUL|||2

01003150319|||||||^^^ |067900^DOCTORLN1^FIRSTNM^^^^MD||||||3012031403

27|||F||1^^^^^S^^STAT||||^OB US TO RULE IN PREGNANCY|000000&UNASSIGNED&

DOCTOR&&&&|<x0D>

OBX|5|TX|36494140&BODY||***** FINAL *****~~~REASON FOR EXAM: OB US TO RULE IN PREGNANCY~DIAGNOSIS: . .~COMMENTS: OB US TO RULE IN PREGNANCY ~ACC#: 12341234~PROCEDURE: ULT 9876- OB LIMITED FOR VIABL SNGL OR MUL - Jul 11 2009 ~*** Anywhere Memorial Hospital ~1234 South Sealevel Blvd., Whitest

Beach, TX 12345 Phone: (123) 456-7890 ~Ext 9999 ~----------~-----~Pat. Name: LASTNAME1 MIDDLENAM, FIRST Study Date: 07/11/2009 3:21am~Pat. No: 999888777 Referring MD: DOCTORLN1, FIRS

TNM~LMP: Unknown Sonographer: SMITHY~NA by US: 08.9 weeks DOB, Age: 05/05/1990, 19~ GA Selected: 08.9 weeks ~(Sonographic)~ EDD: 10/18/2010~----------~-----~MEASUREMENTS \T\ FETAL AGE FETAL GROWTH

EVALUATION~Measurement GA Range Source % for 08.9 Ratios~---------- ------- ------- ------- ---------- ~----------~Sac 3.6 cm 08.7 wk (07.8-09.6) Hellman Sac 38%~CRL 2.5 cm 09.2 wk (08.5-09.9) Hadlock CRL 65%~GA for sonogram 08.9 wk (08

.1-09.8)~based on (Sac,CRL) Avg ~----------~-----~CLINICAL SUMMARY~Fetus Number:single~Fetal Heart Rate: 170 bpm~Yolk Sac seen:yes~Ovaries: wnl~Fibroid seen:NONE~IMPRESSION:~ RADIOLOGIST DICTATED REPORT: \E\ ~DOCTOR UNASSIGNED~~~Report Dictated by DOCTOR UNASSIGNED on: Jul 11 2009 3:23A~Transcribed by: on Jul 11 2009 3:23A~||||||F|<x0D>

Report in plain text

Example Report Export

```
MSH|^~\&|syngo.via|syngo|ANY_RIS|RIS|201310100812||ORU^R01|2|P|2.3.1||||||UNICODE UTF-8

PID|1||99001||RCTest_001||19611212|F OBR|1||1234|^RCTest
Study01|||20100910132420||||||||||1234|000001||123223|20131007101515||

MR;SR|P||||||reason|&&Dr1

OBX|1|CE|&IMP|1|||||||P

OBX|2|FT|&BODY|2|Diagnostic Imaging Report\.br\\.br\\.br\+------------+-----------------
----------------------------------------------+\.br\\F\Name:       \F\RCTest_001,
\F\\.br\+------------+-----------------------------------+--+-------+-----------------
+\.br\\F\Patient ID: \F\99001                                \F\  \F\Sex:   \F\female
\F\\.br\+------------+-----------------------------------+--+-------+-----------------
+\.br\\F\Birth Date: \F\12/12/1961                           \F\  \F\Age:   \F\48 years
\F\\.br\+------------+-----------------------------------+--+-------+-----------------
+\.br\\.br\Request And Procedure\.br\+-----------------------+------------------------
--------------------------+\.br\\F\Requested Procedure:    \F\req proc
\F\\.br\+-----------------------+-----------------------------------------------------
+\.br\\F\Accession Number:       \F\1234
\F\\.br\+-----------------------+-----------------------------------------------------
+\.br\+-----------------------+-----------------------------------------------------
+\.br\\F\                        \F\9/10/2010
\F\\.br\\F\Study Date and Time:    \F\ at
\F\\.br\\F\                        \F\13:24:20
\F\\.br\+-----------------------+-----------------------------------------------------
+\.br\\F\Study Description:      \F\RCTest Study
```

Report in plain text

```
01                                  \F\\.br\+----------------
--------+-----------------------------------------------------
+\.br\\.br\Technique\.br\\.br\Clinical Information\.br\\.br\Findings Summary\.br\\.br\+-
------------------------------------+---------------------------------------
+\.br\\F\Name                                \F\Value
\F\\.br\+-----------------------------------+---------------------------------------
+\.br\\F\[1] Distance Line                   \F\7.75 cm
\F\\.br\+-----------------------------------+---------------------------------------
+\.br\\.br\Impression\.br\\.br\+----------------------+-+-------------------------------
---------------------+\.br\\F\Reading Physician:    \F\ \F\, Dr1
\F\\.br\+----------------------+-+-----------------------------------------------------
+\.br\\.br\Findings Details\.br\\.br\+-----------------------------------------------
--------------------------+\.br\\F\Finding [1] Distance Line:
\F\\.br\+------+-------------------------------------------------------------------
+\.br\\F\Value \F\7.75 cm
\F\\.br\+------+-------------------------------------------------------------------
+\.br\\F\
\F\\.br\+-----------------------------------------------------------------------------
+\.br\\F\                                  [Img]
\F\\.br\+-----------------------------------------------------------------------------
+\.br\\F\
\F\\.br\+-----------------------------------------------------------------------------
+\.br\\F\
\F\\.br\+-----------------------------------------------------------------------------
+\.br\||||||P

OBX|3|FT|&BODY|3|JVBERi0xLjUNCjUgMCBvYmoNCjw8L1R5cGUgL1BhZ2UvUGFyZW50IDMgMCBSL0NvbnRlbnR
zIDYgMCBSL01lZGlhQm94IFswIDAgNjEyIDc5Ml0||||||P
```

Report in PDF (Base64 encoding, truncated sample)

OBX|4|FT|&BODY|1|<?xml version="1.0" encoding="UTF-8"?><ClinicalDocument xmlns="urn:hl7-org:v3" xmlns:voc="urn:hl7-org:v3/voc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"><!--**********************************--><!-- CDA Header --><!--**********************************--><typeId root="2.16.840.1.113883.1.3" extension="POCD_HD000040" /><templateId root="2.16.840.1.113883.10.20.6" /><id root="2.16.840.1.113883.19" extension="20131007081515" /><code code="18748-4" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC" displayName="Diagnostic Imaging Report" /><title>CDA report</title><effectiveTime value="20100910132420" /><confidentialityCode code="N" codeSystem="2.16.840.1.113883.5.25" /><languageCode code="en-US" /><recordTarget><patientRole><id root="1.2.840.113619.2.62.994044785528.10" extension="99001" /><addr nullFlavor="NI" /><telecom nullFlavor="NI" /><patient><name><family>RCTest_001</family></name><administrativeGenderCode codeSystem="DCM" code="F" /><birthTime value="19611212132420" /></patient></patientRole></recordTarget><author><time value="20131007081515" /><assignedAuthor><id root="a43db488-9e87-416b-9b38-bcbf5ea4f2ad" /><addr nullFlavor="NI" /><telecom nullFlavor="NI" /><assignedAuthoringDevice><softwareName>syngo Reporting</softwareName></assignedAuthoringDevice></assignedAuthor></author><custodian><assignedCustodian><representedCustodianOrganization><id root="2.16.840.1.113883.19.5" /><name>ReportingTestTask</name><telecom nullFlavor="NI" /><addr nullFlavor="NI" /></representedCustodianOrganization></assignedCustodian></custodian><participant typeCode="REF"><associatedEntity classCode="PROV"><id nullFlavor="NI" /><addr nullFlavor="NI" /><telecom nullFlavor="NI" /><associatedPerson><name><given>DR ref</given></name></associatedPerson></associatedEntity></participant><inFulfillmentOf><order><id root="2.16.840.1.113883.19.4.27" extension="1234" /></order></inFulfillmentOf><documentationOf><serviceEvent classCode="ACT"><id root="1.3.12.2.1107.5.8.1.12345.30000009999991621020000000001" /><id root="1.2.840.113619.2.62.994044785528.26" extension="ERROR-BAD-REQUESTEDPROCEDUREID" /><effectiveTime value="20131007081515" /></serviceEvent></documentationOf><relatedDocument typeCode="XFRM"><parentDocument><id root="1.3.12.2.1107.5.8.15.999999.30000013100710105764400000006" /></parentDocument></relatedDocument><!--**********************************--><!--

Report in CDA (truncated sample)

6 Required Attributes

The attributes marked as required are checked when ADT or ORU messages enter the system and if not present or exceeding the acceptable length, they are stored within the backlog of the HL7/XML interface of ***syngo.via***.

6.1 ADT

Table 12: Required Fields for ADT messages

HL7	Meaning	Required
MSH-07	Date/Time Of Message	
MSH-09	Message Type	Yes
MSH-10	Message Control ID	
MSH-12	Version ID	Yes
PID-03.01	Patient Identifier List / ID	Yes (max. 64 char)
PID-04	Alternate Patient ID	
PID-05	Patient Name	Yes (max. 64 char)
PID-07	Date Of Birth	
PID-08	Administrative Sex	
PID-09	Patient Alias	
PID-18.01	Patient Account Number / ID	
PID-18.04	Patient Account Number / Assigning Authority	
MRG-01.01	Prior Patient Identifier List	Yes (max. 64 char)
MRG-04.01	Prior Patient ID	
MRG-07	Prior Patient Name	
PV1-02	Patient Class	
PV1-03	Assigned Patient Location	
PV1-06	Prior Patient Location	
PV1-08	Referring Doctor	
PV1-15	Ambulatory Status	
PV1-19	Visit Number	
PV1-21	Charge Price Indicator	
PV1-44	Admit Date and Time	
PV1-45	Discharge Date and Time	

6.2 ORU

Table 13: Required Fields for ORU messages

HL7	Meaning	Required
MSH-07	Date/Time Of Message	
MSH-09	Message Type	Yes
MSH-10	Message Control ID	
MSH-12	Version ID	Yes
PID-03.01	Patient Identifier List / ID	Yes (max. 64 char)
PID-04	Alternate Patient ID	
PID-05	Patient Name	Yes (max. 64 char)
PID-07	Date Of Birth	
PID-08	Administrative Sex	
OBR-03.01	Filler Order Number	Yes (max. 16 char)
OBR-04	Universal Service ID	
OBR-07	Observation Date/Time	Strongly Recommended
OBR-22	Results rpt/status chng - date/time	Strongly Recommended
OBR-25	Result Status	Yes
OBR-31.2	Reason For Study	Strongly Recommended
OBR-32	Principal Result Interpreter	Strongly Recommended
OBX-02	Value Type	Yes
OBX-05	Observation Value	Yes (max. 655236 [1])
OBX-11	Observation Result Status	Yes

[1] The length of the observation value field is variable, depending upon value type. See OBX-2-value type.

7 HL7 Clinical Document Architecture (CDA) Implementation

This chapter describes the hierarchy and content defined by Clinical Document Architecture (CDA) for implementation of ***syngo.via***.

For the CDA report the study related DICOM attributes are available in the Body section of the CDA within the "DICOM Object Catalog".

7.1 Document Types Created

7.1.1 Diagnostic Imaging Report

A Diagnostic Imaging Report contains a consulting specialist's interpretation of image data. It is intended to convey the interpretation to the referring (ordering) physician and becomes part of the patient's medical record. It is intended for use in Radiology, Endoscopy, Cardiology, and other imaging specialties.

Table 14: Diagnostic Imaging Report

Template Name	Optionality and Cardinality	Template ID
Diagnostic Imaging Report	R[1..1]	2.16.840.1.113883.10.20.22.1.5

7.1.1.1 Header Content Modules

Table 15: Header elements of Diagnostic Imaging Report

Element Name	Optionality and Cardinality	Comment
typeId	R[1..1]	Identifies the constraints imposed by CDA Release 2.0 on the content, essentially acting as a version identifier.
templateId	R[1..1]	Identifies the template that imposes constraints on the content. It does not have an *extension* attribute.
id	R[1..1]	Uniquely identifies the document by the values of the attributes *root* and *extension*. It always has an *extension* attribute.
code	R[1..1]	Specifies the type of the clinical document. The value of its *code* attribute is always **18748-4**, which stand for **Diagnostic Imaging Report** (which acts also as display name). The code system name is **LOINC** and the code system is **2.16.840.1.113883.6.1**
title	O[0..1]	It is the title of the study reported on. If the study does not have a title, this element is missing.
effectiveTime	R[1..1]	Specifies the creation time of the document, precise to the second.
confidentialityCode	R[1..1]	It specifies the confidentiality assigned to the document. The *code* attribute has always the value **N**, the *codeSystem* attribute has always the value **2.16.840.1.113883.5.25**.
languageCode	R[1..1]	It specifies the language of the Diagnostic Imaging Report. It is taken over from the Study to be reported on.

Element Name	Optionality and Cardinality	Comment
participants	R[1..1]	It contains the name of the referring physician. The elements id, addr and telcom are always empty. The elements given, family, prefix and suffix are taken from the study but only, if the study does have values for the elements (they are checked one by one).
recordTraget	R[1..n]	It represents the patient in whose medical record the report is to be placed. It contains the ID of the patient (as specified in the study to be reported on), the given name, family name, prefix and suffix of the patient (if specified in the study), the administrative gender of the patient and the birth time of the patient. There is NO guardian element.
author	R[1..1]	It represents the creator of the document. It contains the creation time of the report and the assigned author device (always **syngo Reporting**). The ID of the author is a newly generated Guid, addr and telcom are empty.
custodian	O[0..1]	Represents the custodian of the Diagnostic Imaging Document. The name is the institution name, addr and telcom are empty.
inFullfillmentOf	O[0..n]	Represents the Placer Order that was fulfilled by the imaging procedure(s) covered by this report document. The root of the id is always **2.16.840.1.113883.19.4.27**, the extension is the accession number of the study.
documentationOf	R[1..n]	Indicates the imaging procedure that the provider describes and interprets in the content of the Diagnostic Imaging Report. The *root* attribute of the first ID represents the Study UID, if the Study UID is valid (otherwise the value will be **ERROR-BAD-STUDYUID** and a warning Trace record will be issued). The *root* attribute of the second ID is the Requested Procedure UID, if the Requested Procedure UID is valid (otherwise the value will be **ERROR-BAD-REQUESTEDPROCEDUREID** and a warning Trace record will be issued). The effective time is the exact time of the issuing of the report.

No legal Authenticator is included in the report.

7.1.1.2 Body Section Content Modules Templates

The body section is introduced by the component element, which does include a structured Body element. Inside this are placed the DICOM Object Catalog (if required) and the Findings.

Table 16: Body elements of Diagnostic Imaging Report

Template Name	Optionality and Cardinality	Template Type	Template ID	Comment or reference t detailed description below
DICOM Object Catalog	O[0..1]	section	2.16.840.1.113883.10.20.6.1.1	See below
observation	R[0..n]	entry	2.16.840.1.113883.10.20.6.2.12	As text
observation	R[0..n]	entry	2.16.840.1.113883.10.20.6.2.13	As code (or as list of codes)
observation	R[0..n]	entry	2.16.840.1.113883.10.20.6.2.14	As measurement data (unit and value)
Findings	R[1..1]	section	2.16.840.1.113883.10.20.6.1.2	See below
observation	O[0..n]	entry	2.16.840.1.113883.10.20.6.2.13	Added to the findings section, based on per Body Location and Region
observation	O[0..n]	entry	2.16.840.1.113883.10.20.6.2.14	Added to the findings section based on the clinical findings as measurements
observation	O[0..n]	entry	(depends on the BCR report added)	Added to the findings section, based on the generated BCR reports.
observation	O[0..n]	entry		Non-finding related data
observation	O[0..n]	entry		Added to the findings section, based on the Tumor Burden Data (text, code, list of codes and measurement data with values and their respective units)
observation	O[0..n]	entry		Added to the finding section, based on the Brain Morphometry Data.

7.1.1.2.1 DICOM Object Catalog

It must be present if the document contains references to DICOM Images. If it is present, it must be the first section of the in the document body. It lists all referenced objects and their parent Series and Studies. Also other DICOM attributes can be referenced, if they are required for retrieving the objects.

The ID of the template is explicitly stated for this section.

This implementation does not contain empty section or text elements.

To each DICOM Object observations are automatically added, based on the attributes of DICOM object (e.g., Study):

- Text observations will be added if the attribute is a text attribute and the text contained is not empty.
- Code observations will be added if the attribute is a code attribute and the code itself and the code system is not empty.
- A list of observations will be added if the attribute is a list attribute and its internal list is not empty.
- A measurement type of observation will be added if the attribute represents a measurement and has a valid measurement value and measurement unit.

7.1.1.2.2 Findings

This section contains only direct observations in the report, with such topics as Reason for Study, History and Impression placed in separate sections. Even if the report content provides a single blob of text not separated into these sections, it will be placed in the findings section

The template ID is not stated explicitly for this section.

In the report, there must be at least one section, that is a finding section. If no finding section can be found after the report was built, an exception will occur. In that case the operation will be terminated and no report will be generated.

To the finding section, following data will be added, as observation entries and entry relationships:

- Observations related to Body Parts and Regions (including sub-regions).
- Other clinical findings.
- The coded content of the report.
- Non-Finding related data.
- Tumor burden data.
- Brain morphometry data.

8 Fast Healthcare Interoperability Resource (FHIR) Implementation

Currently there is no FHIR implementation available. A FHIR implementation is planned for future versions.

9 FHIRcast

This section aims to describe the role of FHIRcast in relevance to the ***syngo*.via** VB80A.

9.1 Overview

FHIRcast is a draft standard providing simple context synchronization specification between different applications working on the same patient data.

9.2 FHIRcast Version

The implementation in ***syngo*.via** VB80A is FHIRcast STU2 compliant.

9.3 Subscribing and Unsubscribing

The FHIRcast hub supports websockets.

Subscription Request

To create a subscription, an HTTP POST request is performed to the Hub's base URL (as specified in hub.url) using the parameters described in Table 17: Subscription Request content and formatting.

Table 17: Subscription Request content and formatting

Field	Optionality	Type	Description
hub.channel.type	REQUIRED	string	The literal string websocket.
hub.mode	REQUIRED	string	The literal string subscribe.
hub.topic	REQUIRED	string	The identifier of the session that the subscriber wishes to subscribe to. MAY be a Universally Unique Identifier (UUID).
hub.events	CONDITIONAL	string	Comma-separated list of event types from the Event Catalog for which the Subscriber wants to subscribe.
hub.lease_seconds	OPTIONAL	number	Number of seconds for which the subscriber would like to have the subscription active, given as a positive decimal integer. The Hub has a limit on this value.
hub.channel.endpoint	CONDITIONAL	string	Required when hub.channel.type=websocket for re-subscribes. The WSS URL identifying an existing WebSocket subscription. Re-subscription is not supported by the Hub.

Subscription Response

Upon receiving a subscription request, the Hub responds with an HTTP 202 "Accepted" response. This indicates that the request was received and will now be verified by the Hub. The HTTP body of the response consists of a JSON object containing an element name of hub.channel.endpoint and a value of the WSS URL.
To improve user experience, the Hub also includes the current context of the given Topic.

Subscription Denial

If a Hub refuses the request or finds errors in it, an appropriate HTTP error response code (4xx or 5xx) is returned. In the event of an error, the Hub also returns a description of the error in the response body as plain text.
The Hub rejects subscription requests in following cases:

- invalid API key is used by the client
- webhook is specified as channel
- the number of Topics reaches a set limit
- the number of clients subscribed to the given Topic reaches a set limit.

Subscription Confirmation

Subscription confirmation is not supported.

Unsubscription

If the event notifications are no longer needed, an unsubscribe is performed. This cancels an existing subscription. Since the unsubscribe request is always performed over HTTP(s), it is done over a newly created and communicated WebSocket endpoint, using the fields described in Table 18: Unsubscription Request content and formatting.

Table 18: Unsubscription Request content and formatting

Field	Optionality	Type	Description
hub.channel.type	REQUIRED	string	The literal string websocket.
hub.mode	REQUIRED	string	The literal string subscribe.
hub.topic	REQUIRED	string	The identifier of the session that the subscriber wishes to subscribe to. MAY be a Universally Unique Identifier (UUID).
hub.events	CONDITIONAL	string	Comma-separated list of event types from the Event Catalog for which the Subscriber wants to subscribe.
hub.lease_seconds	OPTIONAL	number	Number of seconds for which the subscriber would like to have the subscription active, given as a positive decimal integer. The Hub has a limit on this value.
hub.channel.endpoint	CONDITIONAL	string	Required when hub.channel.type=websocket for re-subscribes. The WSS URL identifying an existing WebSocket subscription. Re-subscription is not supported by the Hub.

9.4 Event Notifications

The subscriber receives event notification as long as the subscription exists. The fields of these notifications are described in Table 19: Event notification fields.

Table 19: Event notification fields

Field	Optionality	Type	Description
timestamp	REQUIRED	string	ISO 8601-2 timestamp in UTC describing the time at which the event occurred.
id	REQUIRED	string	Event identifier, universally unique for the Hub.
event	REQUIRED	object	A JSON object describing the event as defined in Event Definition.

The Hub supports only websocket.

Event Notification Response

Please see Table 19: Event notification fields.

Event Notification Request

Please see Table 19: Event notification fields.

9.5 Event Notification Errors

Event notification errors are not supported.

9.6 Request Context Change

The subscriber can request context changes with an HTTP POST to the hub.url. The Hub either accepts this context change by responding with any successful HTTP status or rejects it by responding with any 4xx or 5xx HTTP status.
Once a requested context change is accepted, the Hub broadcasts the context notification to all subscribers, including the original requestor.

Table 20: Request notification fields

Field	Optionality	Type	Description
timestamp	REQUIRED	string	ISO 8601-2 timestamp in UTC describing the time at which the event occurred.
id	REQUIRED	string	Event identifier.
event	REQUIRED	object	A JSON object describing the event as defined in Event Definition.

9.7 Events

9.7.1 ImagingStudy-open

A study was opened by the user. The study may have been associated with a specific patient, or not.

Table 21: ImageStudy-open Fields

Key	Optionality	Description
patient	REQUIRED	FHIR Patient resource describing the patient associated with the study currently in context.
study	REQUIRED	FHIR ImagingStudy resource in context. Note that in addition to the request identifier and accession elements, the DICOM UID and FHIR patient reference are included because they're required by the FHIR specification.

9.7.2 ImagingStudy-close

A study was closed by the user.

Table 22: ImageStudy-close Fields

Key	Optionality	Description
study	REQUIRED	FHIR ImagingStudy resource previously in context. Note that in addition to the request identifier and FHIR ImagingStudy resource previously in context. Note that in addition to the request identifier and accession elements, the DICOM uid and FHIR patient reference are included because they're required by the FHIR specification.
patient	REQUIRED	FHIR Patient resource describing the patient associated with the study currently in context.

9.7.3 DiagnosticReport-open

A DiagnosticReport-open request is posted when a new or existing Diagnostic Report is opened by an application. The context field must contain at least one Patient resource and the anchor context resource.

Table 23: DiagnosticReport-open Fields

Key	Optionality	Description
report	REQUIRED	Diagnostic report being opened
patient	REQUIRED	FHIR Patient resource describing the patient associated with the diagnostic report.
study	REQUIRED	Information about the imaging study referenced by the report (if an imaging study is referenced) may be provided

9.7.4 DiagnosticReport-close

A DiagnosticReport-close event is posted when an application desires to close the active workflow.

Table 24: DiagnosticReport-close Fields

Key	Optionality	Description
report	REQUIRED	Anchor context

9.7.5 DiagnosticReport-update

The DiagnosticReport-update event is used by clients to support content sharing.

Table 25: DiagnosticReport-update Fields

Key	Optionality	Description
report	REQUIRED	Anchor context
patient	OPTIONAL	Present if one or more attributes in the Patient resource associated with the report have changed
study	OPTIONAL	Present if one or more attributes in the Study resource associated with the report have changed
updates	REQUIRED	Changes to be made to the current content of the anchor context

9.7.6 DiagnosticReport-select

Using the DiagnosticReport-select can be used to indicate that one or more FHIR resources are to be made visible, in focus, or otherwise "selected".

Table 26: DiagnosticReport-select Fields

Key	Optionality	Description
report	REQUIRED	Anchor context
select	REQUIRED	Contains zero or more references to selected resources. If a reference to a resource is present in the select array, there is an implicit unselect of any previously selected resource. If no resource references are present in the select array, this is an indication that any previously selected resource is now unselected.

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Published by Siemens Healthcare GmbH ·