

CAADAPTER 4.3

User's Guide



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TABLE OF CONTENTS

About This Guide	1
Purpose	1
Audience	1
Typical User	1
Prerequisites	2
Organization of This Guide	2
Recommended Reading	3
Text Conventions Used	4
Credits and Resources	4
 Chapter 1	
Overview of caAdapter	7
About caAdapter	7
caAdapter Core Engine Architecture	8
caAdapter Mapping Tool Architecture	9
About HL7	10
About the Study Data Tabulation Model (SDTM)	11
About the Object and Data Model	12
Prerequisites for Using the caAdapter Mapping Tool	13
Resources for Installing caAdapter	13
Starting the caAdapter Mapping Tool	13
Starting the Mapping Tool from the Binary Distribution	13
Starting the Mapping Tool from the Source Distribution	13
Starting the Mapping Tool from the Windows Distribution	13
Starting the Mapping Tool on the Web (WebStart)	14
 Chapter 2	
Using caAdapter	15
API Process Flow for CSV to HL7 v3 Transformation	15
API Operational Scenario for CSV to HL7 v3	16
Mapping Tool Operational Scenario for CSV to HL7 v3	17
Mapping Tool Operational Scenario for HL7 v2 to HL7 v3 Transformation .	

17	
Mapping Tool Operational Scenario for Regulatory Data Services Module ..	
18	
Mapping Tool Operational Scenario for Model Mapping Service	18

Chapter 3

CSV to HL7 v3 Mapping and Transformation	21
caAdapter Mapping Tool Process Flow	22
caAdapter Mapping Tool Common Features	23
caAdapter Mapping Tool Interface	23
caAdapter Toolbar	25
caAdapter Mapping Tool Validation	25
Source Specification	27
Segmented CSV Specification	27
Creating a New CSV Specification File	28
Opening an Existing CSV Specification File	29
Updating the CSV Specification	29
Validating the CSV Specification	31
Saving a CSV Specification	32
Generating a Report	33
Target Specification	33
HL7 v3 Specification	33
Overview of HL7 v3 Specification Tab	33
Defining Inline Text	36
Defining Units of Measure	36
Defining Default Data	36
Defining Object Identifiers (OIDs)	37
Adding Clones to the HL7 v3 Specification	38
Adding and Deleting Multiples to the HL7 v3 Specification	39
Updating Abstract Data Types in the HL7 v3 Specification	42
Enabling and Disabling Force XML with an Optional Clone	44
Map Specification	47
Business Rules	47
Step-by-Step Instructions	47
HL7 v3 Message	56
Business Rules	56
Step-by-Step Instructions	56
Transforming an HL7 Message into a CSV Format	59
Business Rules	59
Step-by-Step Instructions	59

Chapter 4

HL7 v2 to HL7 v3 Conversion63

Understanding the Mapping and Transformation Processes	63
Mapping and Converting HL7 v2 to CSV Format	64
Mapping and Converting CSV File to HL7 v3 Format	65
Using the HL7 v2 to HL7 v3 Module	65
Advanced HL7 v2 to HL7 v3 Mapping	66
Generating a CSV Specification File without an Actual HL7 v2 Message	
66	
Generating a CSV Specification File from an Actual HL7 v2 Message .	67

Chapter 5

Using Functions in Mapping69

Functions Provided by caAdapter	69
Function Specifications	71
Function Specification Overview	71
Vocabulary Mapping Specification Overview	79
Adding Functions to the Function Library	81

Chapter 6

Using the caAdapter APIs83

caAdapter Directory Structure	83
caAdapter APIs	84
Meta Data Loader	84
Transformation Service	85
HL7 v2 to HL7 V3 Transformation	85
Vocabulary and MIF Schema Validation	86
caAdapter API Error Logs	87

Chapter 7

caAdapter Web Services Transformation Module89

Introduction	89
Setup Mapping Scenarios Through the Web Portal	90
Programmatic Access to the caAdapter Web Services	91
Axis 1.x RPC Style Access to caAdapter Web Services	91
Axis 1.x DII Style Access to caAdapter Web Services	92
Axis 2.0 RPC Style Access to caAdapter Web Services	93

Chapter 8

caAdapter File Types95

caAdapter File Formats and Locations	95
CSV Data File	96

CSV Specification	97
HL7 v3 Specifications	98
HL7 v2 Specifications	103
Message Structure	104
DataTypeSpec	104
Segment Attribute Table	105
Definition Table	105
SDTM Data Files	105
SDTM Meta Data Files	106
Function Specification	107
Function Specification Overview	107
Adding Functions to the Function Library	109
HL7 v3 Message	110
CSV to HL7 v3 Map Specification	111
Object to Database Map Specification	113
Appendix A	
caAdapter Example Data	117
Appendix B	
References	119
Articles	119
caBIG Material	119
caCORE Material	119
HL7 Concepts and Material	119
Software Products	120
Study Data Tabulation Model (SDTM) Concepts and Material	120
caAdapter Glossary	121

ABOUT THIS GUIDE

This section introduces you to the *caAdapter 4.3 User's Guide*.

Topics in this section:

- *Purpose* on this page
- *Audience* on this page
- *Organization of This Guide* on page 2
- *Recommended Reading* on page 3
- *Text Conventions Used* on page 4
- *Credits and Resources* on page 4

Purpose

This guide is the companion documentation to caAdapter 4.3. It includes information and instructions for using the two main caAdapter components: a set of Application Programming Interfaces (APIs) and a mapping tool graphical user interface (GUI).

Audience

Typical User

This guide is designed for the following types of users:

- Technical users (such as Java programmers and system architects) who want to use the major caAdapter APIs to parse, build, and validate Health Level Seven version 3 (HL7 v3) messages; and
- Analysts (such as HL7 analysts, database administrators, and business analysts) who need step-by-step procedures for creating v3 XML message instances using the GUI, mapping and generating Study Data Tabulation Model (SDTM) text files, and mapping object and data models.

Prerequisites

This guide assumes that you are familiar with the following concepts and provides only a brief overview of each:

- HL7
- SDTM
- Object and data model terms and processes

Use of the caAdapter Mapping tool requires additional prerequisites. For more information, see *Prerequisites for Using the caAdapter Mapping Tool* on page 13.

Organization of This Guide

The *caAdapter 4.3 User's Guide* includes the following chapters:

- *Chapter 1, Overview of caAdapter*, on page 7 discusses the caAdapter architecture and related data standards.
- *Chapter 2, Using caAdapter*, on page 15 provides a high-level overview of using caAdapter.
- *Chapter 3, CSV to HL7 v3 Mapping and Transformation*, on page 21 explains the procedures for using the caAdapter Mapping Tool to perform for CSV to HL7 v3 mapping and transformation.
- *Chapter 4, HLV v2 to HL7 v3 Conversion*, on page 63 provides detailed instructions for using the caAdapter GUI for HL7 v2 to HL7 v3 conversion.
- *Chapter 5, Regulatory Data Services Module*, on page 69 provides detailed instructions for using the caAdapter GUI for CSV to SDTM mapping and transformation, and database to SDTM mapping and transformation.
- *Chapter 5, Using Functions in Mapping*, on page 69 provides detailed instructions for using and adding functions in caAdapter mappings.
- *Chapter 6, Using the caAdapter APIs*, on page 83 provides Java developers information required to use caAdapter APIs.
- *Chapter 7, caAdapter Web Services Transformation Module*, on page 89 provides detailed instructions for using the caAdapter Web Service.
- *Chapter 8, caAdapter File Types*, on page 95 provides an overview of the different types of files used by caAdapter and an example of each.
- *Appendix A, caAdapter Example Data*, on page 117 provides a description of the example data delivered with caAdapter.
- *Appendix B, References*, on page 119 provides a list of references used to produce this guide or referred to within the text.

Recommended Reading

The following table lists resources that can help you become more familiar with concepts discussed in this guide.

Resource	URL
HL7 organization Web site	http://www.hl7.org
National Cancer Institute Center for Bioinformatics (NCICB) HL7 tutorial	http://trials.nci.nih.gov/projects/infrastructureProject/caAdapter/HL7_Tutorial
SDTM	http://www.cdisc.org/models/sds/v3.1/
Unified Modeling Language (UML)	http://www.cdisc.org/models/sds/v3.1/

Click the hyperlinks throughout this guide to access more detail on a subject or product.

Text Conventions Used

This section explains conventions used in this guide. The various typefaces represent interface components, keyboard shortcuts, toolbar buttons, dialog box options, and text that you type.

Convention	Description	Example
Bold	Highlights names of option buttons, check boxes, drop-down menus, menu commands, command buttons, or icons.	Click Search .
<u>URL</u>	Indicates a Web address.	http://domain.com
text in SMALL CAPS	Indicates a keyboard shortcut.	Press ENTER.
text in SMALL CAPS + text in SMALL CAPS	Indicates keys that are pressed simultaneously.	Press SHIFT + CTRL.
<i>Italics</i>	Highlights references to other documents, sections, figures, and tables.	See <i>Figure 4.5</i> .
<i>Italic boldface monospaced type</i>	Represents text that you type.	In the New Subset text box, enter <i>Proprietary Proteins.</i>
Note:	Highlights information of particular importance	Note: This concept is used throughout the document.
{ }	Surrounds replaceable items.	Replace {last name, first name} with the Principal Investigator's name.

Credits and Resources

The following people contributed to the development of this document.

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Contacts and Support

NCICB Application Support

<http://ncicb.nci.nih.gov/NCICB/support>

Telephone: 301-451-4384

Toll free: 888-478-4423

LISTSERV Facilities Pertinent to caAdapter

LISTSERV	URL	Name
caAdapter_Users	https://list.nih.gov/archives/caadapter_users-l.html	caAdapter Users Discussion Forum
caBIO_Users	https://list.nih.gov/archives/cabio_users.html	caBIO Users Discussion Forum
caBIO_Developers	https://list.nih.gov/archives/cabio_developers.html	caBIO Developers Discussion Forum

CHAPTER 1

OVERVIEW OF CAADAPTER

This chapter provides an overview of caAdapter, its architecture, and its related data standards.

Topics in this chapter include:

- *About caAdapter* on page 7
- *About HL7* on page 10
- *About the Study Data Tabulation Model (SDTM)* on page 11
- *About the Object and Data Model* on page 12
- *Prerequisites for Using the caAdapter Mapping Tool* on page 13
- *Resources for Installing caAdapter* on page 13
- *Starting the caAdapter Mapping Tool* on page 13

About caAdapter

The caAdapter (<http://trials.nci.nih.gov/projects/infrastructureProject/caAdapter>) consists of several components that, via messaging standards, support data sharing at NCICB (<http://ncicb.nci.nih.gov>) and/or cancer centers as part of the cancer Biomedical Informatics Grid (caBIG) (<http://caBIG.nci.nih.gov>) solution. The components include a core engine for building, parsing, and validating HL7 v3 messages via an API or web service, and a mapping tool for providing mapping and transformation services using an assortment of messaging standards or formats such as HL7 v2 and v3, SDTM, and object and data models.

The caAdapter core engine is an open source toolkit for building, parsing and validating HL7 v3 messages from source clinical systems to promote data exchange in an international, standards-based messaging format. The core engine is a messaging framework that is based on an object-oriented data model, the HL7 RIM, and a set of v3 defined data types. This framework enables clinical applications to build and parse HL7 v3 messages based on specific schema definitions and perform structural, vocabulary

and schema validation. caAdapter integrates with NCICB cancer Common Ontologic Representation Environment (caCORE) components (<http://ncicb.nci.nih.gov/NCICB/infrastructure>). See the caCORE Technical Guide (<ftp://ftp1.nci.nih.gov/pub/cacore>) and the caCORE Software Development Kit Programmer's Guide (<ftp://ftp1.nci.nih.gov/pub/cacore/SDK>) for more information. This supports NCICB's mission of developing a translational research infrastructure and building a clinical research network by providing a common platform for sharing data.

The caAdapter Mapping Tool is an open source application that supports several types of mapping and transformation. It enables analysts and database engineers, who are knowledgeable about HL7, to create a mapping from Comma Separated Value (CSV) clinical data to an equivalent target HL7 v3 XML format. It provides a front end GUI and a back end engine to support specification of file formats, drag-and-drop mapping between source and target, validation of specifications and data, and transformation of actual CSV data into HL7 v3 XML message instances.

Using similar GUI and mapping features, the caAdapter Mapping Tool also enables HL7 v2 analysts to convert v2 messages into CSV format for use with the CSV to HL7v3 mapping capabilities. In addition, the caAdapter Mapping Tool permits SDTM analysts to map CSV study data to the SDTM format. Core engine support for these processes will be added in a later release.

Perhaps most useful to end users is the capability of the caAdapter Mapping Tool to support object to data model mapping. This component allows users to parse and load data and object models from an xmi file, map the object model to the data model using drag-and-drop capabilities, add SDK-required tags and tag values into the xmi file, and generate a Hibernate mapping file.

caAdapter Core Engine Architecture

Figure 1.1 illustrates the caAdapter core engine architecture design including its subsystems and components.

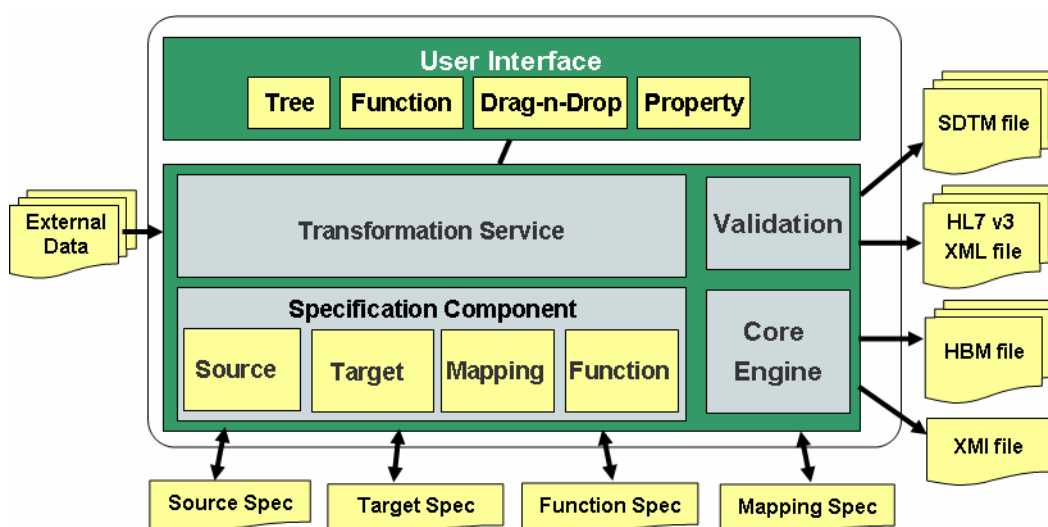


Figure 1.1 caAdapter Core Engine Architecture

The main features of the caAdapter core engine are

- Metadata Loader - represents HL7 v3 metadata in-memory,
- Message Parser – parses HL7 v3 messages to Reference Information Model (RIM) object graph,
- Message Builder – builds HL7 v3 messages from the RIM object graph,
- Validation Services, and
- Message Service Integration (future plans) – integrates with message exchange services.

caAdapter Mapping Tool Architecture

The caAdapter Mapping Tool is a graphical application for mapping clinical data to an HL7 v3 message. [Figure 1.2](#) illustrates the caAdapter Mapping Tool architecture design depicting its subsystems and components.

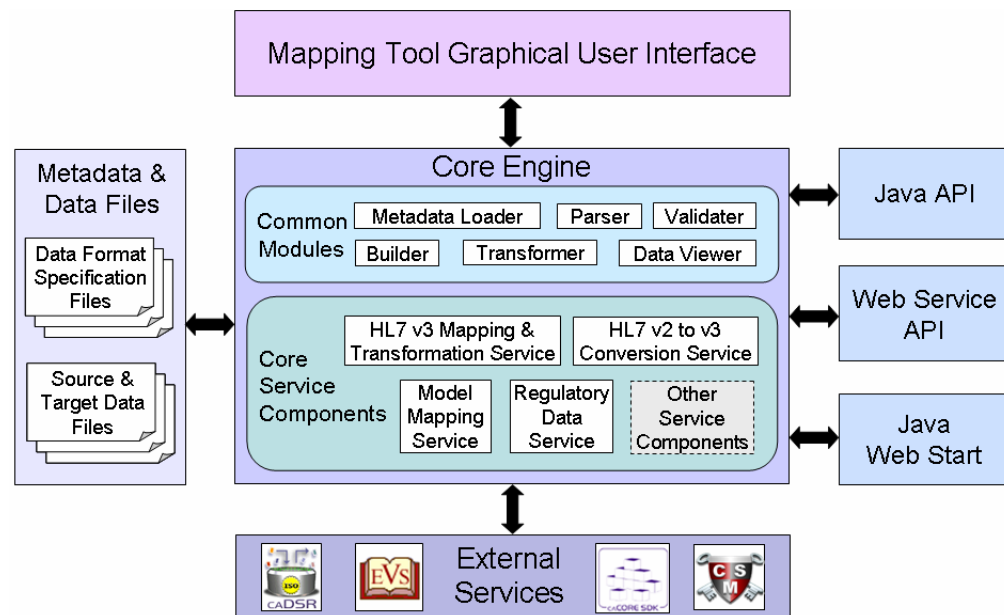


Figure 1.2 caAdapter Mapping Tool Architecture

The mapping tool provides the following:

- Source and Target Specification - graphical interface for defining input and output data formats.
- User Interface - simple mechanism for mapping source fields to target elements containing tree structure, drag-and-drop functionality, and functions and property definitions.
- Mapping Functions - capability to do simple-source data manipulation.
- Transformation Service - generation of HL7 v3 XML message instances and SDTM text files from a source database based on user-defined mapping specifications.
- Validation - capability to validate the structure and content of HL7 v3 messages.

About HL7

Health Level Seven (HL7) (<http://www.hl7.org/>) is one of several American National Standards Institute (ANSI)-accredited Standards Developing Organizations (SDOs) operating in the healthcare arena. HL7 provides standards for data exchange to allow interoperability between healthcare information systems. It focuses on the clinical and administrative data domains. The standards for these domains are built by consensus by volunteers—providers, payers, vendors, government—who are members in the not-for-profit HL7 organization.

HL7 version 2 (v2) is a messaging standard that focuses on syntactic data interchange. HL7 messaging (v2 or higher) has been recommended as a data exchange standard by the e-Government initiative. In fact, various releases of this version are in use in over 90% of U.S. hospitals, and v2 is considered the most widely implemented standard for healthcare information in the world. However, since it lacks an explicit methodology, conformance rules, and grouping of messages, it cannot be considered an interoperability standard.

HL7 v2 messages are composed of segments (individual lines in a message) which are composed of fields (data values) which may in turn be composed of components and sub-components. Several different delimiters or field separators are used to mark boundaries between the various elements. Specifications for messages using these structures are published in a text document format which does not easily lend itself to being computable. Furthermore, messages are often customized at local sites making it difficult to share messages between sites. caAdapter consequently includes a computable version of the message specifications which can be tailored to suit the needs of cancer centers and hospitals.

HL7 as an organization aimed to address some of the problems of v2 in its next major version, version 3 (v3). The key goal of the HL7 community is syntactic and semantic interoperability. This goal is supported in HL7 v3 by what are commonly called the four pillars of semantic interoperability:

1. A common Reference Information Model (RIM) spanning the entire clinical, administrative, and financial healthcare universe. The RIM is the cornerstone of the HL7 v3 development process. An object model created as part of the v3 methodology, the RIM is a large pictorial representation of the clinical data domains and identifies the life cycle of events that a message or groups of related messages will carry. It is a shared model between all the domains and is the model from which all domains create their messages. Explicitly representing the connections that exist between the information carried in the fields of HL7 messages, the RIM is essential to HL7's ongoing mission of increasing precision and reducing implementation costs.
2. A well-defined and tool-supported process for deriving data exchange specifications from the RIM. HL7 has defined a methodology and process for developing specifications, artifacts to document the models and specifications, tools to generate the artifacts and an organization for governing the overall process of standards development. Such structure avoids ambiguity common to many existing standards.
3. A formal and robust data type specification upon which to ground the RIM. Data types are the basic building blocks of attributes. They define the structural

format of the data carried in the attribute and influence the set of allowable values an attribute may assume. HL7 defines an extensive set of complex data types which provide the structure and semantics needed to describe data in the healthcare arena.

4. A formal methodology for binding concept-based terminologies to RIM attributes. Within HL7, a vocabulary domain is the set of all concepts that can be taken as valid values in an instance of a coded field or attribute. HL7 has defined vocabulary domains for some attributes to support use of the RIM in messages. It also provides the ability to use, document, and translate externally coded vocabularies in HL7 messages.

The specifications that are developed upon this foundation are documented in a progressive set of artifacts that represent varying levels of abstraction of the domain data. The artifacts go from purely abstract and universal in scope to implementation-specific and very narrow in subject matter:

- The RIM is the foundational Unified Modeling Language (UML) class diagram representing the universe of all healthcare data that may be exchanged between systems.
- A Domain Message Information Model (DMIM) is a subset of the RIM that includes RIM class clones, attributes, and associations that can be used to create messages for a particular domain (a particular area of interest in healthcare). DMIMs use HL7 modeling notation, terminology, and conventions.
- A Refined Message Information Model (RMIM) is a subset of a DMIM that is used to express the information content for an individual message or set of messages with annotations and refinements that are message specific.
- A Model Interchange Format (MIF) is an XML representation of the information contained in an HL7 specification, and is the format that all HL7 v3 specification authoring and manipulation tools will be expected to use.
- A Message Type (MT) is the specification of an individual message in a specific implementation technology.

The caAdapter APIs make use of the MIF and MT artifacts. While the HL7 standard is not implementation specific, caAdapter uses XML as its implementation technology.

The NCICB provides training resources to assist the caBIG community and other interested parties in implementing HL7 v3 messaging. These resources include online tutorials, self-paced training, and links to HL7 resources (http://trials.nci.nih.gov/projects/infrastructureProject/caAdapter/HL7_Tutorial).

About the Study Data Tabulation Model (SDTM)

The Study Data Tabulation Model, or SDTM, is a set of standards developed by the Clinical Data Interchange Standards Consortium (CDISC). It provides structured guidelines for submitting study data tabulations to a regulatory authority such as the United States Food and Drug Administration (FDA).

SDTM datasets are organized by *domains*, where each domain contains a list of *variables*. Each domain is identified by a two-letter acronym. An eight-character naming convention is used to refer to variables within a domain. An example domain is

Demographics, which is referred to by the acronym *DM*. The Demographics dataset contains variables such as patient name, patient date of birth, race, and sex.

Domains are grouped into *classes*. Domain classes include the following:

- Trial Design
- Interventions
- Events
- Findings, and,
- Special Purpose

Figure 1.3 lists SDTM Domain Classes and associated Domains.

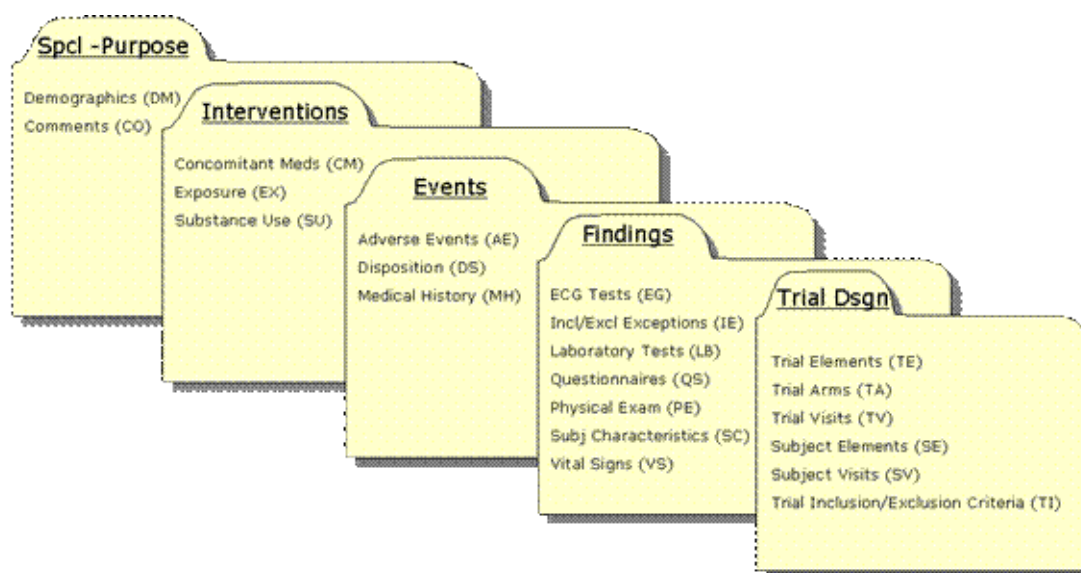


Figure 1.3 SDTM Domain Classes

SDTM dataset structures are fully defined in the guide “Study Data Tabulation Model Implementation Guide: Human Trials,” which is available from the CDISC website at (<http://www.cdisc.org>). Furthermore, SDTM datasets are defined in an XML document often referred to as the `define.xml`. This document allows submitters to define the structure of the dataset being submitted, especially the list of valid values used to validate certain variables. CDISC provides a sample `define.xml` document which was used in the implementation of the CSV to SDTM Mapping capability of caAdapter version 3.2.0.2.

About the Object and Data Model

The caAdapter v4.0 Model Mapping Service takes advantage of the caAdapter mapping infrastructure to facilitate object to database mapping. The model mapping service requires an `.xmi` file (with full Enterprise Architect (EA) roundtrip capability) that includes a data model and an object model as input. It loads all models into the tool and then users can map an object element to a data model element using drag-and-drop capability. Once the mapping is done, caAdapter 3.2.0.2 adds all SDK-required tagged values into the XMI file and saves them to the `.map` file for backwards

compatibility. After reimporting the newly tagged XMI file into EA and exporting an XMI 1.1 compatible XMI file, caCORE SDK can perform all code generation tasks.

Prerequisites for Using the caAdapter Mapping Tool

Successful use of the caAdapter mapping tool requires the following prerequisites:

- Thorough familiarity with source data
- HL7 artifacts, messages, and data types for v2 and v3
- SDTM domains, variables, and `define.xml` document
- Object and data model
- Training on the caAdapter Mapping Tool
- Familiarity with caAdapter Mapping Rules documentation.

Resources for Installing caAdapter

Complete instructions for installing caAdapter are located in the caAdapter Installation Guide at <http://ncicb.nci.nih.gov/download/downloadhl7.jsp>.

Starting the caAdapter Mapping Tool

Starting the Mapping Tool from the Binary Distribution

To launch the caAdapter Mapping Tool GUI, follow these steps:

1. In a Command Prompt window, enter `cd {home directory}` to go to your home directory (Windows example: `C:\caadapter`).
2. Enter `java -jar caadapter_ui.jar`.

The Welcome to the caAdapter screen momentarily appears, followed by the caAdapter Mapping Tool GUI.

Starting the Mapping Tool from the Source Distribution

To launch the caAdapter Mapping Tool GUI, follow these steps:

1. In a command prompt window, enter `cd {home directory}` to go to your caAdapter home directory (Windows example: `C:\caadapter`).
2. Enter `cd ..\hl7sdk`.
3. Enter `ant all`.
4. Enter `ant launchui`.

The Welcome to the caAdapter screen momentarily appears, followed by the caAdapter Mapping Tool GUI.

Starting the Mapping Tool from the Windows Distribution

To launch the caAdapter Mapping Tool GUI, select **caAdapter** from the Start menu.

Starting the Mapping Tool on the Web (WebStart)

You can also use caAdapter in your web browser by entering the following URL:

<http://cbioga101.nci.nih.gov:49080/caadapter-mms/caadapter-mms.jnlp>

Note: The Web version of caAdapter only supports the Model Mapping Services Module. Other modules will be added in future releases.

CHAPTER 2 USING CAADAPTER

This chapter provides a high-level overview for using caAdapter.

Topics in this chapter include:

- *API Process Flow for CSV to HL7 v3 Transformation* on page 15
- *API Operational Scenario for CSV to HL7 v3* on page 16
- *Mapping Tool Operational Scenario for CSV to HL7 v3* on page 17
- *Mapping Tool Operational Scenario for HL7 v2 to HL7 v3 Transformation* on page 17
- *Mapping Tool Operational Scenario for Regulatory Data Services Module* on page 18
- *Mapping Tool Operational Scenario for Model Mapping Service* on page 18

API Process Flow for CSV to HL7 v3 Transformation

This section describes the process for creating a validated HL7 v3 adverse event (AE) message, also known in HL7 as an ICSR, based on a given CSV file or set of files and a corresponding mapping specification. caAdapter uses the Transformation and Validation engine to perform different validation levels based on a user's selection: structural only, structural and vocabulary; or structural, vocabulary and schema.

The basic steps to accomplish this workflow using caAdapter are:

- caAdapter receives a CSV file, its meta file, an HL7 v3 message specification, and the mapping file that the user used to map the CSV schema to the HL7 v3 message.
- The transformation process uses the files above to create a preliminary HL7 v3 message, an internal instance, which will be put through the validation process.
- The validation process uses the internal instance of the message to perform the following validation sub-processes, (1) validation against the MIF specifications.

(2) validation against HL7 v3 published vocabulary, and, (3) validation against the schema of that HL7 v3 message type.

- caAdapter then creates the final HL7 v3 message that corresponds to the source CSV file.

Figure 2.1 illustrates the transformation and validation processes.

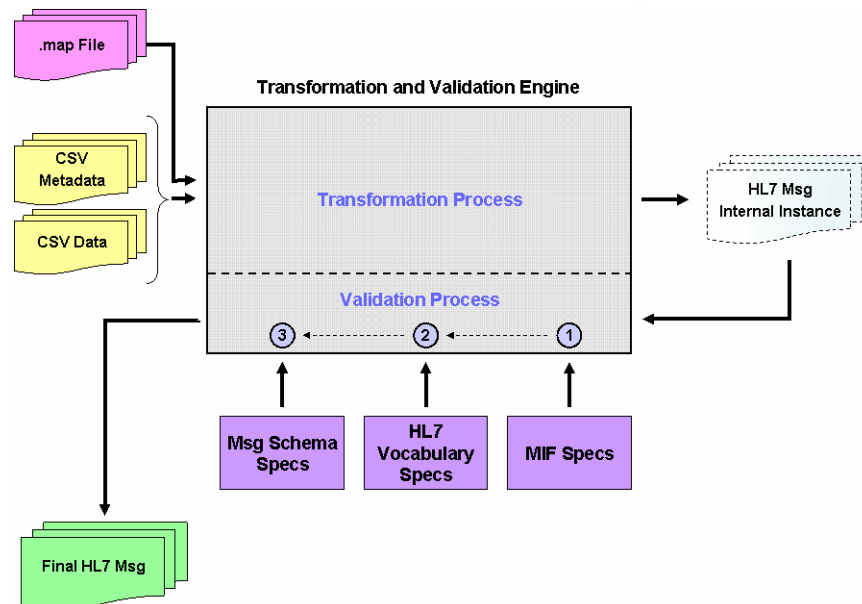


Figure 2.1 Transformation and Validation Processes

API Operational Scenario for CSV to HL7 v3

A clinical trials coordinating center is automating the receipt and routing of AE reporting from the member hospitals and clinical centers. They have researched the options and chosen to implement HL7 v3 messaging. Their hospitals are implementing the messages and the coordinating center is preparing to handle the incoming messages. They have identified the caAdapter APIs as one part of their messaging infrastructure.

When their messaging service receives an HL7 v3 message from a hospital or clinical center, it calls a caAdapter API to parse the incoming message. The parser validates the message against the appropriate XML schema description based on the message ID. It then builds an object graph in memory based on the schema definition and loads the data into the object graph. Another caAdapter API is called to validate the vocabulary used for the HL7 v3 structural attributes using the NCI's EVS. This overall process builds a caAdapter log file that the system administrator can monitor.

With the validated message content held in the object graph, the system can now perform the following:

- Generate the HL7 v3 message for rerouting to the FDA using another caAdapter API for building messages.
- Pass the caAdapter object graph in an API call to a separate persistence application where the data is stored for research/data mining and administrative purposes.

- Notify the sending system that the message was received and processed using identifying data from the object graph.

Mapping Tool Operational Scenario for CSV to HL7 v3

A research hospital has been faxing AE reports to a clinical trials coordinating center for submission to the Food and Drug Administration (FDA). Instead of using a manual effort to fill out the MedWatch 3500A form, they would like to automate and streamline the process. They have a clinical data management system (CDMS) where the necessary AE data is stored. They would like to automate the process by pulling data from this system and transforming it into an HL7 v3 message to route to the FDA. Their clinical systems analyst researched the HL7 standards and identified the correct specification to use, called the ICSR. The analyst uses the caAdapter Mapping Tool to implement this plan.

The clinical systems analyst uses the caAdapter Mapping Tool to define a file specification that describes the source file for the transformation. This source specification outlines the format of a CSV file where each line is a segment containing a logical grouping of fields. Each segment may have one or more dependent child segments to handle one-to-many relationships between logical groups of data. The analyst also uses the caAdapter Mapping Tool and the HL7 ICSR's MIF file to generate a target file specification. This specification is based on the number and types of elements in the HL7 message that are needed to support their AE data. After source and target specifications are defined, the analyst then maps source fields to target fields using caAdapter's map specification tab. The application allows the analyst to drag-and-drop CSV source fields onto HL7 target fields and use functions to manipulate the data on the way. The result of this step is that a mapping specification is generated by the caAdapter Mapping Tool. After the mapping is complete, the analyst then uses the caAdapter Mapping Tool to test the generation of HL7 v3 ICSR XML message instances using a sample CSV file obtained from the CDMS.

When this development process is complete, the caAdapter specification files and transformation APIs can be implemented as part of a message routing infrastructure to deliver AE data to the FDA in a streamlined fashion.

Mapping Tool Operational Scenario for HL7 v2 to HL7 v3 Transformation

A number of research institutes have been submitting daily electronic AE data to a clinical trials coordinating center which in turn consolidates and submits to the FDA. The data is being submitted in HL7 v2.5 format. The coordination center anticipates a new FDA requirement which mandates that all AE submissions be in HL7 v3 format. The coordination center decides that the best way to meet this requirement is to add an HL7 v2.5 to v3 data conversion step to its current FDA submission process.

Instead of manually implementing the conversion process, the coordinating center decided to use the caAdapter Mapping and Transformation tools to expedite the implementation.

The clinical systems analyst researched the HL7 v3 standards and identified the best message type to use for submitting AE data. The next step is to map the data elements

from the HL7 v3 v2.5 message currently being used, to the identified target HL7 v3 message.

The first task of the conversion and transformation process is to use caAdapter to create a CSV file and CSV file specifications that match the HL7 v2.5 source message. The second step is to use the CSV to HL7 v3 mapping and transformation capability to map the CSV data elements to the target HL7 v3 message. For more information, see the previous sections in this chapter. Once the map file has been created, caAdapter will use that to transform the data and create the HL7 v3 file.

Mapping Tool Operational Scenario for Regulatory Data Services Module

A research institute is planning the execution of a clinical trial and is in the process of reviewing reporting procedures to various regulatory entities. The results of the analysis showed that the Institute's current CTMS can satisfy all electronic reporting requirements except for the reporting and submission to the FDA. The FDA has recently introduced the SDTM set of standards which all research centers must adhere to when submitting clinical trials data. The research institute can use caAdapter's Regulatory Data Service (RDS) module to map its data, residing in CSV or relational database formats, to create the necessary SDTM datasets to help implement this new FDA requirement.

In the case where the data resides in CSV formats, the clinical systems analyst can use caAdapter's Mapping Tool to map the data elements from a CSV file to the corresponding SDTM domain data elements using drag-and-drop capability. Once the mapping is complete and a map file is created, the analyst can use the transformation service to transform the data from CSV format into SDTM dataset format.

In the case where the data resides in a relational database, the clinical systems analyst can use caAdapter's Mapping Tool to map a data element directly from the database to the proper SDTM domain(s). The caAdapter Data Viewer will help the user create the necessary SQL queries necessary to extract the data from the databases to create the SDTM datasets. Using the Data Viewer capability is optional; caAdapter automatically creates the SQL statements needed once the user completes the mapping.

Mapping Tool Operational Scenario for Model Mapping Service

In order to generate silver-level compliant software, caCORE SDK developers must first develop an object model and a data model in EA. Second, the developers must manually add tag values to associate objects to tables, associate attributes to columns, and define various associations between objects. This approach is error prone and very time consuming. The caAdapter model mapping service component can greatly automate this process by automatically loading the object model and the database. The user can map objects/attributes to tables/columns using drag-and-drop capability. Next, caAdapter will automatically add tag values to the original xmi file and create an updated one. The user then can use the updated xmi file for caCORE SDK code generation.

Users who are not using the caCORE SDK but want to map an object model to a database must develop a set of hibernate mapping files manually. The caAdapter model mapping service automates the Hibernate mapping file creation process in a

similar fashion as described in the previous scenario. After developing the object model using EA, the user can import the corresponding data model. The user can then drag-and-drop objects/attributes to tables/columns and click the “generate hibernate hbm file” button to create the necessary set of hibernate mapping files.

CHAPTER 3

CSV TO HL7 v3 MAPPING AND TRANSFORMATION

This chapter explains the procedures for using the caAdapter Mapping Tool to perform CSV to HL7 v3 mapping and transformation.

Topics in this chapter include:

- *caAdapter Mapping Tool Process Flow* on page 22
- *caAdapter Mapping Tool Common Features* on page 23
- *Source Specification* on page 27
- *Target Specification* on page 33
- *Map Specification* on page 47
- *HL7 v3 Message* on page 56
- *Transforming an HL7 Message into a CSV Format* on page 59

caAdapter Mapping Tool Process Flow

The process flow for using the caAdapter Mapping Tool (*Figure 3.1*) follows these steps:

1. Generate a CSV specification file from CSV data.
2. Generate an HL7 specification file from an HL7 MIF file.
3. Load the source specification (CSV specification) on the left side and load the target specification (HL7 specification) on the right side in the mapping tool GUI. Define mappings by drawing lines between elements of the source and target sides and save the mapping to an XML file.
4. Select the CSV data and the mapping file; the mapping engine transforms the data into an object instance based on the mapping file. caAdapter uses the object instance and builds the HL7 v3 message instance (*Figure 3.1*).

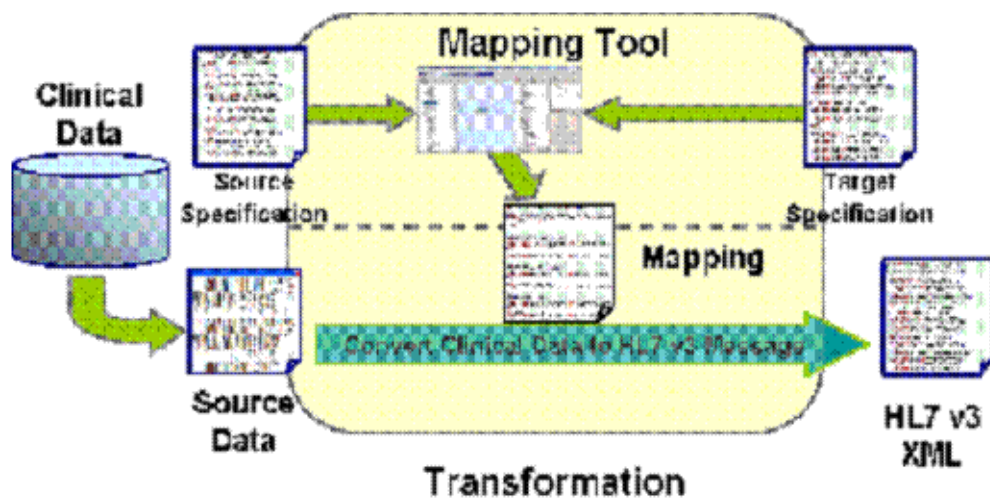


Figure 3.1 Mapping Tool Process Overview

caAdapter Mapping Tool Common Features

caAdapter Mapping Tool Interface

The caAdapter Mapping Tool interface ([Figure 3.2](#)) is Windows-based and includes a main menu bar, a tool bar, and tabs located in the top of the window. You can resize the various panels by selecting the edge of the panel and dragging. Scroll bars appear when needed to display all the information.

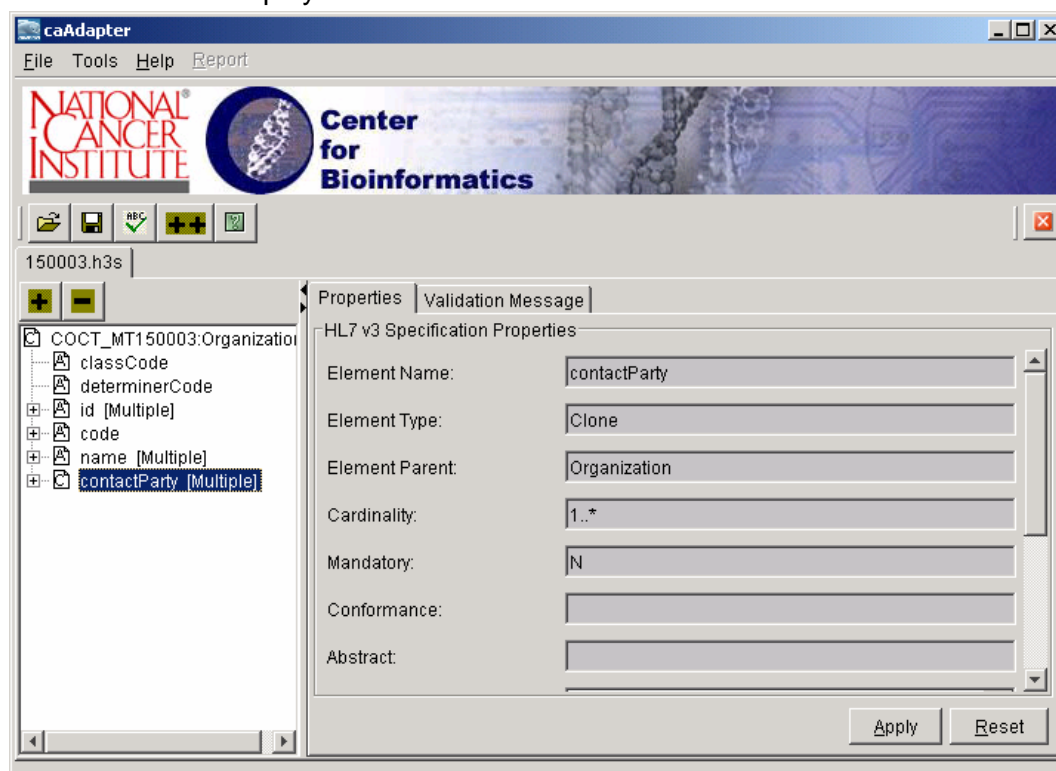


Figure 3.2 Mapping Tool Interface

Menu Bar

The menu bar is context-sensitive. Only the options that are available for your current window appear in black font; unavailable options appear in a faded gray font. For example, the Report option is unavailable in [Figure 3.2](#) since it is not available for the .h3s file.

The menu bar includes the File, Report, and Help commands. The following subsections discuss each command.

File Command

The File command enables you to perform the functions in [Table 3.1](#).

File Option	Description
New	<p>Creates a new file for the type of file you select including:</p> <ul style="list-style-type: none"> • CSV to HL7 v3 Mapping and Transformation Service • CSV Specification • HL7 v3 Specification • CSV to HL7 v3 Map Specification • HL7 v3 Message • HL7 V3 to CSV Transformation Service • HL7 V3 To CSV <ul style="list-style-type: none"> • HL7 v2 to HL7 v3 Mapping and Transformation Service • HL7 V2 to SCS & CSV Conversion • HL7 v3 Specification • CSV to HL7 v3 Map Specification • HL7 v3 Message • RDS Mapping and Transformation Service • CSV Specification • CSV/Database to RDS Map Specification • RDS Text File • Model Mapping Service • Object to Database Map Specification
Open	<p>Opens an existing file for the type of file you select including:</p> <ul style="list-style-type: none"> • CSV Specification • HL7 v3 Specification • CSV to HL7 v3 Map Specification • CSV to SDTM Map Specification • Object to Database Map Specification
Save (CTRL + S)	Saves the file you are currently working on (in the selected tab).
Save as	Opens a Save as dialog box to allow you to save the file to another file name.
Validate	Validates the file you are currently working on in the selected tab.
Close (CTRL + F4)	Closes the file you are currently working on in the selected tab. The following Data Changed message appears if you have not saved your work: <i>Data has been changed but is not saved. Would you like to save your changes?</i> Select Yes , No , or Cancel .
Close all	Closes all open files.
Exit (ALT + F4)	Closes the caAdapter Mapping Tool.

Table 3.1 File menu commands

Report Command

The Report command currently allows you to generate reports for CSV and map specifications and for CSV to SDTM map specifications.

Help Command

The Help command displays information about caAdapter and online help Contents and Index options.

caAdapter Toolbar

The caAdapter toolbar is context sensitive. The toolbar displays only the options that are available for your current window. [Table 3.2](#) describes each of the available toolbar buttons. These serve as shortcuts for specific menu commands.







Button	Description
	Opens a new file of the type of file that is currently open.
	Saves the file that is currently open.
	Closes the tab that is currently open.
	Validates the file that is currently open.
	Refreshes the mapping panel. It is only visible if it is on the mapping panel.
	Opens the Help window.

Table 3.2 Toolbar buttons

The caAdapter Mapping Tool uses a document-oriented paradigm where up to four files of different types can be open at the same time, each within its own tab in a single window. The four different types of tabs are:

1. CSV specification
2. Map Specification (CSV to HL7 v2, CSV to SDTM, and Object to Database)
3. HL7 v3 Specification (.h3s, xml)
4. HL7 v3 Message / CSV data file

In some cases, only one of each file type may be open at a time. If you open a new file of a file type that is restricted and already open, then the existing file will be replaced with the new file. The tab name displayed is the name of the file in the tab (for example, 040011.h3s as shown in [Figure 3.2](#)) or it is labeled `untitled.<ext>`, where `<ext>` is the appropriate file extension for that type of tab. The window layout changes depending on the type of tab displayed. For example, the HL7 v3 specification tab displays a tree structure in the left-hand panel and the properties and validation messages in the right-hand panel.

caAdapter Mapping Tool Validation

The caAdapter Mapping Tool shows validation information on some of its tabs. (Further types of validation will be provided in later releases.)

Validation is used to

- Validate the given specification to ensure it is technically correct before continuing onto the next step.
- Provide a user-friendly method to report errors so you can correct them.
- Provide reminder notes on the process (information messages).

The results of the validation appear in the Validation Messages panel ([Figure 3.3](#)). The panel displays only one level of message at a time.

From this panel you can do the following:

- Change the Message Level by selecting a different level from the drop-down list.
- Click **Save** to save the messages to a file.
- Click **Print** to send the messages to your printer.
- Select a message to display the full content of the selected message in a panel below the Validation Messages panel ([Figure 3.3](#)).

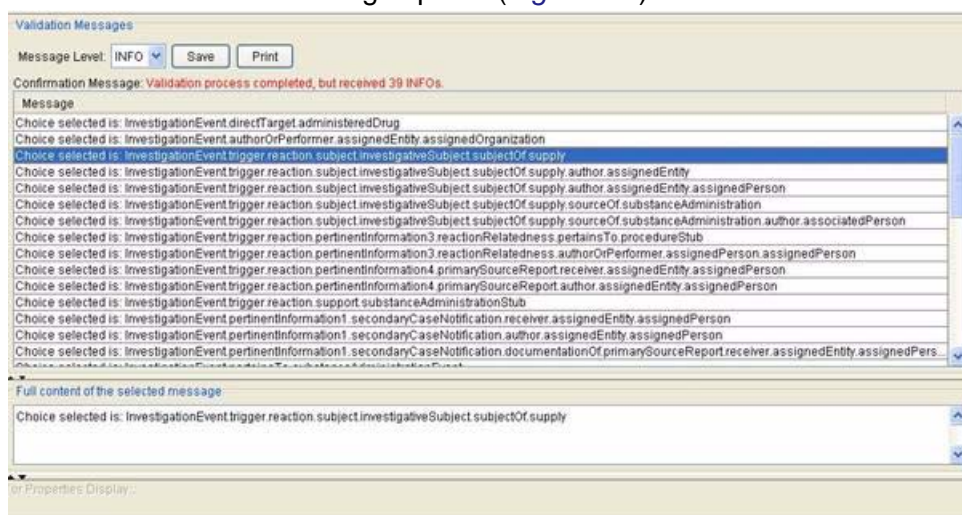


Figure 3.3 Validation Messages Panel

[Table 3.3](#) lists and describes the different levels of messages produced during validation. It also gives examples.

Message Level	Description	Example
FATAL	The process leads the application into an unrecoverable situation where the application itself has to halt the process instead of moving forward.	A file with a wrong file type is given to the map specification module and it does not know how to open the file.

Table 3.3 Validation Messages

Message Level	Description	Example
ERROR	The process leads the application into a recoverable situation with serious issues that require your attention. It is better if these errors are resolved before proceeding or you could receive partial or incorrect results.	The CSV data does not match a given specification.
WARNING	The process leads the application into a recoverable situation with medium level issues that won't prevent the application from proceeding further. However, it may require your attention to resolve them so the process will generate the expected results.	Not all segments and fields within the CSV specification have been mapped to the HL7 v3 specification.
INFO	Contains information, such as tips, suggestions, reminders, etc. You can simply ignore them if you want to.	Contains the choice selected for an element.

Table 3.3 Validation Messages (Continued)

Source Specification

Segmented CSV Specification

Business Rules

Following are the business rules for a segmented CSV specification:

- Two or more segments cannot have the same name.
- Two or more fields cannot have the same name in same segment (case-insensitive).
- Segment names must be a combination of any letters (A-Z) in CAPITAL letters, numbers, or the underscore character.
- Field names must be a combination of any letters (A-Z or a-z), numbers, or the underscore character.

About the CSV Specification Tab

The CSV Specification tab ([Figure 3.4](#)) enables you to identify the hierarchy of segments and fields that describe an incoming CSV data file that must be converted into one or more HL7 v3 XML messages. The tree structure appears in the left-hand panel, and the validation results and properties appear in the right-hand panel.

The tree structure displays the hierarchy of segments and fields that represent the way data in the source CSV files are organized. Using the tree structure, you can drag and drop an element to another location in the tree. You can also expand and collapse a

branch of the tree using the plus (+) and minus (-) symbols. The Properties section in the right panel allows you to work with the metadata on the left.

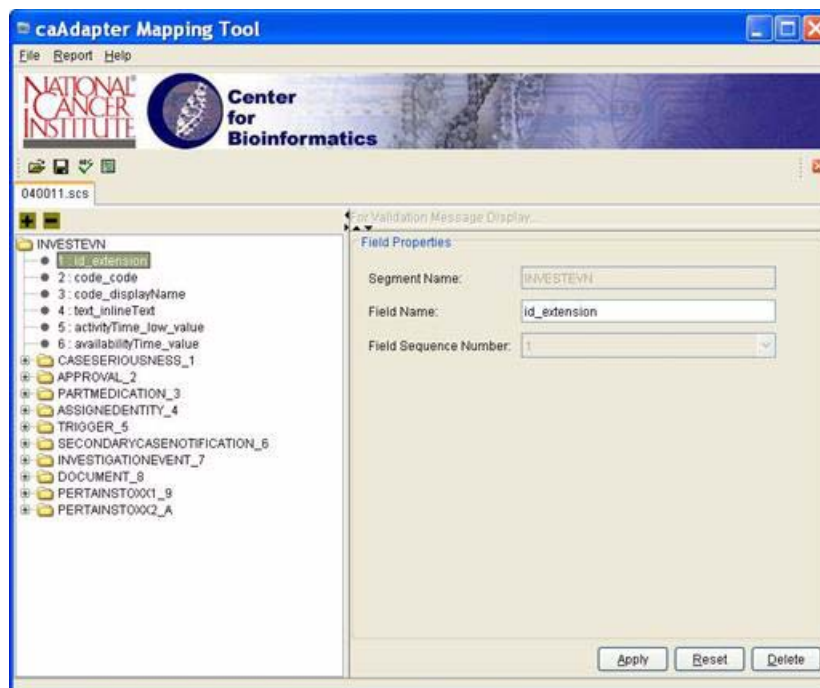


Figure 3.4 CSV Specification Tab

The following sections describe how to access, update, validate, and save the CSV specification.

Creating a New CSV Specification File

To create a new CSV specification file, follow these steps:

1. Select the following menu commands:
File > New > CSV to HL7 v3 Mapping and Transformation Service > CSV Specification

The New CSV Specification dialog box appears.

2. Select one of the following sources, then follow the appropriate steps:

Source	Steps
Blank CSV Schema	Click OK to open the CSV Specification file named <code>Untitled_1.scs</code> . The file opens in a new tab with an empty tree, except for an initial root segment named ROOT (by default).
Generate from a CSV Instance	<ol style="list-style-type: none"> Click Browse to display the Open CSV File dialog box. Select the appropriate <code>.CSV</code> data file, then click Open. The New CSV Specification dialog box opens and displays the file. Click OK. A new tab named <code>Untitled_1.scs</code> opens and displays the contents of the selected file.
New from an Existing CSV Specification File	<ol style="list-style-type: none"> Click Browse to display the Open CSV Specification dialog box. Select the appropriate <code>.scs</code> file, then click Open. The New CSV Specification dialog box opens and displays the file. Click OK. A new tab named <code>Untitled_1.scs</code> opens and displays the contents of the selected file.

Table 3.4 Selecting a Source

Opening an Existing CSV Specification File

To open an existing CSV Specification file, follow these steps:

1. Select the following menu commands:

File > Open > CSV Specification

This displays the Open CSV Specification dialog box.

2. Select the appropriate `.scs` file, then click **Open**.

A new tab opens with the CSV Specification file displayed in the tree.

Updating the CSV Specification

1. Once you have a CSV Specification file open, you can perform the following basic functions to update the tree hierarchy. Update any default field names to have meaningful names.

- a. Click a segment in the tree structure to display the details of that element in the **Segment Properties** section ([Figure 3.5](#)).

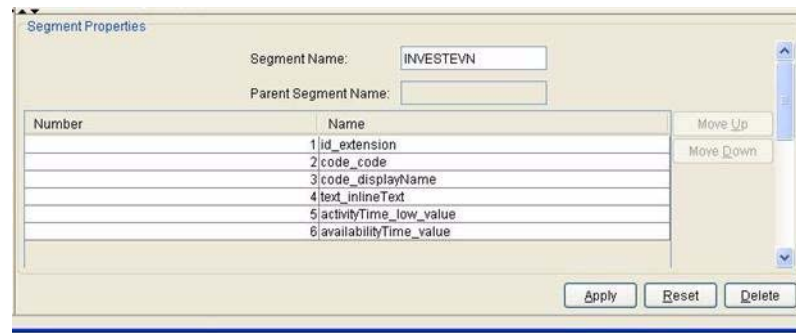


Figure 3.5 Segment Properties

- b. Click the **Move Up** and **Move Down** buttons to re-arrange the sequence of the fields displayed under the given segment. By default the **Move Up** and **Move Down** buttons are both disabled unless you select any element in the field list (they are enabled in [Figure 3.5](#) because **id_extention** is selected). Select a number/name row and click the **Move Up** or **Move Down** button until you have the fields arranged correctly. Click **Apply** to update the tree structure.
- c. Edit the **Segment Name** and click **Apply** to update the tree in the left-hand panel.
- d. Right-click a segment to get the options available to perform on that segment ([Figure 3.6](#)).



Figure 3.6 CSV segment right-click options

- e. Right-click and select **Add Segment** to display the **Add Segment** dialog box. Enter the **CSV segment name** and click **OK**. The segment is added to the tree structure.
- f. Right-click and select **Add Field** to display the **Add Field** dialog box. Enter the **CSV field name** and click **OK**. The field is added to the tree structure.
- g. Right-click and select **Edit** to display the **Edit** dialog box. Edit the **CSV segment name** and click **OK**. The segment name is changed in the tree structure.
- h. Select one or more segments, right-click and select **Delete** to display the **Confirmation** dialog box. Click **Yes** or **No**. The segment name(s) are deleted from the tree structure.

- Click on a field in the tree structure, to display the details of that element in the **Field Properties** section (*Figure 3.7*).

The image shows a 'Field Properties' dialog box. It contains three labeled input fields: 'Segment Name' with the text 'INVESTEVN', 'Field Name' with the text 'code_displayName', and 'Field Sequence Number' with the value '3'. Below these fields, at the bottom right of the dialog, are three buttons: 'Apply', 'Reset', and 'Delete'.

Figure 3.7 Field Name metadata properties

- Edit the **Field Name** and click **Apply** to update the tree in the left-hand panel.
- Right-click a field to get the options (**Edit**, **Delete**) available to perform on that field.
- Right-click and select **Edit** to display the **Edit** dialog box. Edit the **field name** and click **OK**. The field name is changed in the tree structure.
- Select one or more fields, right-click and select **Delete** to display the **Confirmation** dialog box. Click **Yes** or **No**. The field name(s) are deleted from the tree structure.
- Drag-and-drop a field or segment to another area in the tree to rearrange the tree contents. Moving a segment takes its complete sub-tree with it. You may not drag-and-drop the root segment; it must remain as the root, but its fields may be moved. The cursor indicates when the field or segment can be dropped.
- Use the **Reset** button to reset changes made before selecting **Apply**.
- Use the **Delete** button to delete an element from the tree.

Validating the CSV Specification

Once you are satisfied with the CSV specification, you can validate it by performing the following steps.

1. Select **File > Validate** or select the Validate icon from the tool bar to display the Validate dialog box (*Figure 3.8*).

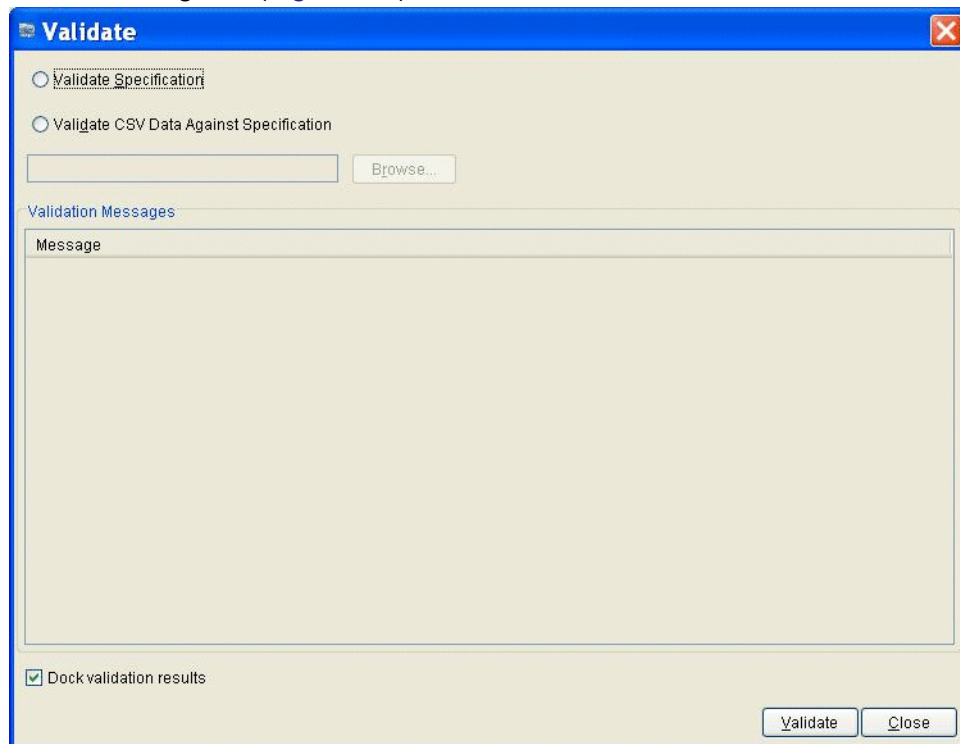


Figure 3.8 CSV Validate options

2. Select one of the following:
 - a. To validate the specification, click **Validate**.
 - b. Or select **Validate CSV Data Against Specification** to test a CSV data file against the specification. Click **Browse** to display the Open CSV File dialog box. Select the appropriate .CSV file and click **Open**. Click **Validate**.
3. The **Dock validation results** check box is automatically selected so that the messages are displayed in the right-hand panel, after the validation dialog is closed. The read-only validation messages appear. See *caAdapter Mapping Tool Validation* on page 25 for more information on using the validation messages.

Saving a CSV Specification

When you are finished working on the CSV specification, do the following:

- From the menu bar, select **File > Save** or **File > Save As**.
- or

Click the **Save** icon on the tool bar.

This creates an XML-like file describing the tree structure. This file is portable and available for your or another user's future use.

Generating a Report

When the CSV Specification tab is selected, you can export the CSV specification to an Excel spreadsheet by performing the following steps.

1. Select **Report > Generate Report** from the menu bar to display the Select File to Save Generated Report dialog box.
2. Enter a file name and click **Save**. A “Report has been successfully generated” message appears.

A part of a generated CSV report is shown in [Figure 3.9](#).

Segment Name	Field 1	Field 2	Field 3	Field 4
INVESTEVN	id_extension	code_code	code_displayName	text_inlineText
CASESERIOUSNESS_1	code_code	code_displayName	value_code	value_displayName
APPROVAL_2	id_extension	effectiveTime_low_value		
TERRITORY_21	code_code	code_displayName		
GOVERNINGAGENCY_22	id_extension	name_inlineText	name_suffix	
PLAYINGMANUFACTURER_23	id_extension	code_code	code_displayName	name_inlineText
PARTMEDICATION_3	code_code	code_displayName	name_inlineText	name_suffix
ASSIGNEDENTITY_4	code_code	code_displayName		
REPRESENTEDSCOPINGORGANIZATION_41	code_code	code_displayName	name_inlineText	name_suffix
ASSIGNEDORGANIZATION_42	id_extension	code_code	code_displayName	name_inlineText
TRIGGER_5	priorityNumber_value			
REACTION_51	code_code	code_displayName	text_inlineText	effectiveTime_value
INVESTIGATIVESUBJECT_511	id_extension			
SUBJECTAFFECTEDPERSON_5111	name_family_in	name_given_in	name_suffix_in	telecom_value

Figure 3.9 Part of a generated CSV report

Target Specification

HL7 v3 Specification

Business Rules

Following are the business rules for the HL7 v3 specification:

- Abstract data types must be specialized.
- A choice must be selected on choice options.
- If an element's cardinality is one then it must have either a default value or a mapping.
- If an element's cardinality is greater than one then you have a choice to add multiple fields.
- Only mandatory clones are included when a new HL7 v3 specification is first created. Optional clones may be added.
- nullFlavor field is optional.
- Address data types are only enabled with a pre-defined subset of its data fields. All other data fields can be optionally added or removed.

Step-by-Step Instructions

This section contains the detailed instructions on how to use the mapping tool to create or update an HL7 v3 specification.

Overview of HL7 v3 Specification Tab

The HL7 v3 specification tab ([Figure 3.10](#)) allows you to identify the hierarchy of elements needed for your data based on what is available in the predefined structure of

an HL7 v3 message type. You update the basic specification to reflect your specific requirements, such as adding multiples of fields with a cardinality of greater than one, including or excluding clones, defining concrete data types for abstract ones or selecting choice options.

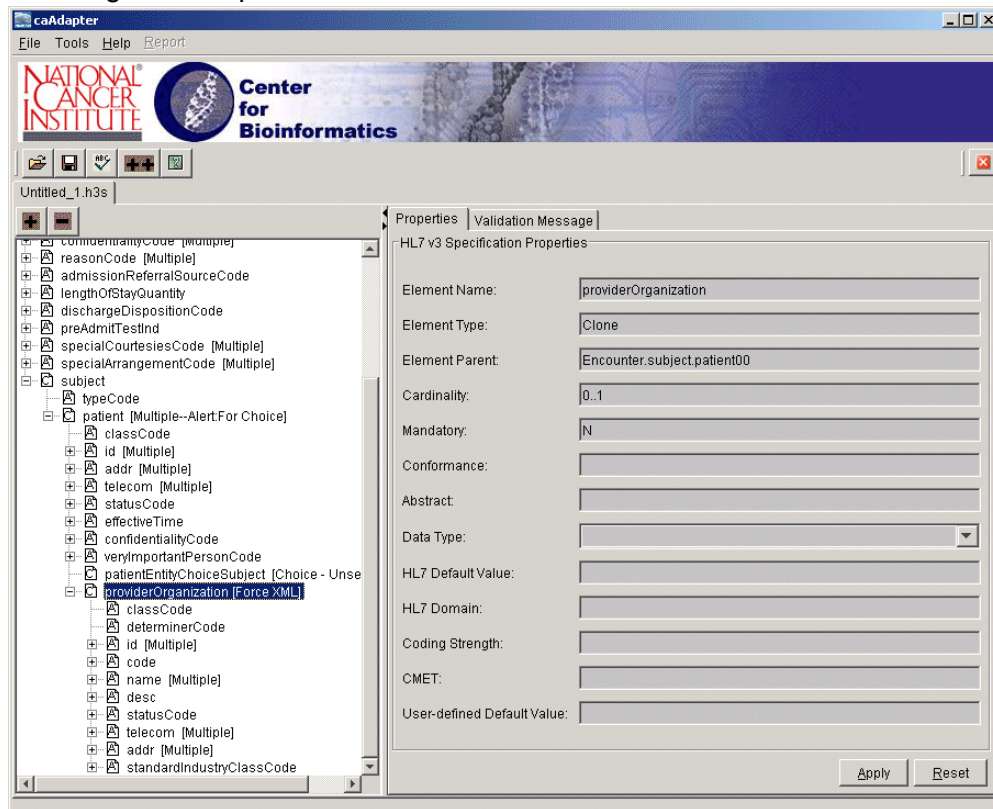


Figure 3.10 HL7 v3 Specification tab

The HL7 v3 specification tab separates the tree structure in the left-hand panel from the properties and validation messages in the right-hand panel. The tree structure displays the hierarchy of elements that represent the way data in the .h3s files are organized. The elements are designated as follows:

- **C** - Clone
- **A** - Attribute
- **D** - Data Type

Typical features of the tree structure are used, such as the ability to expand and collapse a branch of the tree using the + and - symbols respectively. The properties panel allows you to update some information such as the user-defined default value for a given data type field or to select a concrete data type for a given Attribute. Right-click

on an element to display the available actions as shown in the submenu in *Figure 3.11*. The available options are regular font.

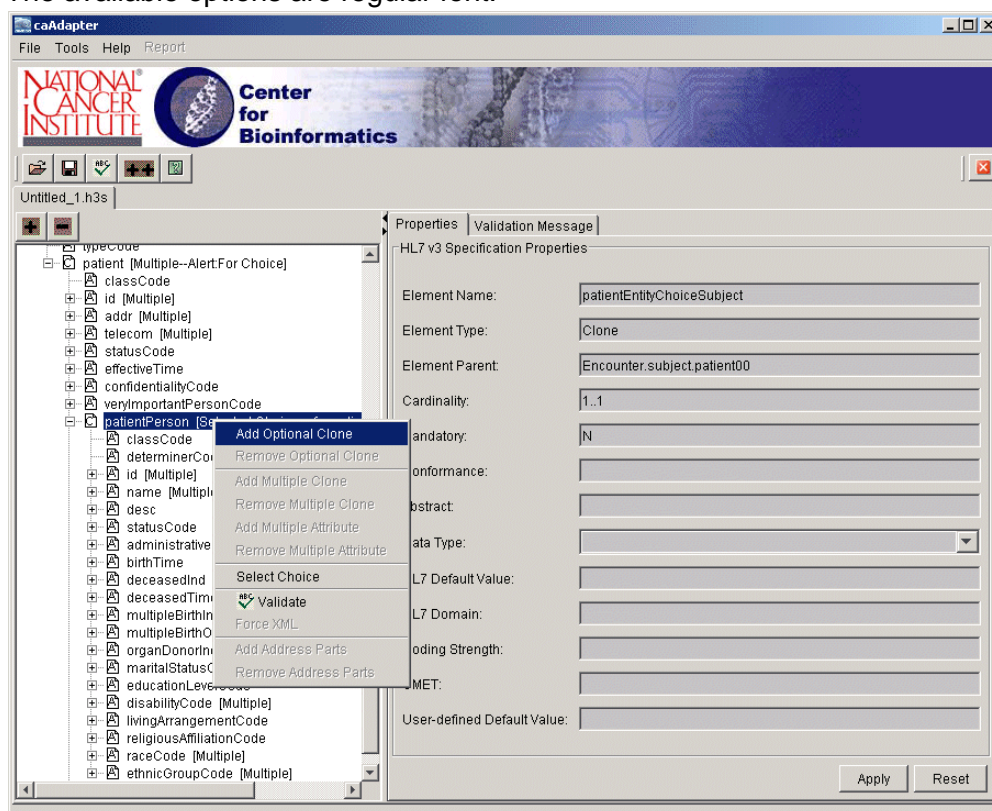


Figure 3.11 Options for HL7 v3 elements

The following sections describe how to create, update, validate, and save the HL7 v3 specification.

Creating and Opening an HL7 v3 Specification

You must either create a new or open an existing HL7 v3 specification. The following steps describe how to create a new HL7 v3 specification.

1. Select **File > New > CSV to HL7 v3 Mapping and Transformation Service > HL7 v3 Specification** to display the **HL7 v3 Specification** dialog box with valid message types.

2. Select the appropriate HL7 message category and message type from the drop-down lists (*Figure 3.12*) and click **OK**.

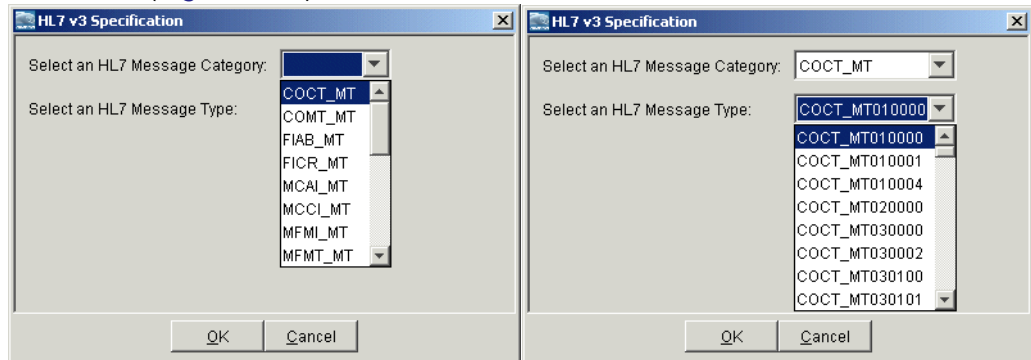


Figure 3.12 Example HL7 v3 message types

Currently, the mapping tool supports all message types as defined by HL7 standards

3. A new HL7 v3 specification tab displays with the name `untitled_1.h3s`.

To open an existing HL7 v3 specification, select **File > Open > HL7 v3 Specification (.h3s)** or **File>Open >HL7 V3 Specification (.xml)** to display the **Open HL7 v3 Specification (H3S) File** dialog box. Select a **File name** to open and click **OK**. The HL7 v3 specification displays in a tab with the name of the file and its extension.

Defining Inline Text

The data type field named **inline Text** is caAdapter's way of referring to text that appears between XML tags as opposed to being a value assigned to an XML attribute. The names of data types designed with inline Text fields are configured within the `caadapter.properties` file under the item: `caadapter.hl7.attribute.inlinetext.required`. The data types of address parts and name parts are assigned as system default. Any other data type may be added in. For example, in the following XML, "Rockville" is the inlineText: `<city>Rockville</city>`. But in the following XML, "WP" is the value for an XML attribute: `<addr use="WP">`. Enter the required text for such an attribute in the **User-defined Default Value** field.

Defining Units of Measure

Some HL7 v3 data types contain units of measure properties. These units of measure must match those specified in the Unified Code for Units of Measure (UCUM). The UCUM is a code system intended to include all units of measure being contemporarily used in international science, engineering, and business. For a complete list, see <http://aurora.regenstrief.org/UCUM/ucum.html>.

Defining Default Data

User-defined default values are pre-defined constants for data type field values. These defaults allow you to assign values for data type fields that may not be available from the source data. For example, if the root for all user ids is common across the organization, this value can be entered in the target specification. HL7 structural

attributes and other elements that have their values fixed by the HL7 v3 standard cannot have user-defined default values.

User-defined default values are overridden by values mapped from a data source. While required attributes should always be populated with either an HL7-defined or user-defined default value, optional ones are only populated when a map is present for that data type. [Table 3.5](#) shows the expected behavior for attributes that are mapped with a CSV value, mapped with a null CSV value and unmapped data types.

	<i>Mapped to Non-Null Field</i>	<i>Mapped to Null Field</i>	<i>Unmapped</i>
Optional	CSV Value	Default Value	Element not created unless other sibling fields are mapped
Optional (Force XML)	CSV Value	Default Value	Default Value
Required	CSV Value	Default Value	Default Value
Mandatory	CSV Value	Default Value	Default Value

Table 3.5 Default value behavior

“Optional” means that the element is optional in the target message. It is not required if it has not been mapped.

“Optional (Force XML)” means that the element is optional in the HL7 MIF specification, but it is required by the user to create an empty element with a default value.

“Mandatory” means that the value may not be NULL, unless its container (clone, attribute, etc.) is NULL. Required means values must be supported but they may be NULL.

Defining Object Identifiers (OIDs)

HL7 v3 artifacts use OIDs to identify coding schemes and identifier namespaces. A full list of HL7 assigned OIDs, and the details of the registered schemes, is available from the **OID Registry** page of the www.hl7.org web site (**Members Only** section). There are two types of OIDs that can be used within an HL7 message:

1. HL7 OIDs
2. Existing OIDs

In HL7, OIDs are assigned within the appropriate branch of the HL7 OID root (2.16.840.1.113883). If you are interested in assigning an OID to a scheme, be sure to check that the scheme you are assigning does not already have an OID assigned to it within the HL7 OID hierarchy. The process of registering an existing OID with HL7 involves adding an OID and its descriptive data to a central registry. The OID does not have to be within the HL7 root OID or any other specific root or branch OID. Once a scheme has been registered, no other OIDs that identify the same scheme can be registered.

Examples of OIDs used in HL7 are:

- Coding schemes created by professional bodies that are intended to be used widely. For example, Systematized Nomenclature of Medicine (SNOMED), Logical Observation Identifiers, Names and Codes (LOINC), International Classification of Diseases (ICD), etc. need to be registered by HL7 International.
- Civil namespaces. Identification schemes such as driver's license, social security numbers need to be registered by the appropriate HL7 Affiliate.
- In the HL7 v3 specification, when you have a codeSystem data type field, you must assign the OID in the User-defined Default Value field ([Figure 3.13](#)) or you must have a map.

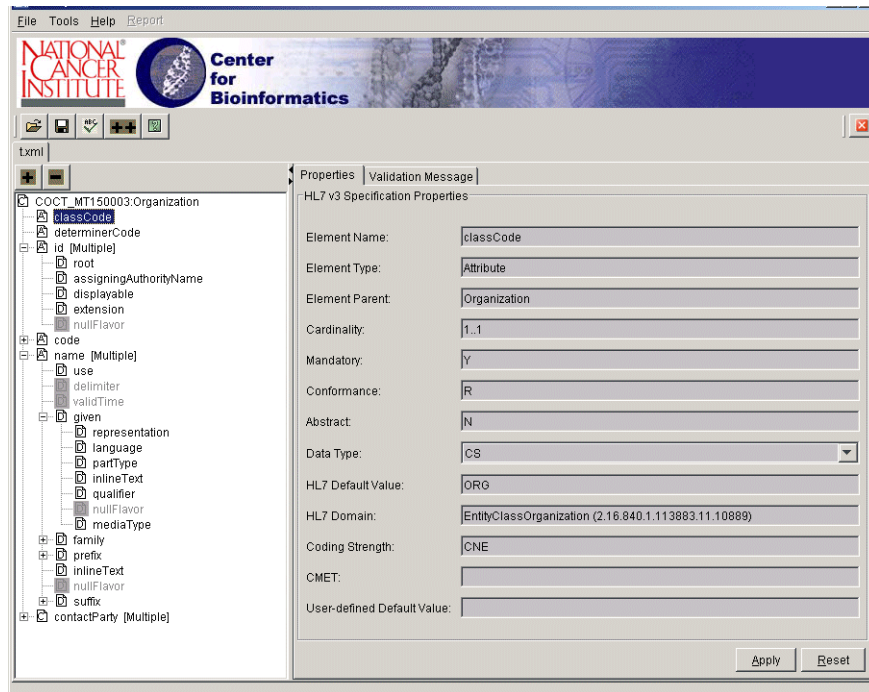


Figure 3.13 OID entered in the User-defined Default Value field

Adding Clones to the HL7 v3 Specification

The ability to add or remove a clone is the way the caAdapter Mapping Tool accommodates optional associations in an HL7 message. Due to the size and complexity of numerous associations, nodes are initially created in the tree for mandatory associations only. You must customize the HL7 v3 specification to include the associations that are needed for your particular mapping plans by using the **Add Clone** and **Remove Clone** options.

Perform the following steps to add associations or expand one recursive child generation at a time.

1. Right-click an element name with an optional or recursive relationship and select **Add Clone**. The **Clone List** dialog box appears (*Figure 3.14*).

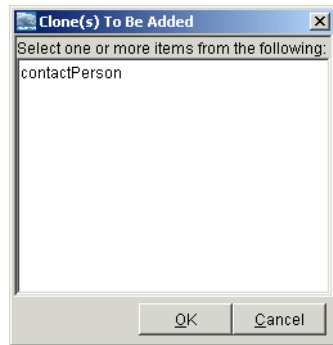


Figure 3.14 Clone List dialog box

2. In the Clone List dialog box, select one or more of the unused clones and click **OK**. The corresponding nodes are added to the tree in the left-hand panel.
3. There may be further optional associations available on the new clones just added. This is the case with a recursive association, where you could continue adding recursive levels to an arbitrary level as needed by using Add Clone.

Perform the following steps to remove clones.

1. Right-click on an element name with an optional or recursive relationship to its parent and select **Remove Clone** to display the **Clone List** dialog box.
2. In the **Clone List** dialog box, select one or more of the unused clones and click **OK**. The corresponding nodes are deleted from the tree in the left-hand panel.

Adding and Deleting Multiples to the HL7 v3 Specification

Message elements that have either a cardinality of 0..* or 1..* and/or a data type that involves a collection (for example, SET, BAG, LIST) contain the **[Multiple]** label. The **[Multiple]** label is displayed as a numbered label to indicate the number of elements defined for that multiple (for example, **[1]**, **[2]**, etc.). These items appear in the HL7 v3 specification as simple repeats of the element. To accommodate the possible requirement of mapping more than one source element to the same target element, you must add multiples of these elements.

Perform the following steps to add multiple clones.

1. Right-click a clone that contains a **[Multiple]** label (or a **[1]** label, which is the first of this group of multiple clones) and select **Add Multiple Clone** (Figure 3.15).



Figure 3.15 HL7 v3 specification multiple clones

Another element is created and the label is changed to the number of elements created.

Perform the following steps to remove multiple clones.

1. Right-click a clone with the **[xx]** label (where xx is a number greater than one), indicating that it is a replicated clone, the **Remove Multiple Clone** is enabled, select **Remove Multiple Clone**. See Figure 3.15. One multiple of the element is removed from the tree structure.
2. Perform the following steps to add multiple attributes.
 - a. Right-click an attribute with the **[1]** label, indicating that it is a replicated attribute. The **Remove Multiple Attribute** is enabled.

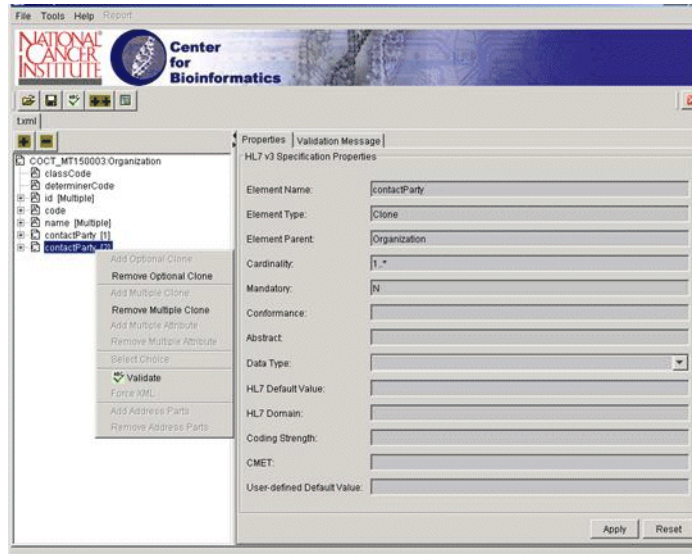
b. Select **Remove Multiple Attribute** (Figure 3.16).

Figure 3.16 HL7 v3 specification multiple attributes

Another element is created and the label is changed to the number of elements created.

Perform the following steps to remove multiple attributes.

1. Right-click an attribute with the **[1]** label, indicating that it contains multiple numbered labels, and select **Remove Multiple Attribute**.
2. One multiple of the attribute is removed from the tree structure.

If a clone contains one or more child choice associations, it is always enabled with “Adding and Deleting multiple clone” without influencing its cardinality. This feature is implemented to support more than the possible chosen item for the child choice associations. Figure 3.17 and Figure 3.18 show that the patient is a clone with a cardinality of 1..1, but is enabled with “Add Multiple Clone” and “Remove Multiple Clone” actions.

Another element is created and the label is changed to the number of elements created.

Perform the following steps to remove multiple attributes.

1. Right-click on an attribute with the **[1]** label, indicating that it contains multiple numbered labels, and select **Remove Multiple Attribute**.
2. One multiple of the attribute is removed from the tree structure.

If a clone contains one or more child choice associations, it is always enabled with “Adding and Deleting multiple clone” without influencing its cardinality. This feature is implemented to support more than the possible chosen item for the child choice associations. Figure 3.17 and Figure 3.18 show that the patient is a

clone with a cardinality of 1..1, but is enabled with “Add Multiple Clone” and “Remove Multiple Clone” actions.

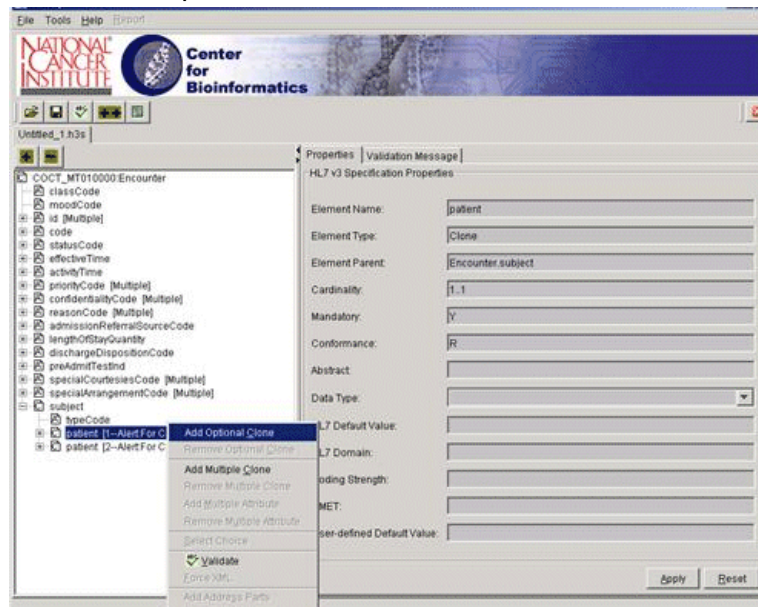


Figure 3.17 Clone with one or More Child (Patient 1)

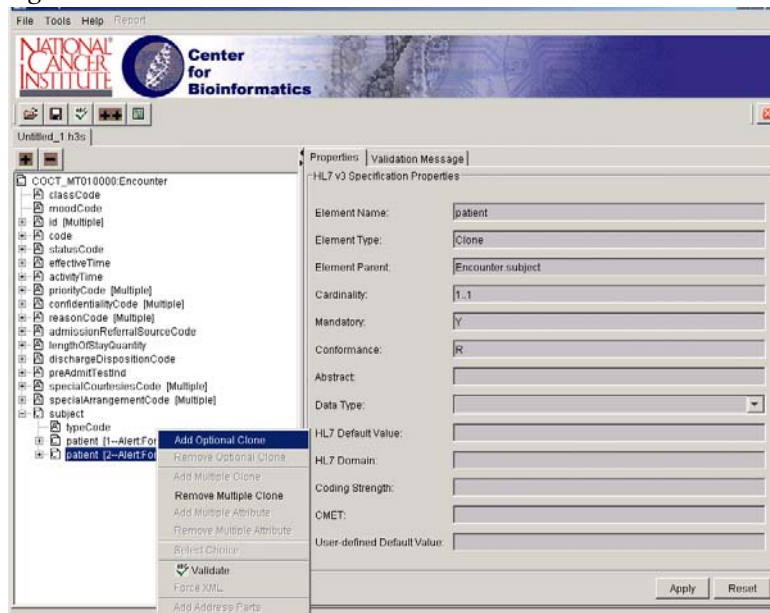


Figure 3.18 Clone with one or More Child (Patient 2)

Updating Abstract Data Types in the HL7 v3 Specification

Abstract data types occur when HL7 message developers do not specify a particular data type to use when populating attributes and are indicated by a **[QTY]** or **[ANY]** label in an HL7 v3 specification. You must assign a specialized data type to the abstract element by performing the following steps.

1. Select the element name in the left-hand panel to display its properties in the **HL7 v3 Specification Properties** panel.

2. Use the drop-down list in the **Data Type** field ([Figure 3.19](#)) to select the data type. Click **Apply**.

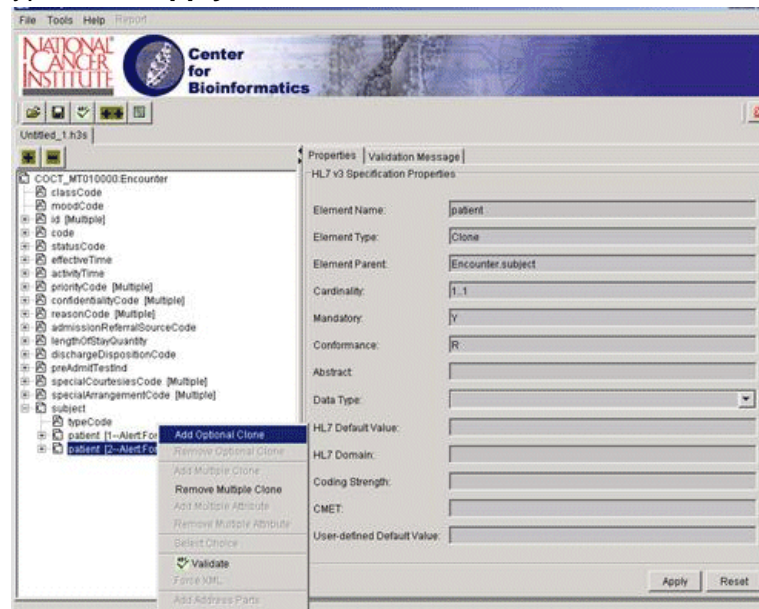


Figure 3.19 Data Type drop-down list

After assigning a concrete data type with an abstract data type, the system will retrieve the data fields of the assigned data type and attach those to the original attributes accordingly. Repeat steps 1 and 2 above if you need to change a different concrete data type.

Using Choice Boxes in the HL7 v3 Specification

HL7 choice boxes pose a challenge in the representation of options in a mapping tool. Currently, the caAdapter Mapping Tool's implementation limitation for choice boxes is the ability to choose only a single option to which all logical records in the source file may be mapped. The presence of a choice is indicated with a **[Selected Choice]** or **[Choice Unselected]** label.

Perform the following steps to make a choice selection for an element.

1. Right-click an element name that contains a **[Choice - Unselected]** label and select **Select Choice** to display the **Clone List** dialog box.
2. Select one and only one clone from the displayed list and click **OK**. This creates an expandable node with the **[Selected Choice for]** label displayed beside the parent clone node ([Figure 3.20](#)).

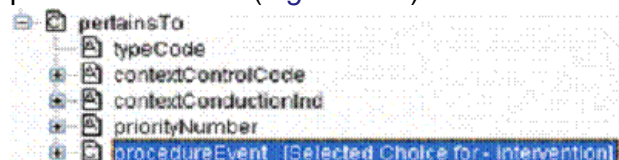


Figure 3.20 Selected choice

Note: Since a business rule for an HL7 v3 specification specifies a choice must be selected, there is no option to unselect a choice. However, if the parent association is optional, the association can be dropped and re-added.

Enabling and Disabling Force XML with an Optional Clone

If a clone is optional for the target message specification, right click the tree node to make **Enable Force XML** active (*Figure 3.21*).

If a clone is optional for the target message specification, and it has been enabled, right click the tree node to enable **Disable Force XML**. **Enable Force XML** or **Disable Force XML** will inform the HL7 message transformation engine whether or not to create an empty element if no mapping has been set (*Figure 3.22*).

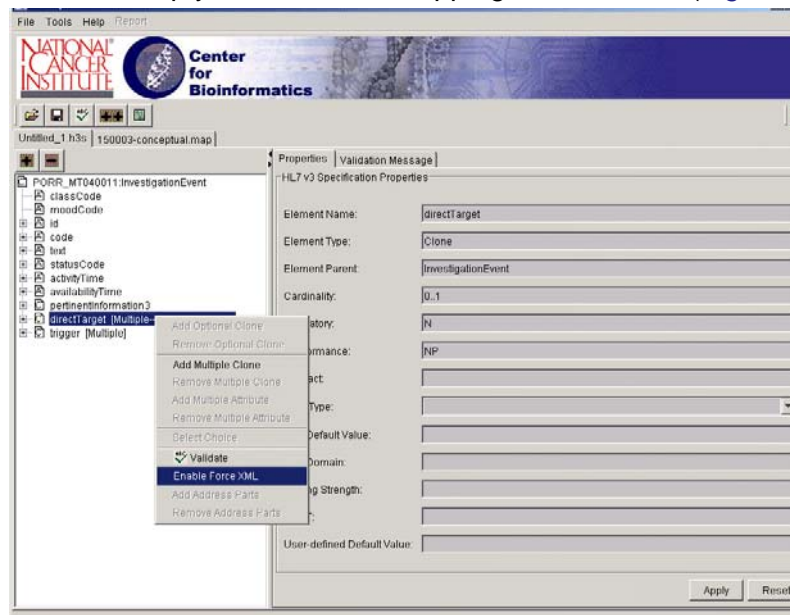


Figure 3.21 Enable Force XML

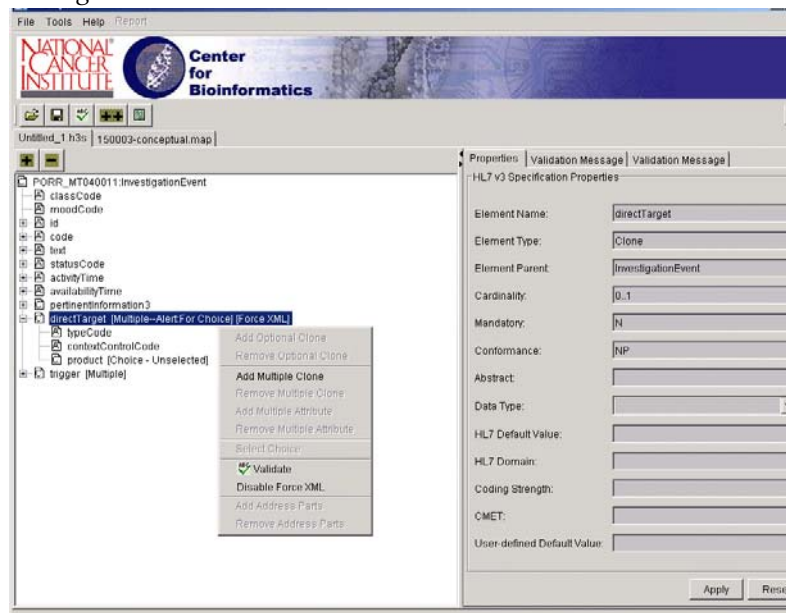


Figure 3.22 Disable Force XML

Adding and Removing Parts of an Address Data Type

If the system has predefined a subset of data fields for an attribute with an Address data type, other data fields can be added or removed (*Figure 3.23* and *Figure 3.24*).

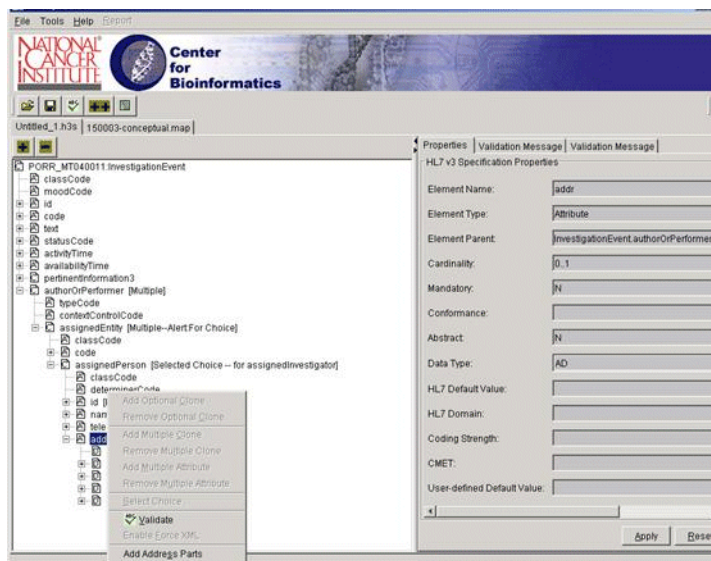


Figure 3.23 Adding or removing parts of an Address data type

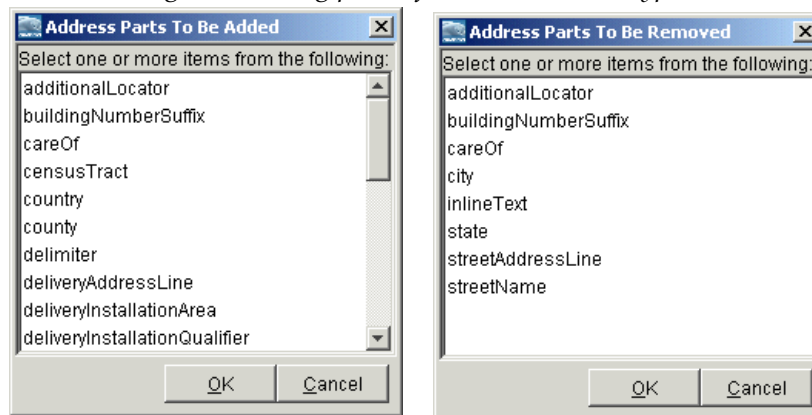


Figure 3.24 Modifying an Address data type

Validating the HL7 v3 Specification

You can validate a portion of or the entire HL7 v3 specification. A clone must be selected to perform the validation. The validation is performed on the selected clone and any children and further descendants below it in the tree structure.

To validate the HL& v3 specification

1. Choose one of the following ways to validate the HL7 v3 specification:
 - select **File > Validate**,
 - select the **Validate** icon from the tool bar, or
 - right-click a clone and select **Validate** to perform the validation.

A Message dialog box appears (*Figure 3.25*), indicating the status of the validation.

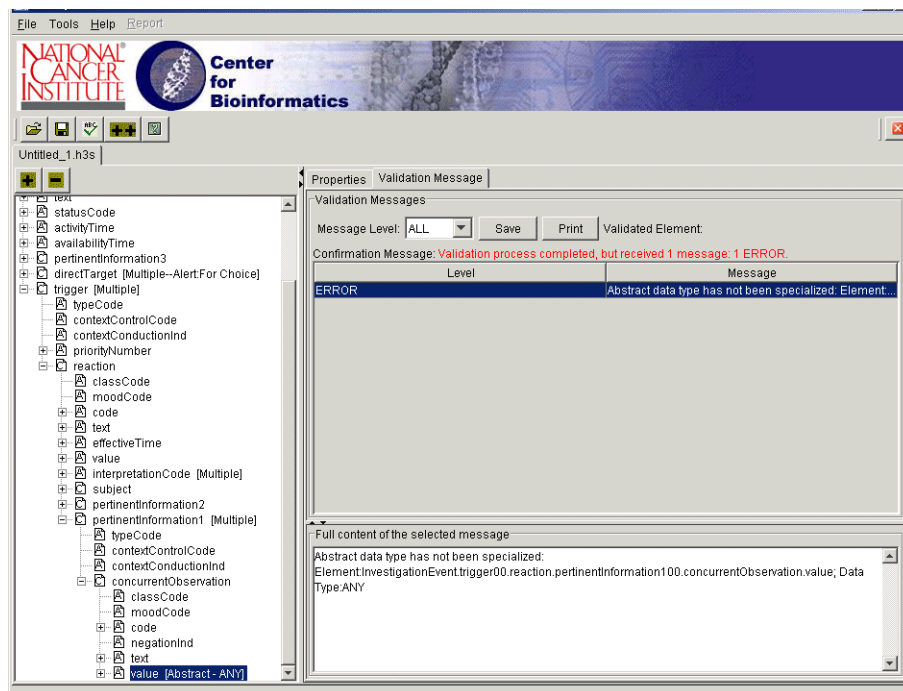


Figure 3.25 HL7 v3 specification validation

- Click **OK**. The messages display in the **Validation Messages** panel (caAdapter Mapping Tool Validation).

Saving an HL7 v3 Specification

When you are finished working on the HL7 v3 specification, select **File > Save** or **File > Save As** from the menu bar, or click the save icon on the tool bar. If the specification is being saved for the first time, the system prompts to select either an `.h3s` or `.xml` format (*Figure 3.26*). To change the format after it has been selected the first time, select **Save As**. The file is portable and can be opened by the same or another user later.

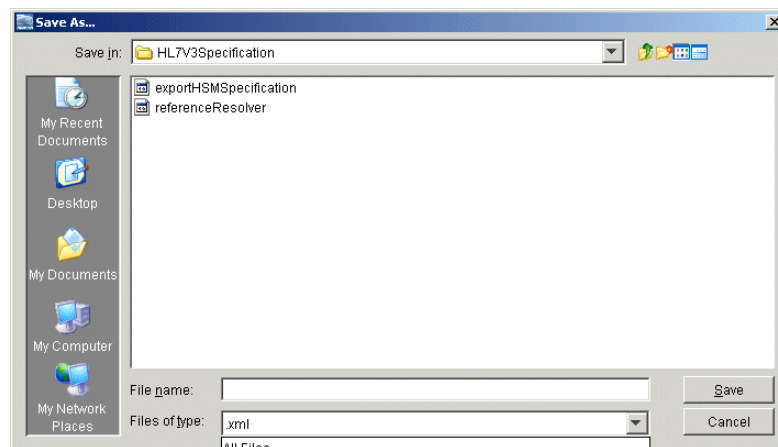


Figure 3.26 Saving HL7 Specifications

Map Specification

A map is a user-defined, direct relationship between two pieces of specification elements. Using the mapping tool, you create links between source fields and target data type fields and between source segments and target clones or attributes. Links between source fields and target data type fields are used to represent data relationships. Links between segments and clones or attributes are used to explicitly link concepts that provide a context to the data and are also called container mappings. Links may also be created between source fields and input parameters of a variety of functions provided by caAdapter, and between the function's output parameters and target elements.

Business Rules

Following are the business rules for a map specification:

- It must contain a valid mapping pair (source and target files).
- The source element referenced in the map specification must exist in the source specification.
- The destination element referenced in the map specification must exist in the destination specification.
- A mandatory MIF element must have either a mapping in the map specification or an HL7-defined or user-defined default value in the HL7 v3 specification.
- Each input parameter for a function must have a mapping or a constant defined.
- Each output parameter for a function must have a mapping.

Step-by-Step Instructions

This section contains the step-by-step instructions to create the mappings. See [Appendix A, caAdapter Example Data](#), on page 117 for detailed information on mapping scenario 8 included with the example data.

Overview of the Map Specification Tab

The map specification tab allows you to assign fields in a source specification to elements in a target specification. For the source (the CSV specification) and the target (HL7 v3 specification), the hierarchy is visually represented using an expandable/collapsible tree structure. The target specification can either be .h3s or .xml format.

The Map Specification tab ([Figure 3.27](#)) consists of the following:

- **Two tree panels** - contain the source specification in the left-hand panel and the target specification in the right-hand panel.
- **Center mapping panel** - displays the lines that indicate the mapping between source and target elements and any functions that are used in the mappings.
- **Functions panel** - displays a tree of available functions.

- **Properties panel** - changes depending on the item selected in the other panels (for example, displays link properties, HL7 v3 specification data type field properties, CSV field properties, etc.)

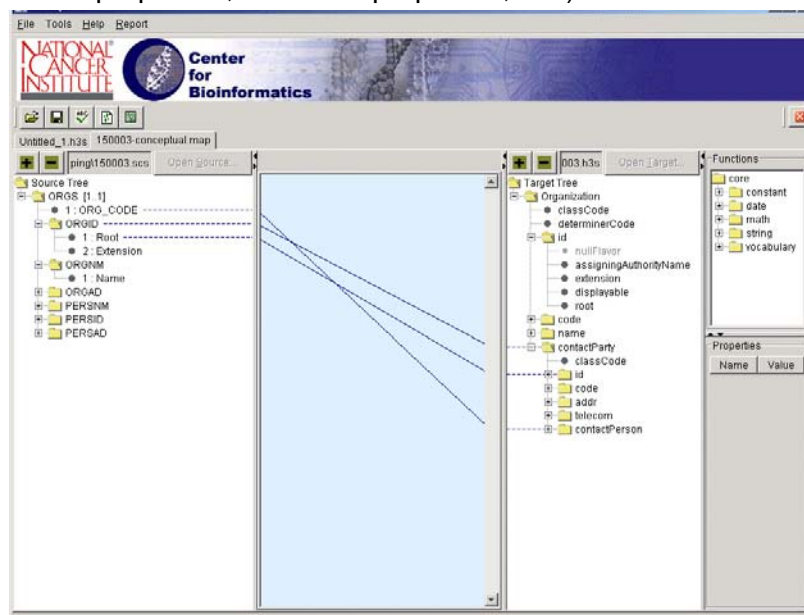


Figure 3.27 Map Specification tab

The tree structures are read-only; you must make any changes to the tree structures in the source or target specification tabs. You can only define the mappings from this tab.

Caution: Adding to source or target specifications that are referenced in a map file is allowable, but editing or removing source or target elements may result in a related mapping (link) getting dropped or producing other unpredictable behavior.

The following sections describe how to access, create, and save the map specification.

Creating and Opening a Map Specification

You must create a new or open an existing map specification.

Perform the following steps to create a new map specification.

1. Select **File > New > CSV to HL7 v3 Mapping and Transformation > Map Specification** from the menu bar to open a new mapping tab with empty source and destination panels.
2. Click **Open Source** to display the **Open Source File** dialog box.
3. Select the source file and click **Open** to populate the source panel with its tree structure.
4. Click **Open Target** to display the **Open Target File** dialog box.
5. Select the target file (.h3s or .xml format) and click **Open** to populate the target panel with its tree structure.

Perform the following steps to open an existing map specification.

1. Select **File > Open > CSV to HL7 v3 Map Specification**. The Open Map File dialog box displays.
2. Select the map specification file and click **Open** to display the source and target trees along with any existing mappings.

Updating the Map Specification

Perform the following steps to create a mapping.

1. Select a source element and drag it to the appropriate target element. The cursor indicates if the source is not allowed to be mapped to the target element ([Figure 3.28](#) and [Figure 3.29](#)).

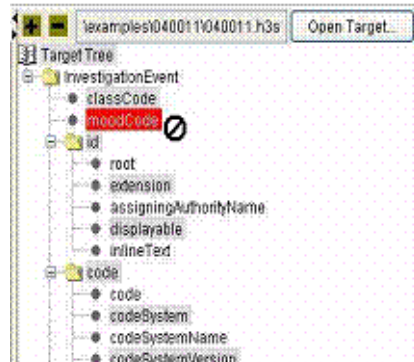


Figure 3.28 Mapping is not allowed

The cursor indicates when the source can be mapped to the target element. Drop the source on the target element.

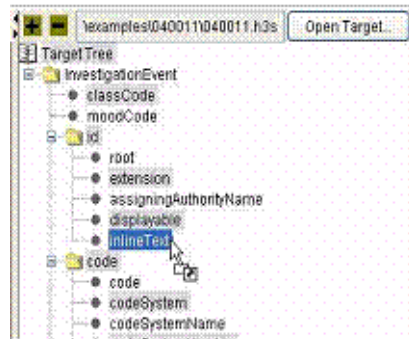


Figure 3.29 Mapping is allowed

- Once a source field is mapped to a target element, a mapping line appears between them in the mapping panel. [Figure 3.30](#) shows a mapping line between **id_root** and **root**.

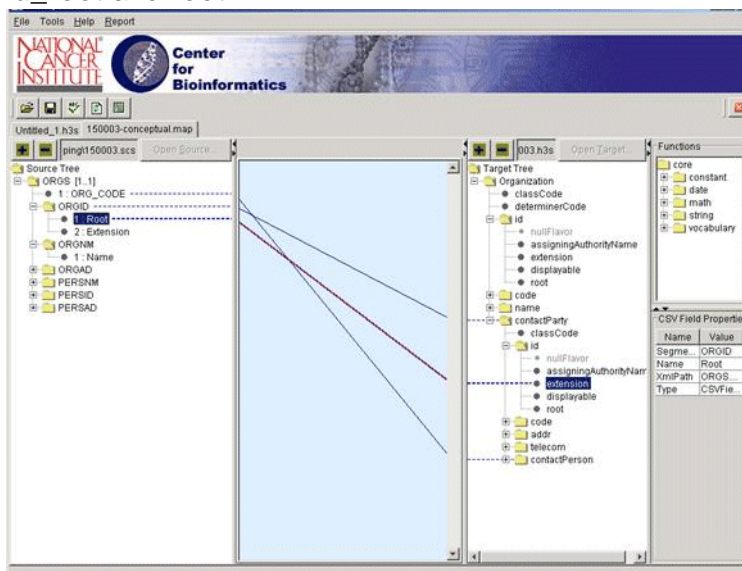


Figure 3.30 Mapping line between a source field and target element

To delete a mapped line or a function in the center panel, perform the following steps.

- Select the item you want to delete, right-click and select **Delete**.
- Click **Yes** to confirm the deletion. The selected item is deleted from the mapping.

The **Properties** panel displays information on the selected element. When you select a source element, the **CSV Field Properties** appears ([Figure 3.31](#)).

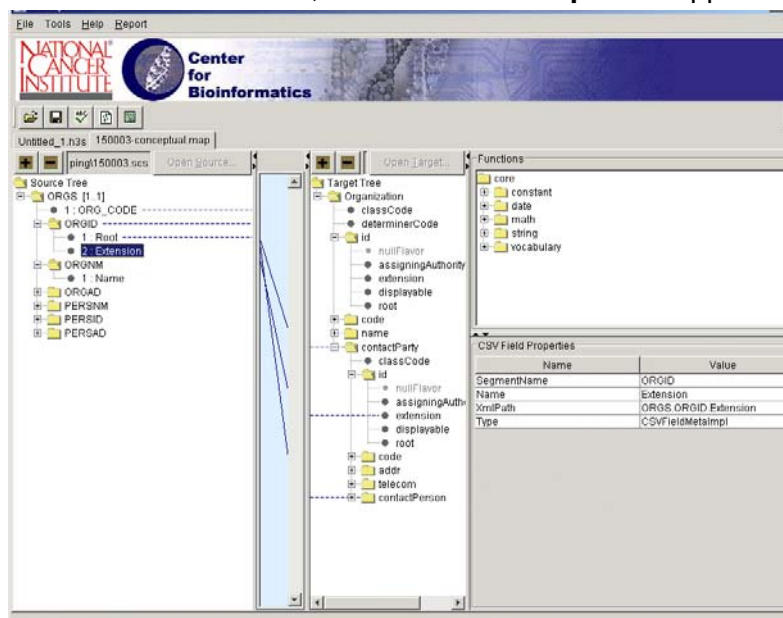


Figure 3.31 CSV Field Properties panel

When you select a mapping line, the **Link Properties** appears ([Figure 3.32](#)).

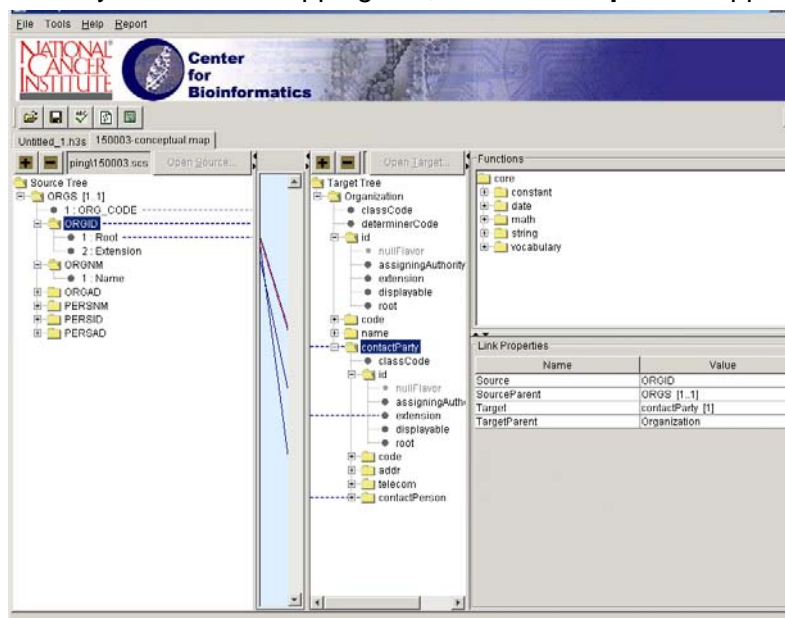


Figure 3.32 Link Properties pane

When you select a target element, the **HL7 v3 Specification Attribute Properties**, **HL7 v3 Specification Data Type Field Properties** or the **Clone Attribute Object Properties** appears ([Figure 3.33](#)).

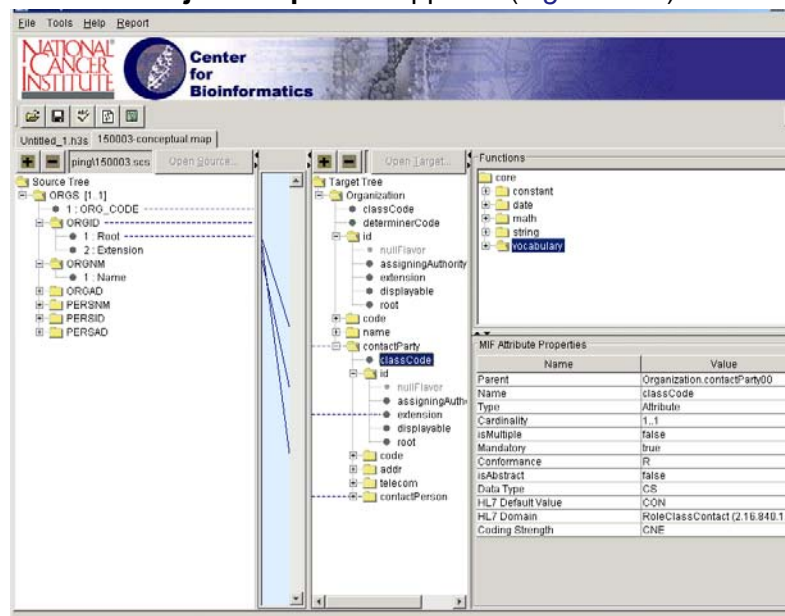


Figure 3.33 Attribute properties

When you select a function either in the **Mapping** panel or in the **Functions** panel, the **Function Properties** display. When you select a function group in the **Functions** panel, the **Function Group Properties** appears ([Figure 3.34](#)).

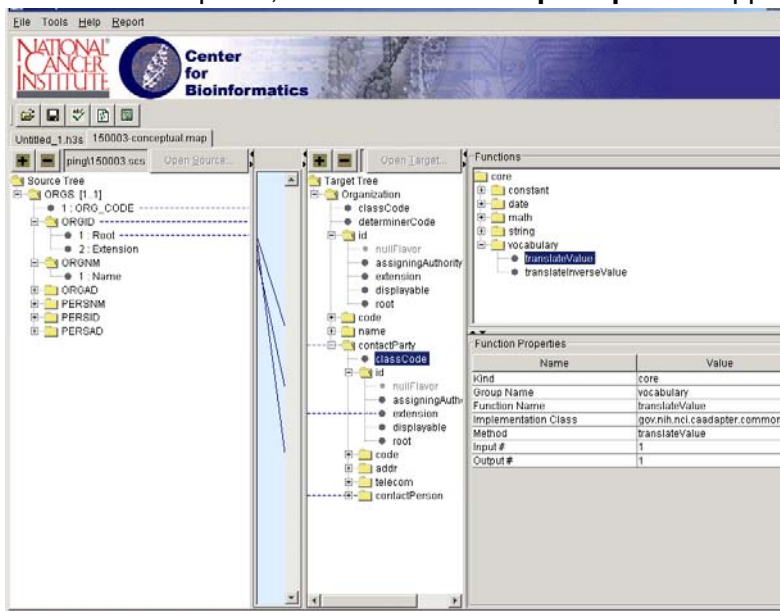


Figure 3.34 Function Group Properties

Using Functions in Map Specifications

The **Functions** panel ([Figure 3.35](#)) provides a list of system defined functions that facilitate the data transformation requirement. Functions are grouped by functional categories (for example, constant, date, math, string, etc.). You may use a function in the mapping to effect a change of the source element to the target element. For example, you can use the concatenate function to add a prefix to an element.

Note: You can add your own required functions to the function library.

When a function is selected in the function library, its properties information appears, such as name and number of input and output parameters, in the **Function Properties** panel (*Figure 3.35*).

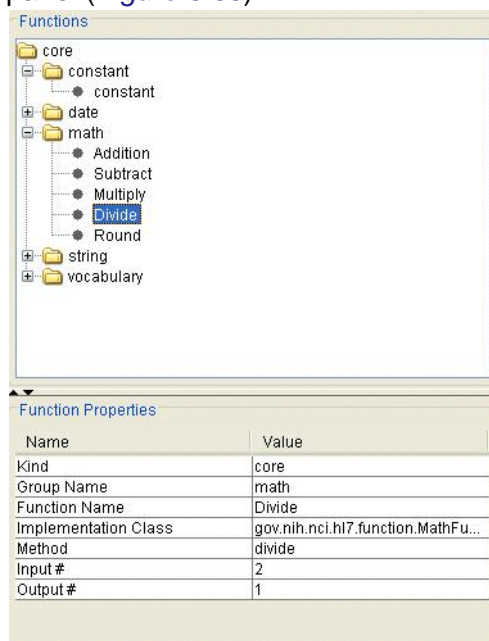


Figure 3.35 Functions in mapping specification

Perform the following steps to include a function in your mapping specification.

1. Add a function to the mapping panel. Select a function in the **Functions** panel, right-click in the center panel and select **Add Function**, or drag-and-drop the required function from the **Functions** panel to the mapping panel. Move this function box around the mapping panel as convenient to attach the map.
2. Drag-and-drop the source field(s) onto the input parameters. *Figure 3.36* shows the selected field **text** being dropped as an input to the **Initcap** function.

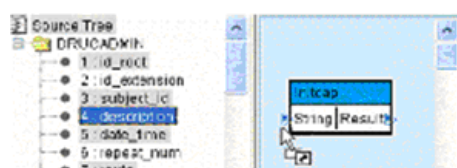


Figure 3.36 Adding input to a function

3. Drag-and-drop the target field onto the output parameter. The mapping lines go from the source fields into the function box and out of the function box to the target fields.

Editing a Constant Function

Perform the following steps to edit a constant function.

1. Select a constant function in the mapping panel, right-click and select **Edit Constant**.
2. In the **Edit Constant** dialog box, change the **Type** and/or **Value** for the constant and click **OK**.

Using the Date Function

The date function, **changeFormat**, uses the Java `SimpleDateFormat` class. See <http://java.sun.com/j2se/1.5.0/docs/api/java/text/SimpleDateFormat.html> for more information. *Table 3.6* shows the correct syntax for each date or time component.

Date or Time Component	Presentation	Example Pattern 1	Example Pattern 2
Year	Lowercase y	yy => 05	yyyy => 2005
Month	Uppercase M	MM => 07	MMM => JUL
Day	Lowercase d	dd => 07 or 17 (7th or 17th date of the month)	d => 7 or 17
Hour	Uppercase H or lowercase h	Using 2 PM HH => 14	hh => 02, h => 2
Minute	Lowercase m	mm => 09	m => 9
Second	Lowercase s	ss => 12	
Millisecond	Uppercase S	SSS => 002	

Table 3.6 Date formats

For example, July 7th 1988, PM 02:23:14 can be presented in the following ways:

- yyyyMMddHHmmss => 19880707142314
- dd-MMM-yyyy, HH:mm:ss => 07-JUL-1988, 14:23:14
- MM/dd/yy => 07/07/88

Refreshing the Map Specification Tab

Click the **Refresh** button on the tool bar to check and update the associated CSV specification or HL7 v3 specification used in the mapping panel. If changes to the mapping panel were required, an information message (*Figure 3.37*) appears.

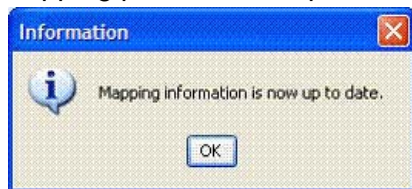


Figure 3.37 Mapping panel refreshed message

This option allows you to update and save the associated CSV or H3S file in their own tabs, while you are also performing the mapping between the two.

If either the CSV or H3S files are updated and saved in their own tabs, and you switch back to the mapping panel, then a dialog (*Figure 3.38*) appears, notifying you of the

changes. You are not forced to refresh the mapping panel at this time, since you may have some pending mapping activity unsaved.

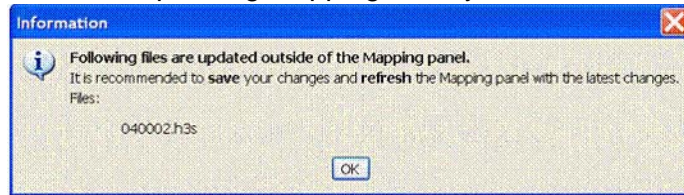


Figure 3.38 Refresh mapping panel recommendation

Validating the Map Specification

Perform the following steps to validate the map specification.

1. Select **File > Validate** or select the **Validate** icon from the tool bar to perform the validation. A **Message** dialog box appears indicating the status of the validation.
2. Click **OK**. The detailed messages appear in the **Validation Messages** dialog box (see *caAdapter Mapping Tool Validation* on page 25).

Saving a Map Specification

When you are finished working on the map specification, select **File > Save** or **File > Save As** from the menu bar or click the save icon on the tool bar to save the file. This file is portable and can be opened by the same or another user later.

Caution: The map specification has an internal reference to the full path name of the source and target specification files and those must be accurate to process the conversion or edit a map specification successfully. If you are sharing map specification files with other users, you must send all three files, the CSV specification (.scs), HL7 v3 specification (.h3s), and map specification (.map); not just the map specification. Furthermore, the CSV and HL7 v3 specification files must be in the same path locations as they were on the machine where they were created. Alternatively, the path name can be manually removed by editing the .map file however this is dangerous and unpredictable results may occur if the file is changed improperly.

Generating a Map Specification Report

When a map specification tab is selected, you can generate a report on the status of the mapping specification by performing the following steps.

1. Select **Report > Generate Report** from the menu bar to display the **Select File to Save Generated Report** dialog box.
2. Enter a **File name** and click **Save**. A “Report has been successfully generated” message appears.

The report is an Excel spreadsheet containing the status of the mapping specification. The report contains up to six worksheets (tabs) within the generated report. Under the mapped category, it contains the mapping status between:

- Source and target - Mapped(Source_Target)
- Source and function - Mapped(Source_Function)

- Function and target - Mapped(Function_Target)
- Function and function - Mapped(Function_Function)

Under the unmapped category, it contains the unmapped elements:

- Source - Unmapped_Source
- Target - Unmapped_Target

HL7 v3 Message

Generating the HL7 v3 message is the end goal in using the mapping tool. XML HL7 message instances are created using the map specification and a corresponding CSV data file.

Business Rules

Following are the business rules for creating an HL7 v3 message:

- You must have data in a CSV format.
- The map specification must be valid.
- The source and target specifications used to create the map must be located in the same directory as they were when the map specification was created (or the map specification must have been edited to point to the new location of these files if they were moved). The map specification uses the references to these files as it converts the data into the new format.

Step-by-Step Instructions

This section contains the step-by-step instructions to generate the HL7 v3 message.

Note: There is no **File > Open** option that corresponds to HL7 v3 messages since you always want to generate fresh messages based on the current selection of source and map files.

About the HL7 v3 Message Tab

The purpose of the HL7 v3 Message tab is to allow you to generate and view the XML instances and messages converted from a data file and map specification. Each data file may have one or more logical records which result in a corresponding number of XML instances (or more depending on the structure of the mapping). The user interface allows you to navigate between the instances. The HL7 v3 message tab ([Figure 3.39](#)) contains the following four panels:

- Regenerate and navigation buttons
- Name of data file and map specification used
- Scrollable text fields for XML instances

- Scrollable text fields for validation messages

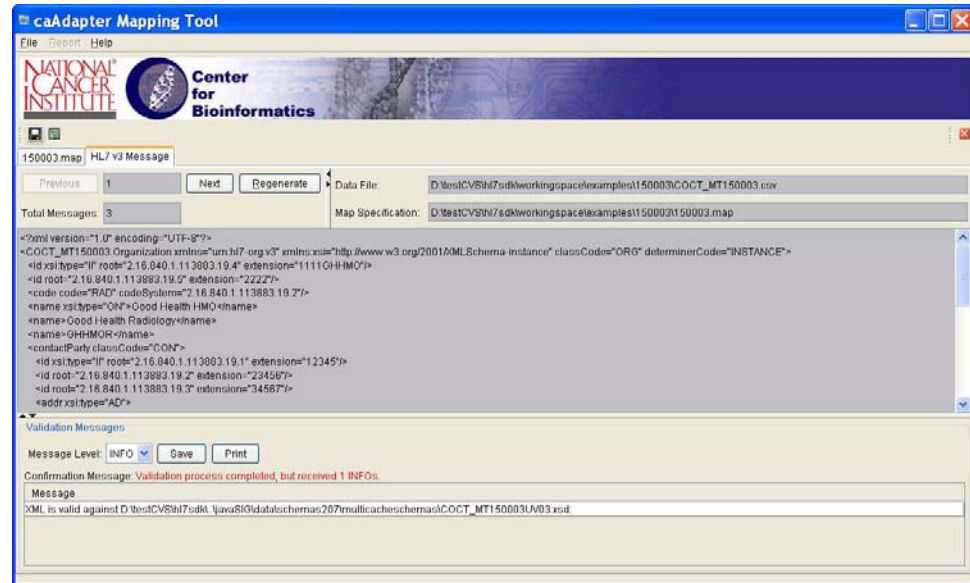


Figure 3.39 HL7 v3 Message tab

Starting the Conversion Process

Perform the following steps to convert a data file into an HL7 v3 message.

1. Select **File > New > CSV to HL7 v3 Mapping and Transformation > HL7 v3 Message** from the menu bar to display the **HL7 v3 Message** dialog box (Figure 3.40).

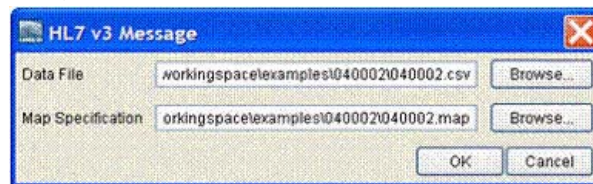


Figure 3.40 HL7 v3 Message dialog box

2. Click **Browse** next to **Data File** to display the **Open Data File** dialog box.
3. Select the data file you want to use in the conversion process and click **Open**.
4. Click **Browse** next to **Map Specification** to display the **Open Map Specification** dialog box.
5. Select the map specification file you want to use in the conversion process and click **Open**.
6. Click **OK** to generate HL7 v3 messages from the selected files.
7. Given the underlying data and mapping structure, it could take a long time to complete the HL7 v3 message generation task. If the system estimates that it will take longer than ten seconds (as is defined and configurable in the source distribution), then the **Question** dialog displays as shown in Figure 3.41. Click

Yes to start the process or click **No** to abort the process given the estimated time.

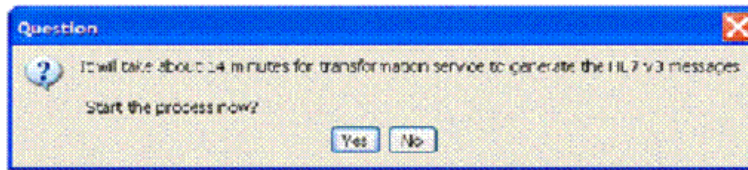


Figure 3.41 HL7 v3 message generation confirmation

8. After a **Yes** confirmation, the process starts and a progress dialog box appears (Figure 3.42). The system monitors the transformation progress for both loading the data, which includes reading the map file, source and target data specification; and the count of messages generated.

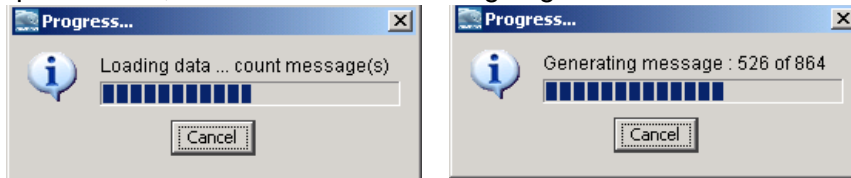


Figure 3.42 HL7 v3 message generation progress dialog

9. Once the process starts, you can cancel the process by clicking **Cancel**. If cancelled, the underlying generation process is terminated and an information dialog appears (Figure 3.43).

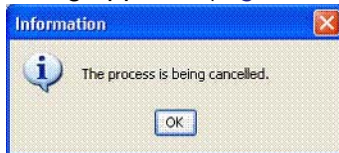


Figure 3.43 HL7 v3 message generation cancelled

A message displays (Figure 3.44) after the overall process completes.

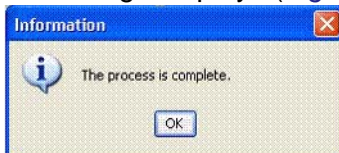


Figure 3.44 HL7 v3 message process complete

10. Click **OK**. The **HL7 v3 Message** tab appears.

Using the Basic Features of the HL7 v3 Messages Tab

The two main features of the **HL7 v3 Message** tab (Figure 3.45) are the two scrollable text fields containing an XML instance and the associated error, warning and/or informational messages generated during the conversion process.

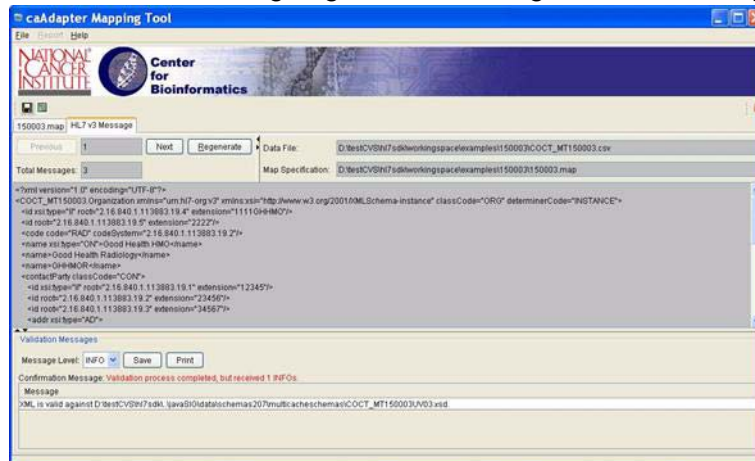


Figure 3.45 HL7 v3 Message tab

Click the **Previous** and **Next** buttons to cycle through the XML messages one at a time. As the messages change, the validation messages change. See *caAdapter Mapping Tool Validation* on page 25 for more information on the validation messages. Click the **Regenerate** button to regenerate the messages from scratch using the same data file and map specification.

Saving an HL7 v3 Message

Select **File > Save** or **File > Save As** from the menu bar or click the save icon on the tool bar to save the HL7 v3 message. If there is more than one instance of a message, then the files are saved with number extensions (for example, example_message_1.xml, example_message_2.xml, example_message_3.xml).

Note: Validation messages are not saved with their corresponding XML message and must be saved separately using the Save button in the Validation Messages panel.

Transforming an HL7 Message into a CSV Format

This version of caAdapter provides the capability to map and transform an HL7 messages into a CSV structured files. This capability addresses such requirement where HL7 v3 data must be persisted into a system already capable to of persisting data from CSV files.

Business Rules

The business rules are similar to those that apply to transforming CSV data into HL7 v3 messages with the source and target reversed, i.e. transforming HL7 V3 into CSV structure/file.

Step-by-Step Instructions

This section contains the step-by-step instructions to generate a CSV dataset from an HL7 V3 message.

Note: There is no **File > Open** option that corresponds to CSV data file since you always need to generate fresh CSV data based on the current selection of the source HL7 V3 message, and the map files.

Reusing the HL7 v3 Message Tab

The purpose for reusing the HL7 V3 Message tab is to generate and view the CSV data generated from the HL7 V3 message data. Each data file may have one or more logical records which result in a corresponding number of CSV meta instances (or more depending on the structure of the mapping). The user interface allows navigating between the various instances. The reused HL7 v3 message tab ([Figure 3.46](#)) contains four panels:

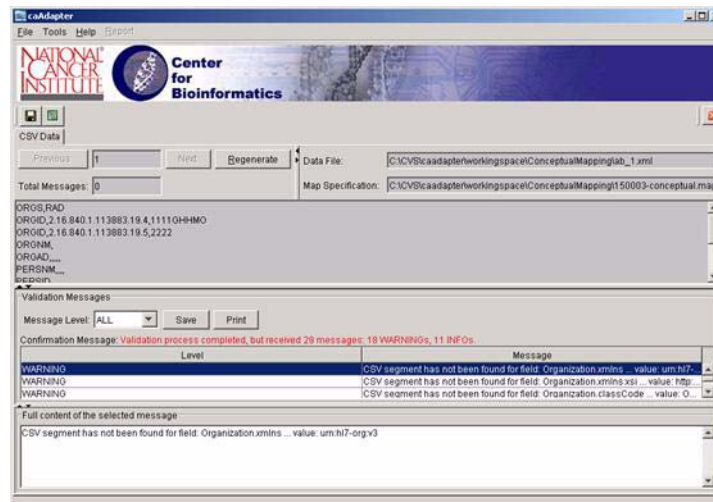


Figure 3.46 Displaying CSV Data with HL7 v3 Message Tab

Starting the Conversion Process

Use the following steps to convert an HL7 v3 message into a CSV data file.

1. Select **File > New > HL7 V3 To CSV Transformation Service> New HL7 V3 To CSV** from the menu bar to display the **HL7 V3 To CSV** dialog box ([Figure 3.47](#)).

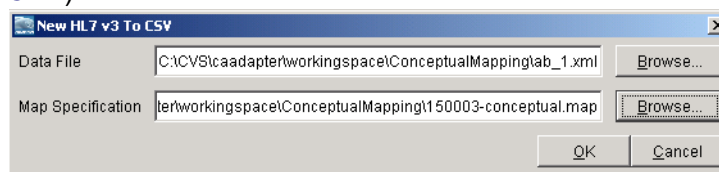


Figure 3.47 HL7 V3 to CSV Dialog Box

1. Click **Browse** next to **Data File**. The **Open Data File** dialog box appears.
2. Select the data file to use in the conversion process and click **Open**.
3. Click **Browse** next to **Map Specification**. The **Open Map Specification** dialog box appears.
4. Select the map specification file to use in the conversion process and click **Open**.

5. Click **OK** to generate CSV data file from the selected files.
6. Click the **Previous** and **Next** buttons to cycle through the CSV data one at a time. As the data change, the validation messages change as well. See caAdapter Mapping Tool Validation for more information on the validation messages. Click the **Regenerate** button to regenerate the data from scratch using the same data file and map specification.

Saving the CSV Data File

Select **File > Save** or **File > Save As** from the menu bar, or click the Save icon on the tool bar, to save the data file.

CHAPTER 4

HL7 v2 TO HL7 v3 CONVERSION

This chapter provides instructions on using caAdapter to map and convert an HL7 v2 message to an HL7 v3 message.

Topics in this chapter include:

- [Understanding the Mapping and Transformation Processes](#) on this page
- [Using the HL7 v2 to HL7 v3 Module](#) on page 65
- [Advanced HL7 v2 to HL7 v3 Mapping](#) on page 66

Understanding the Mapping and Transformation Processes

There are two major steps involved in converting an HL7 v2 message to an HL7 v3 message:

- **Step 1:** Map and convert the HL7 v2 message to CSV format (for more information, see [Mapping and Converting HL7 v2 to CSV Format](#) on page 64)
- **Step 2:** Map and convert the CSV file (which is equivalent to the original HL7 v2 format), to HL7 v3 format (for more information, see [Mapping and Converting CSV File to HL7 v3 Format](#) on page 65)

Figure 4.1 shows the entire conversion process and the sub-steps involved.

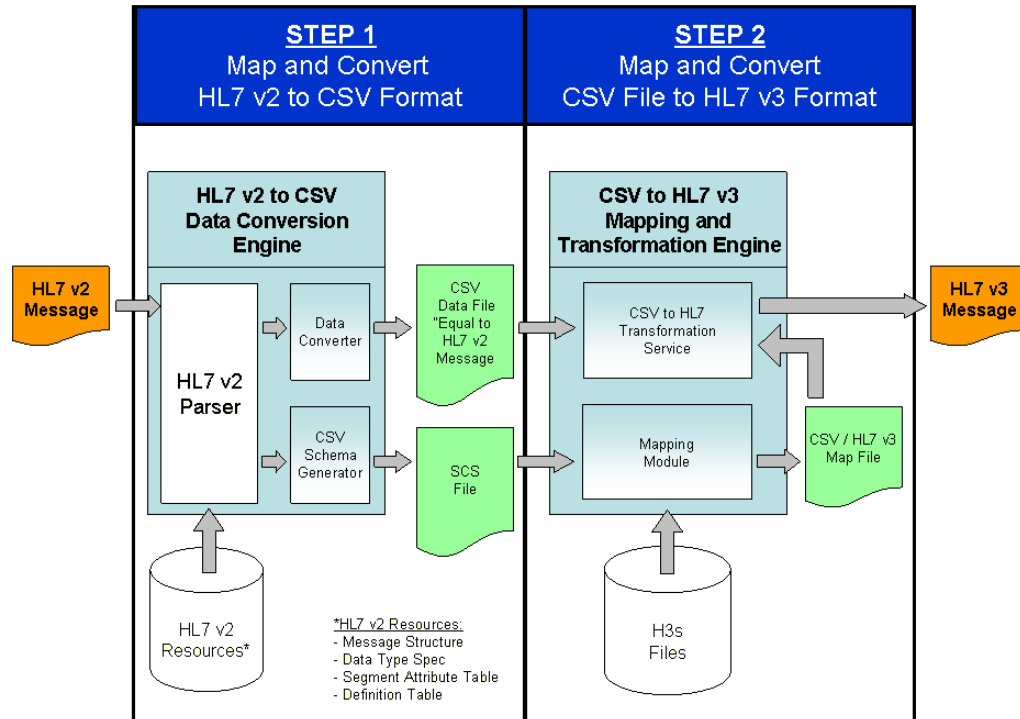


Figure 4.1 HL7 v2 to HL7 v3 Conversion Steps

Mapping and Converting HL7 v2 to CSV Format

The first step in the process involves using caAdapter to reproduce the HL7 v2 message in CSV format. The input files in this step are:

1. HL7 v2 Message file
2. HL7 v2 Resources file collection. Those include HL7 v2 specifications files to help parse the message. The Resources file collection includes four types of files which describe:
 - Message Structure
 - Data Type Specs
 - Segment Attributes
 - Vocabulary Definition

The Resources file collection may vary depending on the version of the HL7 v2. This release of caAdapter includes the Resources file collections for HL7 v2.4 and HL7 v2.5. Update to the files reflects the exact “flavor” of the v2.4 or v2.5 used.

The output files in this step are:

1. CSV specification, or an .scs, file. This file defines a CSV file equivalent in structure to the HL7 v2 message. caAdapter detects the message type, retrieves its specifications from the Resources file collection, and creates the corresponding CSV file.

2. CSV data file. This file contains HL7 v2 data in CSV format that corresponds to the scs specification file described above.

Mapping and Converting CSV File to HL7 v3 Format

In the second step, caAdapter uses the files generated in step 1 to create the HL7 v3 message. The input files in this step are:

1. The CSV specification file created in Step 1.
2. The CSV data file created in Step 1.
3. H3s Files, which contain the specifications for HL7 v3 messages.
4. Using caAdapter's Mapping Tool, the user will map the data elements from the CSV file to the proper HL7 v3 message.

Note: caAdapter cannot determine the target HL7 v3 message to which the source v2 message is mapped. The user must have thorough understanding of both HL7 v2 (source) and HL7 v3 (target) message structures to make this determination.

The output files in this step are:

1. CSV to HL7 v3 .map file. This file contains the mapping rules between the CSV file and HL7 v3. This file will be used by caAdapter's Transformation Service to create the actual HL7 v3 message.
2. HL7 v3 Message. This file contains the transformed data in HL7 v3 format.

Using the HL7 v2 to HL7 v3 Module

This section describes the detailed instructions for using the HL7 v2 to v3 Module which is organized by the two major steps involved as listed in the previous section.

1. Select **File > New > HL7 v2 to HL7 v3 Conversion Service > HL7 v2 to scs & CSV Conversion** (*Figure 4.2*).

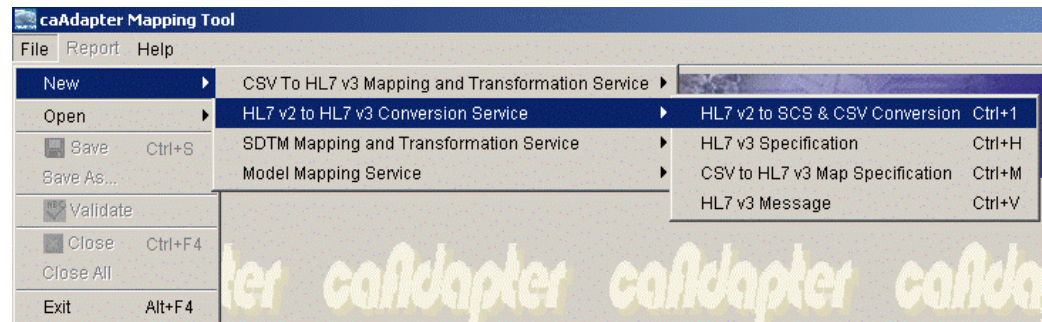


Figure 4.2 Launching the HL7 v2 to CSV Conversion Module

2. Use the window in *Figure 4.3* on page 66 to define the input and output files needed to complete step one of the process. The top two input files are:
 - HL7 v2.x Resource file collection directory. This example uses the Resources file collection for HL7 v2.4.
 - HL7 v2.x message file

The bottom two files are the output files that caAdapter will generate:

- CSV file that contains the HL7 v2 message data presented in CSV format.
- A CSV specification file that matches that of the HL7 v2 message.

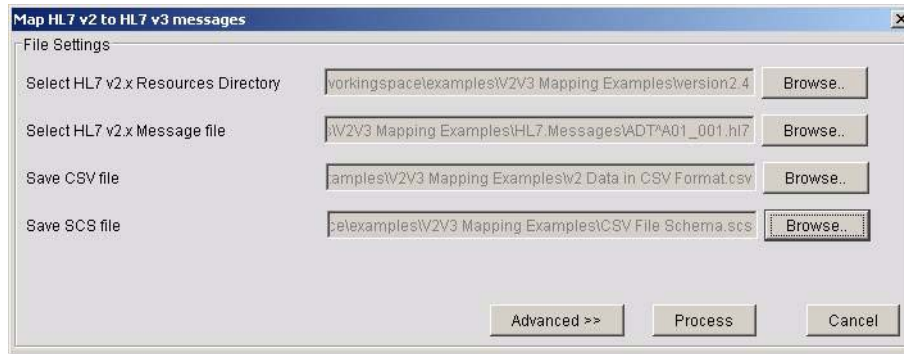


Figure 4.3 Creating the CSV and SCS Files that Correspond to the HL7 v2 Message

3. Click the **Process** button. caAdapter presents a confirmation message that the two output files were created successfully (Figure 4.4).

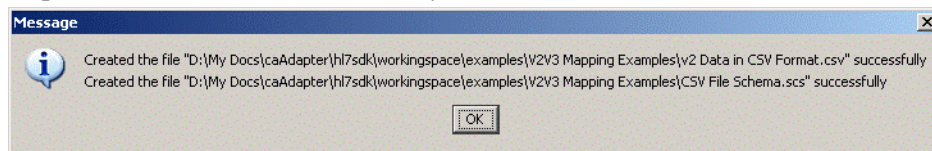


Figure 4.4 Confirmation Message

In the second step, use the Mapping Module to map the .scs file created in step one to the appropriate HL7 v3 message. See *Chapter 3, CSV to HL7 v3 Mapping and Transformation*, on page 21 for detailed instructions on performing this task.

Advanced HL7 v2 to HL7 v3 Mapping

The Advanced HL7 v2 to HL7 v3 mapping option provides the following additional features.

1. Create a CSV specification file without an actual HL7 v2 message. Specify the HL7 v2 message type and trigger event. caAdapter then uses the Resources file collection to create the corresponding CSV specification file.
2. Explicitly set up the OBX Segment in the CSV specification file. The OBX segment contains essential clinical information including lab results, X-ray image data, doctor's comments, and others. Such information is captured into various OBX data types, i.e. ST for String, ED for Encapsulated Data, etc. caAdapter provides the capability to specify the exact OBX data types to include in the generated CSV specification file.

Generating a CSV Specification File without an Actual HL7 v2 Message

When the user specifies a message type that contains an OBX segment to generate a CSV Specification file, the "OBX Data Type Selection" on the bottom of the window becomes active (Figure 4.5 on page 67). The following options determine the content of the generated CSV specification file.

- Treat all OBX data types as an ST data type by selecting the **ST Data Type Only** radio button.
- Group all OBX data types into an ST data type for simplification by selecting the **Yes** radio button in the “Grouping” block.
- Specify the OBX data types to include by selecting the **Selecting Data Types** radio button and checking the data types to be included.

Note: When the OBX data types are specified, e.g. ST and ED, caAdapter can only transform HL7 v2 messages that contain ST and ED OBX data types. If the user provides an HL7 v2 message containing OBX data types other than ST and ED, caAdapter will flag those as errors during the transformation process.

Generating a CSV Specification File from an Actual HL7 v2 Message

When the user provides an actual HL7 v2 message to create the CSV specification file, and the message contains OBX segments, the “OBX Data Type Selection” section on the bottom of the window becomes active. The following options determine the content of the generated CSV specification file:

- Include specifications that correspond to the actual OBX data types provided in the message by selecting the **Apparent Data Type Only** radio button.
- Treat all OBX data types as ST data type by selecting the **ST Data Type Only** radio button.
- Group the ST, TX, and FT OBX data types into a single ST data type for simplification by selecting the **Yes** radio button in the “Grouping” block.

Specify additional OBX data types to include by selecting the Selecting Data Types radio button and checking the data types to be included.

The screenshot shows the 'V2 Message Converter Main' window. The 'V2 Message Source' section has 'Message File' selected. The 'Output File Option' section has 'Both' selected. The 'SCS File Option' section has 'Apparent Segments only in this Message File' selected. The 'Output Files' section has fields for 'SCS File' and 'CSV File'. The 'OBX Data Type Selection' section is active, showing 'OBX Option' with 'Apparent Data Type only' selected, and 'Grouping' with 'No' selected. Below these are checkboxes for various OBX data types: ST, TX, FT, NM, TS, DT, TM, TN, XTN, CE, MO, CP, SN, ED, RP, AD, XAD, PN, XPB, CX, CF, CN, XCN, CK, and XON.

Figure 4.5 Advanced HL7 v2 Converting Panel

Figure 4.6 contains an example CSV specification file for an HL7 v2 message that contains two OBX data types: ST and ED.

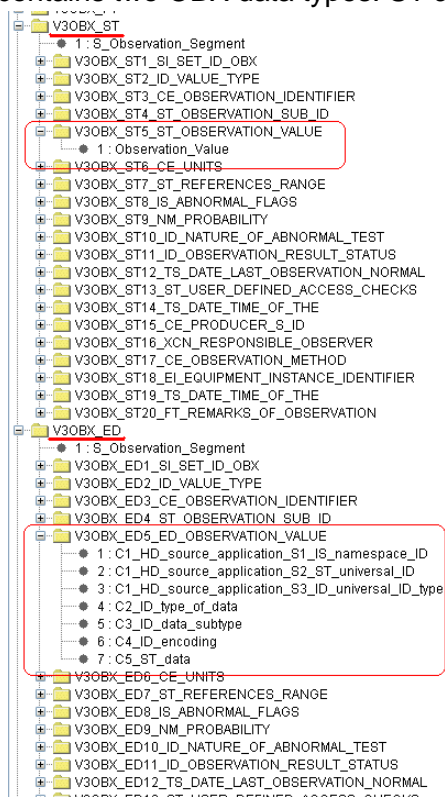


Figure 4.6 Example Case of Various Forms of OBX Segments

CHAPTER 5

USING FUNCTIONS IN MAPPING

This chapter describes the different functions provided by caAdapter. Topics in this chapter include:

- *Functions Provided by caAdapter* on this page
- *Function Specifications* on page 71
- *Function Specification Overview* on page 71
- *Adding Functions to the Function Library* on page 81

Functions Provided by caAdapter

caAdapter provides a variety of basic functions as part of the initial installation. These functions may be used in any mapping where the function panel is available. There are five groups of functions:

- **constant** – There is one function in this group that allows the user to define a value that can be used as input with other functions
- **date** – There is one function in this group that allows the user to convert any date format into the HL7 v3 required date format.
- **math** – Five basic math functions are provided in this group.
- **string** – Ten commonly used functions in this group allows users to do basic data manipulation.
- **vocabulary** – These functions were new in the 3.2 release of caAdapter and allow a user to translate values in incoming data into a different value in the outgoing format.

The following table provides a simple overview of the functions that reside in each of these groups.

Function Group Name	Function Name	Function Description
constant	Constant	Allows the user to define a string or integer for use as an input value to another function or to a target field.
Date	changeFormat	Requires the user to define the incoming date format (using either a constant function or a source field mapping) and the date field to be converted. Only transforms to the HL7 v3 required date format, but does handle varying levels of specificity (e.g. with or without time).
math	Addition	Takes in two values and provides the sum.
math	Subtract	Takes in two values and provides the difference.
math	Multiply	Takes in two values and provides the product.
math	Divide	Takes in two values and provides the quotient.
math	Round	Takes in two values, a value to be rounded, and the digit number to which to round.
string	Concatenate	Takes in two strings and provides a single value have the first string appended with the second.
string	Split	Takes in a string and a position number and breaks the string into two strings at the given position.
string	Length	Takes in a single string and provides the number of characters present.
string	Substring	Takes in a string and a starting and ending position, returning a portion of the string.
string	Trim	Takes in a single string and provides the same basic value with leading and trailing blanks removed.
string	Replace	Takes in three strings, one containing the value to be operated on, one containing the "from" characters to search for, and the last containing the "to" characters to substitute, producing a single string with "from" characters substituted with "to" characters.
string	Instring	Takes in a string on which to operate and a pattern to search for, returning the position within the string where the pattern is found, or 0.

Table 5.1 caAdapter Functions

Function Group Name	Function Name	Function Description
string	Upper	Takes in a single string and returns the same string only with all alphabetic characters in uppercase.
string	Lower	Takes in a single string and returns the same string only with all alphabetic characters in lowercase.
string	Initcap	Takes in a single string and returns the same string only with all alphabetic characters in lowercase except the first which is in uppercase.
vocabulary	translateValue	Requires the user to select either a vocabulary mapping file (.vom) or a URL to use as the basis of the conversion. Also may require a domain to be specified if the .vom file has more than one translation set in it. Takes in a single string and returns a converted string based on the “from” and “to” values and business rules defined in the vocabulary mapping file or the URL-based function.
vocabulary	translateInverseValue	Behaves the same way as the translateValue function only in reverse, matching the input value to the “to” side of the vocabulary mappings and returning the value from the “from” side.

Table 5.1 *caAdapter Functions*

Function Specifications

There are two function-related specifications. The first one describes the function groups and functions, and the inputs, outputs and implementation for each function. The second one describes the vocabulary mappings used by the vocabulary functions.

Function Specification Overview

The function specification is used as a guide for function objects to read the function specification and determine what objects to call to execute a function (for example, concatenation). The function specification also stores data points for rendering by a function graphical representation within the mapping tool. It uses the following types of nested elements:

```

<function>
  <group name>
    <function name>
      <inputs>
      <datapoint>
      <outputs>

```

Following is an example of a function specification file (`core.flis`). See the `{home directory}\map\functions` directory for the entire file.

```
<?xml version="1.0"?>
<functions>
  <group name="constant" xmlPath="constant">
    <function name="constant"
xmlPath="constant.constant">
      <outputs>
        <datapoint pos="0"
name="constant" datatype="string"
xmlPath="constant.constant.outputs.0"/>
      </outputs>
    </function>
  </group>
  <group name="date" xmlPath="date">
    <function name="changeFormat"
xmlPath="date.changeFormat">
      <inputs>
        <datapoint pos="0"
name="fromFormat" datatype="string"
xmlPath="date.changeFormat.inputs.0"/>
        <datapoint pos="1"
name="dateIn" datatype="string"
xmlPath="date.changeFormat.inputs.1"/>
      </inputs>
      <outputs>
        <datapoint pos="0"
name="dateOut" datatype="string"
xmlPath="date.changeFormat.outputs.0"/>
      </outputs>
      <implementation
classname="gov.nih.nci.caadapter.common.function.DateFunction
" method="changeFormat"/>
    </function>
    <function name="countDays" xmlPath="date.countDays">
      <inputs>
        <datapoint pos="0"
name="fromDate" datatype="string"
xmlPath="date.countDays.inputs.0"/>
        <datapoint pos="1"
name="toDate" datatype="string"
xmlPath="date.countDays.inputs.1"/>
      </inputs>
      <outputs>
        <datapoint pos="0"
name="dayNumber" datatype="int"
xmlPath="date.countDays.outputs.0"/>
      </outputs>
      <implementation
```

```

classname="gov.nih.nci.caadapter.common.function.DateFunction
" method="countDays"/>
    </function>
</group>
    <group name="math" xmlPath="math">
        <function name="Addition"
xmlPath="math.Addition">
            <inputs>
                <datapoint pos="0"
name="Value1" datatype="double"
xmlPath="math.Addition.inputs.0"/>
                <datapoint pos="1"
name="Value2" datatype="double"
xmlPath="math.Addition.inputs.1"/>
            </inputs>
            <outputs>
                <datapoint pos="0" name="Sum"
datatype="double" xmlPath="math.Addition.outputs.0"/>
            </outputs>
            <implementation
classname="gov.nih.nci.caadapter.common.function.MathFunction
" method="add"/>
            </function>
            <function name="Subtract"
xmlPath="math.Subtract">
                <inputs>
                    <datapoint pos="0"
name="Value1" datatype="double"
xmlPath="math.Subtract.inputs.0"/>
                    <datapoint pos="1"
name="Value2" datatype="double"
xmlPath="math.Subtract.inputs.1"/>
                </inputs>
                <outputs>
                    <datapoint pos="0"
name="Difference" datatype="double"
xmlPath="math.Subtract.outputs.0"/>
                </outputs>
                <implementation
classname="gov.nih.nci.caadapter.common.function.MathFunction
" method="subtract"/>
                </function>
                <function name="Multiply"
xmlPath="math.Multiply">
                    <inputs>
                        <datapoint pos="0"
name="Value1" datatype="double"
xmlPath="math.Multiply.inputs.0"/>
                        <datapoint pos="1"
name="Value2" datatype="double"

```



```
xmlPath="math.Multiply.inputs.1"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="Product" datatype="double"
xmlPath="math.Multiply.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.MathFunction
" method="multiply"/>
    </function>
    <function name="Divide"
xmlPath="math.Divide">
    <inputs>
        <datapoint pos="0"
name="Dividend" datatype="double"
xmlPath="math.Divide.inputs.0"/>
        <datapoint pos="1"
name="Divisor" datatype="double"
xmlPath="math.Divide.inputs.1"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="Quotient" datatype="double"
xmlPath="math.Divide.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.MathFunction
" method="divide"/>
    </function>
    <function name="Round" xmlPath="math.Round">
    <inputs>
        <datapoint pos="0"
name="Input" datatype="double" xmlPath="math.Round.inputs.0"/>
    >
        <datapoint pos="1" name="roundDigit"
datatype="int" xmlPath="math.Round.inputs.1"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="Output" datatype="double"
xmlPath="math.Round.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.MathFunction
" method="round"/>
    </function>
</group>
<group name="string" xmlPath="string">
    <function name="Concatenate"
```

```

xmlPath="string.Concatenate">
    <inputs>
        <datapoint pos="0"
name="String1" datatype="string"
xmlPath="string.Concatenate.inputs.0"/>
        <datapoint pos="1"
name="String2" datatype="string"
xmlPath="string.Concatenate.inputs.1"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="Result" datatype="string"
xmlPath="string.Concatenate.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.StringFunction" method="concat"/>
    </function>
    <function name="Split"
xmlPath="string.Split">
        <inputs>
            <datapoint pos="0"
name="String1" datatype="string"
xmlPath="string.Split.inputs.0"/>
            <datapoint pos="1" name="Pos"
datatype="int" xmlPath="string.Split.inputs.1"/>
        </inputs>
        <outputs>
            <datapoint pos="0"
name="Result1" datatype="string"
xmlPath="string.Split.outputs.0"/>
            <datapoint pos="1"
name="Result2" datatype="string"
xmlPath="string.Split.outputs.1"/>
        </outputs>
        <implementation
classname="gov.nih.nci.caadapter.common.function.StringFunction" method="split"/>
        </function>
        <function name="Length"
xmlPath="string.Length">
            <inputs>
                <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Length.inputs.0"/>
            </inputs>
            <outputs>
                <datapoint pos="0"
name="Length" datatype="int"
xmlPath="string.Length.outputs.0"/>
            </outputs>
        </function>
    </function>

```

```

                                </outputs>
                                <implementation
classname="gov.nih.nci.caadapter.common.function.StringFuncti
on" method="length"/>
                                </function>
                                <function name="Substring"
xmlPath="string.Substring">
                                <inputs>
                                    <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Substring.inputs.0"/>
                                    <datapoint pos="1"
name="StartPos" datatype="int"
xmlPath="string.Substring.inputs.1"/>
                                    <datapoint pos="2"
name="EndPos" datatype="int"
xmlPath="string.Substring.inputs.2"/>
                                </inputs>
                                <outputs>
                                    <datapoint pos="0"
name="Result" datatype="string"
xmlPath="string.Substring.outputs.0"/>
                                </outputs>
                                <implementation
classname="gov.nih.nci.caadapter.common.function.StringFuncti
on" method="substring"/>
                                </function>
                                <!-- function name="Trim"
xmlPath="string.Trim">
                                <inputs>
                                    <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Trim.inputs.0"/>
                                </inputs>
                                <outputs>
                                    <datapoint pos="0"
name="Result" datatype="string"
xmlPath="string.Trim.outputs.0"/>
                                </outputs>
                                <implementation
classname="gov.nih.nci.caadapter.common.function.StringFuncti
on" method="trim"/>
                                </function -->
                                <function name="Replace"
xmlPath="string.Replace">
                                <inputs>
                                    <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Replace.inputs.0"/>
                                    <datapoint pos="1"
```

```

name="FromStr" datatype="string"
xmlPath="string.Replace.inputs.1"/>
    <datapoint pos="2" name="ToStr"
datatype="string" xmlPath="string.Replace.inputs.2"/>
    </inputs>
        <outputs>
            <datapoint pos="0"
name="Result" datatype="string"
xmlPath="string.Replace.outputs.0"/>
        </outputs>
        <implementation
classname="gov.nih.nci.caadapter.common.function.StringFuncti
on" method="replace"/>
        </function>
        <function name="Instring"
xmlPath="string.Instring">
            <inputs>
                <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Instring.inputs.0"/>
                <datapoint pos="1"
name="Pattern" datatype="string"
xmlPath="string.Instring.inputs.1"/>
            </inputs>
            <outputs>
                <datapoint pos="0"
name="Result" datatype="int"
xmlPath="string.Instring.outputs.1"/>
            </outputs>
            <implementation
classname="gov.nih.nci.caadapter.common.function.StringFuncti
on" method="instring"/>
            </function>
            <function name="Upper"
xmlPath="string.Upper">
                <inputs>
                    <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Upper.inputs.0"/>
                </inputs>
                <outputs>
                    <datapoint pos="0"
name="Result" datatype="string"
xmlPath="string.Upper.outputs.0"/>
                </outputs>
                <implementation
classname="gov.nih.nci.caadapter.common.function.StringFuncti
on" method="upper"/>
                </function>
                <function name="Lower"

```

```
xmlPath="string.Lower">
    <inputs>
        <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Lower.inputs.0"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="Result" datatype="string"
xmlPath="string.Lower.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.StringFunction" method="lower"/>
    </function>
    <function name="Initcap"
xmlPath="string.Initcap">
    <inputs>
        <datapoint pos="0"
name="String" datatype="string"
xmlPath="string.Initcap.inputs.0"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="Result" datatype="string"
xmlPath="string.Initcap.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.StringFunction" method="initcap"/>
    </function>
</group>
<group name="vocabulary" xmlPath="vocabulary">
    <function name="translateValue"
xmlPath="vocabulary.translateValue">
    <inputs>
        <datapoint pos="0"
name="dataIn" datatype="string"
xmlPath="vocabulary.translateValue.inputs.0"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="dataOut" datatype="string"
xmlPath="vocabulary.translateValue.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.FunctionVocabularyMapping" method="translateValue"/>
    </function>
    <function name="translateInverseValue"
```

```

xmlPath="vocabulary.translateInverseValue">
    <inputs>
        <datapoint pos="0"
name="dataIn" datatype="string"
xmlPath="vocabulary.translateInverseValue.inputs.0"/>
    </inputs>
    <outputs>
        <datapoint pos="0"
name="dataOut" datatype="string"
xmlPath="vocabulary.translateInverseValue.outputs.0"/>
    </outputs>
    <implementation
classname="gov.nih.nci.caadapter.common.function.FunctionVoca
bularyMapping" method="inverseTranslateValue"/>
    </function>
</group>
</functions>

```

Vocabulary Mapping Specification Overview

The vocabulary mapping specification is used as a guide for translating values from one vocabulary set to another. It includes one or more vocabulary domain names with associated translations (source and target values) and a mechanism for handling cases where the incoming value does not match any of the mapped values.

The vocabulary mapping specification uses the following types of nested elements:

1. <VocabularyMapping>
2. <comment>
3. <domain>
4. <translation>
5. <source>
6. <target>
7. <elseCase>
8. <inverseElseCase>

The `elsecase` and `inverseElseCase` elements can have several types which govern what happens when an incoming value doesn't match any of the maps. Some of the flavors also include a value that the mapping can define for that case. The types include the following:

<i>Else Case Type</i>	<i>Description</i>	<i>Includes a Value?</i>
keepValue	Returns the incoming value without any change	No
null	Returns a null	No
assignValue	Returns the value provided in the value attribute	Yes

Table 5.2 Else Case Types

Else Case Type	Description	Includes a Value?
makeAnError	Returns an error status to cause caAdapter to report a vocabulary mapping error	No

Table 5.2 Else Case Types

Following is an example of a vocabulary mapping specification file (using the designated file extension, .vom). See the {home directory}\workingspace\examples\V2V3 Mapping Examples\ADT_A03_to_402003 file for a soft copy of this code and see the {home directory}\etc functions file for the vom.xsd file that governs the structure of the .vom file.

```
<?xml version="1.0" encoding="UTF-8"?>
<VocabularyMapping name="Test_Example01">
  <comment>
    This vom file was made for test instance of V2-V3
mapping
    which is between ADT^A03 and PRPA_MT402003
  </comment>
  <domain name="AdministrativeGender">
    <comment>
      Source:HL70001(Administrative Sex),
Target:2.16.840.1.113883.11.1(AdministrativeGender)
    </comment>
    <translation name="Male">
      <source value="M" remark="Male"/>
      <target value="M" remark="Male"/>
    </translation>
    <translation name="Female">
      <source value="F" remark="Female"/>
      <target value="F" remark="Female"/>
    </translation>
    <translation name="unknown1">
      <source value="U" remark="Unknown"/>
      <target value="UN" remark="Undifferentiated"/
    >
    </translation>
    <translation name="unknown2">
      <source value="O" remark="Other"/>
      <target value="UN" remark="Undifferentiated"/
    >
    </translation>
    <translation name="unknown3">
      <source value="A" remark="Ambiguous"/>
      <target value="UN" remark="Undifferentiated"/
    >
    </translation>
```



```
<translation name="unknown4">
  <source value="N" remark="Not applicable"/>
  <target value="UN" remark="Undifferentiated"/>
>

</translation>
<elseCase type="keepValue"/>
<inverseElseCase type="assignValue" value="UN"/>

</domain>
<domain name="DiseaseCodingSystemOID">
  <translation name="ICD-10">
    <source value="I10"/>
    <target value="2.16.840.1.113883.6.3"/>
  </translation>
  <translation name="ICD-9CM">
    <source value="I9C"/>
    <target value="2.16.840.1.113883.6.2"/>
  </translation>
  <translation name="SNOMED">
    <source value="SNM"/>
    <target value="2.16.840.1.113883.6.5"/>
  </translation>
  <elseCase type="keepValue"/>
  <inverseElseCase type="keepValue"/>
</domain>
</VocabularyMapping>
```

Adding Functions to the Function Library

The function library provides a list of system defined functions that facilitate the data transformation requirement. Functions are grouped by its functional categories (for example, math group, string group, etc). It is required that each group has to have a unique name across the whole function library, but the name of individual function is only required to be unique within its defined group.

The design of function library encompasses some extensibility on the support of user-customized functions in the definition of the function library's XML schema. In this version of release, no GUI utility is available to allow you to register custom function libraries to the mapping tool. However, advanced software engineers can update the function library definition file, named `core.flx`, located in the `{home directory}\etc` directory, to register or replace your own function implementations. After registration, the configuration engineer needs to make sure the corresponding customized Java library is available on the classpath, so that next time the mapping tool starts, it can secure the needed Java implementation classes during the generation of HL7 v3 messages.

CHAPTER 6

USING THE CAADAPTER APIs

This chapter describes the set of primary caAdapter APIs.

Topics in this chapter include:

- [caAdapter Directory Structure](#) on this page
- [caAdapter APIs](#) on page 84
- [caAdapter API Error Logs](#) on page 87

caAdapter Directory Structure

Depending on the type of distribution of caAdapter, the directory structure will vary. *Table 6.1* contains the directories under your {home directory} for the binary distribution.

Directory	Contents
conf	Component level configuration
docs	Javadocs and other useful information
lib	Java libraries and dependencies; and the MIF.zip file
schema	HL7 v3 Schema files
workspace	Default directory where you can save project files. It contains log files and HL7 v3 XML instances. It also contains an <code>examples</code> directory with example data (see <i>caAdapter Example Data</i> on page 117).

Table 6.1 Directory Structure for caAdapter (Binary Distribution)

Table 6.2 contains the directories under your {home directory} for source distribution.

Directory	Contents
components	Different caAdapter components. Each component has its own build script, required libraries, and configurations. caAdapter has common, hl7, RDS, UI, and web service components.
conf	Component level configuration
docs	Javadocs and other useful information
lib	Java libraries and dependencies; and the MIF.zip file
etc	Important supplementary files
workspace	Default directory where you can save project files. It contains log files and HL7 v3 XML instances. It also contains an examples directory with example data (see <i>caAdapter Example Data</i> on page 117).

Table 6.2 Directory Structure for caAdapter (Source Distribution)

caAdapter APIs

There are four primary modules in the set of caAdapter APIs.

- Meta Data Loader
- Transformation Service
- HL7 v2 to HL v3 Transformation
- Vocabulary and MIF schema Validation

The following sections provide a description of each.

Meta Data Loader

HL7 provides the following format for specifying message metadata (structure, format, and constraints):

- Model Interchange Format (MIF. MIF is XML based. When the message is being parsed, the Meta Data Loader drives how the internal HL7 message instance is built.

Note: The Meta Data Loader supports both format types: a java object of the serialized MIF file, a XML based file. The following example demonstrates how to use the Meta Data Loader.

1. Load Serialized MIF file from resource.zip - located at lib directory.

```
InputStream is = this.getClass()
.getResourceAsStream("/mif/" + mifFileName);
ObjectInputStream ois = new ObjectInputStream(is);
MIFClass mifClass = (MIFClass)ois.readObject();
ois.close();
is.close();
```

2. Load Serialized MIF file from a XML file.

```

XmlToMIFImporter xmlToMIFImporter = new XmlToMIFImporter();
MIFClass mifClass = xmlToMIFImporter
    .importMifFromXml(new File(filepath));

```

Transformation Service

The transformation service reads the mapping file and converts a compliant source file into a series of HL7 v3 XML instances. The mapping file contains a reference to the source specification, target specification, function library specification, and mapping information.

The transformation service classes are located in the `gov.nih.nci.caadapter.hl7.transformation` package.

The following example demonstrates how to use the transformation service. Given the CSV source file and the mapping file, the `TransformationService` class transforms the CSV file into the `MapGenerateResult` class, which contains the generated HL7 v3 message text and the corresponding validation results.

```

TransformationService ts = new TransformationService
    ("data/Transformation/COCT_MT010000_MAP1-1.map",
     "data/Transformation/COCT_MT01000_Person.CSV");

List<XMLElement> xmlElements = ts.process();
if (xmlElements==null)
{
    //if failed in processing the source data
    //file,it returns error messages
    ValidatorResults rs=ts.getValidatorResults();
    String errorMsg= rs.getAllMessages().toString();
}

else {
    //return a list of generated messages
    for(XMLElement rootElement: xmlElements) {
        String hl7MessageXml= rootElement.toXML().
            toString();
    }
}

```

HL7 v2 to HL7 V3 Transformation

The first step in mapping an HL7 v2 to an HL7 v3 is to create a CSV specification file, or an scs file, equivalent to the HL7 v2 message structure. The user can then use the caAdapter GUI to transform the HL7 v2 message into a CSV file based on the CSV specification file created in this step. The second step is to map the elements of the CSV file to the appropriate HL7 v3 message. These steps have been described in previous chapters.

Alternatively, the user may use caAdapter's APIs to automatically transform the HL7 v2 data to create the corresponding CSV file (reference the second part of the first step above).

Following is a sample code that shows how to accomplish this task.

```
V2Converter con = new
V2Converter(FileUtil.getV2DataDirPath());
con.convertV2ToCSV(hl7FileName, csvFileName, scsFileName);
if (!con.isCSVValid())
    List<String> errList = con.getValidationMessages();
```

This sample code must be caught by the `HL7MessageTreeException`.

Vocabulary and MIF Schema Validation

Vocabulary validation provides the ability to validate HL7 structural attributes against the HL7 published vocabulary. MIF schema validation validates an XML format HL7 message against a MIF schema file provided by the user (calling program).

The following example demonstrates how to invoke the two validation processes:

```
ValidatorResults validatorsToShow=new ValidatorResults();
String level=CaadapterUtil.readPrefParams(
Config.CAADAPTER_COMPONENT_HL7_TRANSFORMATION_VALIDATION_LEVEL);
//always process the structure validation ... level_0
validatorsToShow.addValidatorResults(xmlMsg.getValidatorRe-
sults());
if(level!=null&&! level.equals( CaAdapter-
Pref.VALIDATION_PERFORMANCE_LEVLE_0))
{
//add vocabulary validation ... level_1
validatorsToShow.addValidatorResults(xmlMsg.validate());
if(level.equals(CaAdapterPref.VALIDATION_PERFORMANCE_LEVLE_2))
{ //add xsd validation
try {
String xsdFile= FileUtil.searchMessageTypeSchemaFileName(
xmlMsg.getMessageType(), "xsd");
HL7V3MessageValidator h7v3Validator=new
HL7V3MessageValidator();
//add xsd validation ... level_2 validatorsToShow.addValidator-
Results(h7v3Validator.validate(xmlMsg.toXML().toString(), xsd-
File);
} catch (Exception e)
{
e.printStackTrace();
}
}
```

caAdapter API Error Logs

Many of the targets provide logging information that is printed to the console and saved to a file. The log files can be found in the `{home directory}\workspace` directory. All log messages are saved to the file `caadapter.log.#` where # is the number of the log file created.

The logging utility is configurable; edit the `{home directory}\logging.properties` file to change your logging properties.

CHAPTER 7

CAADAPTER WEB SERVICES TRANSFORMATION MODULE

This chapter contains information on using caAdapter's Web Services.

Topics in this chapter include:

- [Introduction](#) on this page
- *Setup Mapping Scenarios Through the Web Portal* on page 90
- *Programmatic Access to the caAdapter Web Services* on page 91

Introduction

A Web service is a software application identified by a URI, whose interface and bindings are capable of being identified, described and discovered by XML artifacts. The web service also supports direct interactions with other software applications using XML based messages via Internet-based protocols (by World Wide Web Consortium).

caAdapter's CSV to HL7 v3 Message Transformation Service API is a JAVA API and can only be directly integrated with a JAVA-based application. This web service provides a powerful mechanism to integrate caAdapter's CSV to HL7 v3 Transformation Service into a variety of systems that are developed under different platforms and software environment.

caAdapter 3.2.0.2 Web Service Model includes the following two sub-components:

- Web Portal – provides basic mapping scenario management.
- Web Service API – provides CSV to HL7 v3 transformation service.

The Web Portal provide a mechanism to upload all the mapping files including the actual .map file, CSV specification file, and HL7 v3 specification file. Once uploaded, the files can be used by subsequent transformation services. This is typically a one time effort.

Figure 7.1 illustrates the Web Service Module architecture.

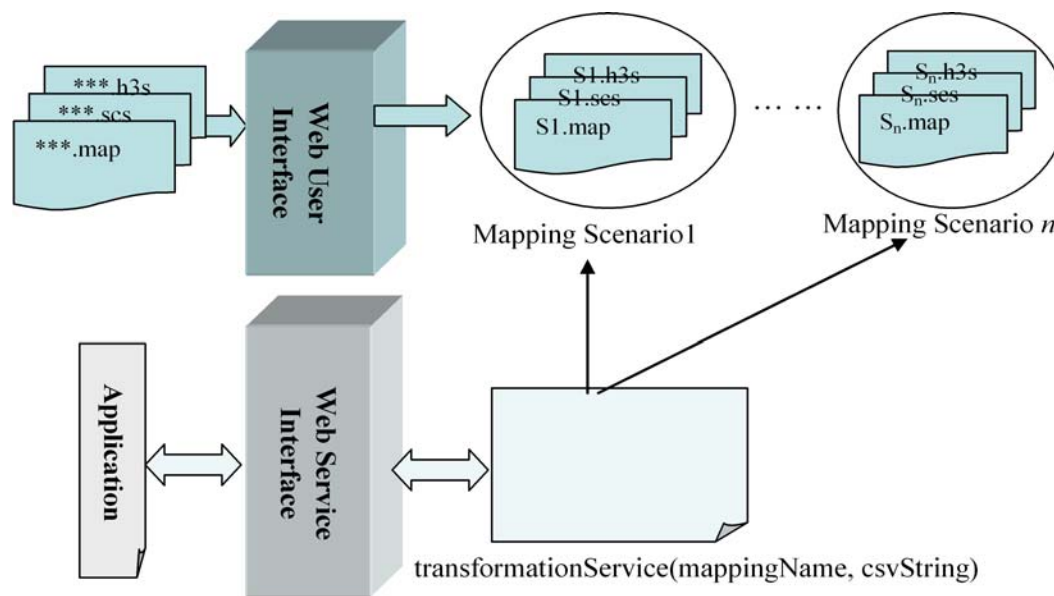


Figure 7.1 caAdapter Web Service Module Architecture

Setup Mapping Scenarios Through the Web Portal

This section contains the step-by-step instructions to upload mapping, CSV, and HL7 v3 specification.

1. Open an IE/Firefox browser and enter the following link:

<http://caadapter.nci.nih.gov>

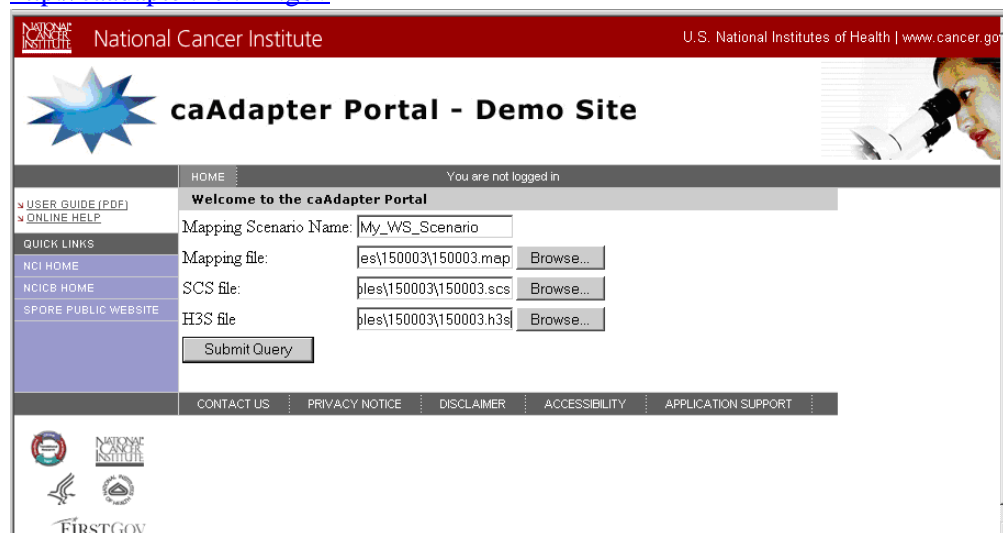


Figure 7.2 caAdapter Portal

2. In the "Mapping Scenario Name" field, specify the name for the set of mapping files you are going to upload, and use this name in the later web services clients.

3. In the "Mapping file" field, specify the name and path to the mapping file, usually with .map suffix.
4. In the "scs file" field, specify the name and path to the CSV specification file, usually with .scs suffix.
5. In the "H3S file" field, specify the name and path to the HL7 v3 metadata file, usually with .h3s suffix.

Once the mapping scenario is created successfully, a confirmation message appears.

Programmatic Access to the caAdapter Web Services

See the following sections for information about accessing the caAdapter Web Services:

- *Axis 1.x RPC Style Access to caAdapter Web Services* on page 91
- *Axis 1.x DII Style Access to caAdapter Web Services* on page 92
- *Axis 2.0 RPC Style Access to caAdapter Web Services* on page 93

Axis 1.x RPC Style Access to caAdapter Web Services

1. Download Axis 1.x (axis-bin-1_4.zip) from the following URL: http://www.apache.org/dyn/closer.cgi/ws/axis/1_4
2. Unzip the axis-bin-1_4.zip
3. Add the following files for the axis-1_4/lib directory to you classpath.
 - a. axis.jar
 - b. axis-ant.jar
 - c. commons-discovery-0.2.jar
 - d. commons-logging-1.0.4.jar
 - e. jaxrpc.jar
 - f. log4j-1.2.8.jar
 - g. saaj.jar
 - h. wsdl4j-1.5.1.jar
4. Run the following command to generate all the stubs:


```
java org.apache.axis.wsdl.WSDL2Java http://caadapter.nci.nih.gov/caAdapterWS/ws/caAdapterTransformationService?wsdl
```
5. Use the following code to access the caAdapter Web Services.

```
import java.util.*;
import
gov.nih.nci.caadapter.caAdapterWS.ws.caAdapterTransformationS
ervice.*;
public class AxisRPCClient {
    public static void main(String[] args) {
        try {
            String csvString = "ORGS,RAD\nORGID,2.1 ... ..";
```

```
CaAdapterTransformationServiceService service
= new CaAdapterTransformationServiceServiceLocator();
CaAdapterTransformationService caAdapterService
= service.getcaAdapterTransformationService();
Object[] res =
(Object[])caAdapterService.transformationService(
" My_WS_Scenario",csvString);
    for(int i=0;i<res.length;i++)
        System.out.println((String)res[i]);
    }catch(Exception e) {
        e.printStackTrace();
    }
}
```

Axis 1.x DII Style Access to caAdapter Web Services

1. Download Axis 1.x (axis-bin-1_4.zip) from the following URL: http://www.apache.org/dyn/closer.cgi/ws/axis/1_4
2. Unzip axis-bin-1_4.zip
3. Add the following files for the axis-1_4/lib directory to your classpath.
 - a. axis.jar
 - b. axis-ant.jar
 - c. commons-discovery-0.2.jar
 - d. commons-logging-1.0.4.jar
 - e. jaxrpc.jar
 - f. log4j-1.2.8.jar
 - g. saaj.jar
 - h. wsdl4j-1.5.1.jar
4. Use the following code to access the caAdapter web services

```
import org.apache.axis.client.Call;
import org.apache.axis.client.Service;
import org.apache.axis.encoding.XMLType;
import javax.xml.rpc.ParameterMode;
import javax.xml.namespace.QName;
import org.apache.axis.utils.Options;
import java.util.*;

public class AxisClient {

    public static void main(String[] args) {
        try {
            String endpointURL = " http://caadapter.nci.nih.gov/
caAdapterWS/ws/caAdapterTransformationService";
            String methodName = "transformationService";
```

```

        String csvString = "ORGS,RAD\nORGID,2.1 ... ";
        Service service = new Service();
        Call call = (Call)service.createCall();
        call.setTargetEndpointAddress(new
java.net.URL(endpointURL));
        call.setOperationName(methodName);
        call.addParameter("parameter_name",
XMLType.XSD_STRING,
ParameterMode.IN );
        call.addParameter("csvstringname",
XMLType.XSD_STRING,
ParameterMode.IN );
        call.setReturnClass(java.util.ArrayList.class);
        ArrayList res = (ArrayList)call.invoke(
new Object[]{"My_WS_Scenario",csvString});
        System.out.println(res);
    }catch(Exception e) {
        e.printStackTrace();
    }
}

```

In the above code, "My_WS_Scenario" is the "Mapping Scenario Name" you used in the caAdapter Web Service Management Portal. CSV String is the actual data that needs to be transformed. The result is an XML message of the result HL7 v3 messages.

Axis 2.0 RPC Style Access to caAdapter Web Services

1. Download Axis 2.0 (axis2-1.1.zip) from the following URL: <http://ws.apache.org/axis2/>
2. Unzip axis2-1.1.zip.
3. Add the following files for the axis-1_4/lib directory to your classpath.
 - a. axis.jar
 - b. axis-ant.jar
 - c. commons-discovery-0.2.jar
 - d. commons-logging-1.0.4.jar
 - e. jaxrpc.jar
 - f. log4j-1.2.8.jar
 - g. saaj.jar
 - h. wsdl4j-1.5.1.jar
4. Use the following code to access the caAdapter Web Services

```

package swe645;
import java.util.ArrayList;
import javax.xml.namespace.QName;
import org.apache.axis2.AxisFault;
import org.apache.axis2.addressing.EndpointReference;

```

```
import org.apache.axis2.client.Options;
import org.apache.axis2.rpc.client.RPCServiceClient;
import org.apache.axiom.om.impl.llom.OMTextImpl;
import org.apache.axiom.om.impl.llom.OMElementImpl

public class AxisClient {

    public static void main(String[] args1) throws AxisFault {
        String csvString = "ORGS,RAD\nORGID,2.1 ... ...";

        RPCServiceClient serviceClient = new RPCServiceClient();
        Options options = serviceClient.getOptions();
        EndpointReference targetEPR = new EndpointReference("
http://caadapter.nci.nih.gov/caAdapterWS/ws/
caAdapterTransformationService");
        options.setTo(targetEPR);
        // QName of the target method
        QName opAddEntry = new QName("caAdapter",
"transformationService");
        Object[] opAddEntryArgs = new Object[] {
"My_WS_Scenario",
csvString };
        Class[] returnTypes = new Class[] { ArrayList.class
};

        // Invoking the method
        Object[] res =
serviceClient.invokeBlocking(opAddEntry,
        opAddEntryArgs, returnTypes);

        ArrayList resultArrayList = (ArrayList) res[0];
        for(int i=0;i< resultArrayList.size();i++) {
            OMElementImpl omE = (OMElementImpl)resultArrayList.get(i);
            OMTextImpl textOM = (OMTextImpl)omE.getFirstOMChild();
            System.out.println(textOM.getText());
        }
    }
}
```


CHAPTER 8

CAADAPTER FILE TYPES

This chapter includes the different file types and their formats used by caAdapter.

Topics in this chapter include:

- [caAdapter File Formats and Locations](#) on this page
- *CSV Data File* on page 96
- *CSV Specification* on page 97
- *HL7 v3 Specifications* on page 98
- *HL7 v2 Specifications* on page 103
- *SDTM Data Files* on page 105
- *SDTM Meta Data Files* on page 106
- *Function Specification* on page 107
- *HL7 v3 Message* on page 110
- *CSV to HL7 v3 Map Specification* on page 111
- *Object to Database Map Specification* on page 113

caAdapter File Formats and Locations

caAdapter uses a variety of files in its APIs and mapping tool. *Table 8.1* contains the files and extensions used by caAdapter.

File Type	Extension
CSV Specification	.scs
HL7 v3 Specification	.h3s and .xml
HL7 v2 Message Structure	.dat

Table 8.1 File Extensions

File Type	Extension
HL7 v3 DataTypeSpec	.dat
HL7 v3 Segment Attribute Table	.dat
HL7 v3 Definition Table	.dat
Function Library Specification	.fls
SDTM Data File	.txt
SDTM Metadata File	.xml
Map Specification	.map
HL7 v3 Message	.xml

Table 8.1 File Extensions

Note: Manual editing of those files is not supported and is highly discouraged.

Caution: The map specification has an internal reference to the full path name of the source and target specification files. This must be accurate in order to process the conversion or to edit a map specification successfully. Though it is not recommended, the map specification file can be manually edited to change the file path for the source and target specification if necessary. If you are sharing map specification files with other users, you must send all three files, the CSV Specification (.scs), HL7 v3 Specification (.h3s, or .xml), and map specification (.map) and not just the map specification.

CSV Data File

It is an assumption for this version of the mapping tool that the source data systems provide data in CSV flat file formats with the following characteristics:

- File contents are organized into multi-line logical records.
- Each line, called a segment, begins with an identifier, called a segment name, and is terminated by a new-line character.
- Each segment has one or more data items, called fields, which follow the segment name and terminates by commas (except for the last field on the line that uses the segment terminator).
- Segments may occur more than once in the same logical record, except for the first, or root, segment, which always indicates the beginning of a new record.
- Segments are related to one another in a parent-child hierarchy that documents the one-to-many nature of the association between related data items.
- A CSV file may have one or more logical records. Each of these is terminated by the beginning of the next record (a new root segment) or the end of file.
- The intention is that each logical record will become one single HL7 v3 XML message instance.

CSV Specification

CSV specification describes the structure of a CSV instance. In essence, it is a CSV specification in the same way an XSD is a specification of an XML instance. The CSV specification is based on common concepts found in EDI, CSV and HL7 v2-related files. To document this structure, the CSV specification uses an XML format that has three main elements:

1. <csvMetadata>
2. <segment>
3. <field>

There can only be one root <segment>, but within it there can be any number of dependent <segment> elements and any number of <field> elements. All <field> elements have a column number assigned which corresponds to the second, third, etc., column in the CSV file (the first is the segment name which is considered column 1). The field names are informational and are not used in the mapping file; only the segment name and column number are referenced.

Following is a CSV specification file (090102.scs) example.

```
<?xml version="1.0" encoding="UTF-8"?>
<csvMetadata xmlPath="csvMetaData" version="1.2">
  <segment name="ORGS" xmlPath="ORGS" cardinality="1..1">
    <segment name="ORGID" xmlPath="ORGS.ORGID"
cardinality="0..*">
      <field column="1" name="Root" datatype="String"
xmlPath="ORGS.ORGID.Root"/>
      <field column="2" name="Extension" datatype="String"
xmlPath="ORGS.ORGID.Extension"/>
    </segment>
    <segment name="ORGNM" xmlPath="ORGS.ORGNM"
cardinality="0..*">
      <field column="1" name="Name" datatype="String"
xmlPath="ORGS.ORGNM.Name"/>
    </segment>
    <segment name="ORGAD" xmlPath="ORGS.ORGAD"
cardinality="0..*">
      <field column="1" name="Street_1" datatype="String"
xmlPath="ORGS.ORGAD.Street_1"/>
      <field column="2" name="Street_2" datatype="String"
xmlPath="ORGS.ORGAD.Street_2"/>
      <field column="3" name="City" datatype="String"
xmlPath="ORGS.ORGAD.City"/>
      <field column="4" name="State" datatype="String"
xmlPath="ORGS.ORGAD.State"/>
      <field column="5" name="Zip_Code" datatype="String"
xmlPath="ORGS.ORGAD.Zip_Code"/>
    </segment>
    <segment name="PERSNM" xmlPath="ORGS.PERSNM"
cardinality="0..*">
```

```
        <field column="1" name="First_Name"
datatype="String" xmlPath="ORGS.PERSNM.First_Name"/>
        <field column="2" name="Last_Name" datatype="String"
xmlPath="ORGS.PERSNM.Last_Name"/>
        <field column="3" name="Middle_Initial"
datatype="String" xmlPath="ORGS.PERSNM.Middle_Initial"/>
        <field column="4" name="Job_Code" datatype="String"
xmlPath="ORGS.PERSNM.Job_Code"/>
    </segment>
    <segment name="PERSID" xmlPath="ORGS.PERSID"
cardinality="0..*">
        <field column="1" name="Root" datatype="String"
xmlPath="ORGS.PERSID.Root"/>
        <field column="2" name="Extension" datatype="String"
xmlPath="ORGS.PERSID.Extension"/>
    </segment>
    <segment name="PERSAD" xmlPath="ORGS.PERSAD"
cardinality="0..*">
        <field column="1" name="Street_1" datatype="String"
xmlPath="ORGS.PERSAD.Street_1"/>
        <field column="2" name="Street_2" datatype="String"
xmlPath="ORGS.PERSAD.Street_2"/>
        <field column="3" name="City" datatype="String"
xmlPath="ORGS.PERSAD.City"/>
        <field column="4" name="State" datatype="String"
xmlPath="ORGS.PERSAD.State"/>
        <field column="5" name="Zip_Code" datatype="String"
xmlPath="ORGS.PERSAD.Zip_Code"/>
    </segment>
    <field column="1" name="ORG_CODE" datatype="String"
xmlPath="ORGS.ORG_CODE"/>
</segment>
</csvMetadata>
```

HL7 v3 Specifications

The HL7 v3 specification, used to define the HL7 v3 metadata information, is based largely on the MIF for the target HL7 v3 message. An HL7 V3 specification may be saved either as a binary .h3s file or as an .xml file. The .h3s file is not readable. The .xml file uses four main types of nested elements:

- < class>
- < association>
- <attribute>
- < type>
- < dataField>

Following is part of an HL7 v3 specification file (150003.h3s) example. See the {home directory}\workspace\examples\150003 for the entire file.

```

<class name="ContactParty" isEnabled="true" title="MIF Clone
Properties" referenceName="" sortKey="">

<packageLocation /

<attribute name="classCode" type="CS" defaultValue="CON"
isEnabled="true" title="MIF Attribute Properties"
mnemonic="CON" sortKey="1" minimumMultiplicity="1"
isStrutural="true"
parentXmlPath="Organization.contactParty00"
maximumMultiplicity="1" isMandatory="true" conformance="R"
dDefaultValueProperty="CON"
dDomainNameOidProperty="RoleClassContact
(2.16.840.1.113883.11.12205)" codingStrength="CNE"
multiplicityIndex="0" minimumSupportedLength="0"
domainName="RoleClassContact" />

<attribute name="id" type="II" isEnabled="true" title="MIF
Attribute Properties" sortKey="2" minimumMultiplicity="0"
parentXmlPath="Organization.contactParty00"
maximumMultiplicity="-1" multiplicityIndex="0"
minimumSupportedLength="0">

<type name="II" isEnabled="true" parents="ANY">

<dataField name="nullFlavor" type="NullFlavor" max="-2"
isValid="true" title="MIF Data Field Properties"
isSimple="true"
parentXmlPath="Organization.contactParty00.id00" min="-2"
isOptional="true" isAttribute="true" />

<dataField name="assigningAuthorityName" type="st" max="-2"
isValid="true" isEnabled="true" title="MIF Data Field
Properties" isSimple="true"
parentXmlPath="Organization.contactParty00.id00" min="-2"
isOptional="true" isAttribute="true" />
... ..
    </type>

</attribute>

<attribute name="addr" type="AD" isEnabled="true" title="MIF
Attribute Properties" sortKey="4" minimumMultiplicity="0"
parentXmlPath="Organization.contactParty00"
maximumMultiplicity="-1" multiplicityIndex="0"
minimumSupportedLength="0">

<type name="AD" isEnabled="true" parents="ANY">

```

```
<dataField name="direction" type="adxp.direction" max="-2"
isValid="true" title="MIF Data Field Properties" min="-2" />

<dataField name="city" type="adxp.city" max="-2"
isValid="true" isEnabled="true" title="MIF Data Field
Properties" isOptionChosen="true"
parentXmlPath="Organization.contactParty00.addr00" min="-2">

<type name="adxp.city" isEnabled="true" parents="ADXP">

<dataField name="reference" type="TEL" max="0" title="MIF
Data Field Properties" min="0" />

<dataField name="mediaType" type="cs" max="-2" isValid="true"
isEnabled="true" title="MIF Data Field Properties"
isSimple="true"
parentXmlPath="Organization.contactParty00.addr00.city"
min="-2" isAttribute="true" />

... ..

</type>

</dataField>

<dataField name="streetNameBase" type="adxp.streetNameBase"
max="-2" isValid="true" title="MIF Data Field Properties"
min="-2" />

<dataField name="precinct" type="adxp.precinct" max="-2"
isValid="true" title="MIF Data Field Properties" min="-2" />

<dataField name="unitType" type="adxp.unitType" max="-2"
isValid="true" title="MIF Data Field Properties" min="-2" />

... ..

</attribute>

<association name="contactPerson" isEnabled="true" title="MIF
Association Properties" sortKey="1" minimumMultiplicity="0"
isOptionChosen="true"
parentXmlPath="Organization.contactParty00"
maximumMultiplicity="1" multiplicityIndex="0">

<class name="Person" isEnabled="true" title="MIF Clone
Properties" referenceName="" sortKey="">

<packageLocation />
```

```

<attribute name="classCode" type="CS" isEnabled="true"
title="MIF Attribute Properties" mnemonic="PSN" sortKey="1"
minimumMultiplicity="1" isStrutural="true"
parentXmlPath="Organization.contactParty00.contactPerson"
maximumMultiplicity="1" isMandatory="true" conformance="R"
dDefaultValueProperty="PSN"
dDomainNameOidProperty="EntityClass
(2.16.840.1.113883.11.10882)" codingStrength="CNE"
multiplicityIndex="0" fixedValue="PSN"
minimumSupportedLength="0" domainName="EntityClass" />

<attribute name="determinerCode" type="CS" isEnabled="true"
title="MIF Attribute Properties" mnemonic="INSTANCE"
sortKey="2" minimumMultiplicity="1" isStrutural="true"
parentXmlPath="Organization.contactParty00.contactPerson"
maximumMultiplicity="1" isMandatory="true" conformance="R"
dDefaultValueProperty="INSTANCE"
dDomainNameOidProperty="EntityDeterminer
(2.16.840.1.113883.11.10878)" codingStrength="CNE"
multiplicityIndex="0" fixedValue="INSTANCE"
minimumSupportedLength="0" domainName="EntityDeterminer" />

<attribute name="name" type="EN" isEnabled="true" title="MIF
Attribute Properties" sortKey="3" minimumMultiplicity="1"
parentXmlPath="Organization.contactParty00.contactPerson"
maximumMultiplicity="-1" conformance="R"
multiplicityIndex="0" minimumSupportedLength="0">

<type name="EN" isEnabled="true" parents="ANY">

<dataField name="suffix" type="en.suffix" max="-2"
isValid="true" isEnabled="true" title="MIF Data Field
Properties" isOptionChosen="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00" min="-2">

<type name="en.suffix" isEnabled="true" parents="ENXP">

<dataField name="mediaType" type="cs" max="-2" isValid="true"
isEnabled="true" title="MIF Data Field Properties"
isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00.suffix" min="-2" isAttribute="true" />

<dataField name="representation" type="BinaryDataEncoding"
max="-2" isValid="true" isEnabled="true" title="MIF Data
Field Properties" isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00.suffix" min="-2" isAttribute="true" />

```

```
<dataField name="integrityCheckAlgorithm"
type="IntegrityCheckAlgorithm" max="-2" isEnabled="true"
title="MIF Data Field Properties" isProhibited="true"
isSimple="true" min="-2" isAttribute="true" />

<dataField name="language" type="cs" max="-2" isValid="true"
isEnabled="true" title="MIF Data Field Properties"
isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00.suffix" min="-2" isOptional="true" isAttribute="true" />

<dataField name="thumbnail" type="ED" max="0" title="MIF Data
Field Properties" min="0" />

<dataField name="compression" type="CompressionAlgorithm"
max="-2" isEnabled="true" title="MIF Data Field Properties"
isProhibited="true" isSimple="true" min="-2"
isAttribute="true" />

<dataField name="nullFlavor" type="NullFlavor" max="-2"
isValid="true" isEnabled="true" title="MIF Data Field
Properties" isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00.suffix" min="-2" isOptional="true" isAttribute="true" />

<dataField name="partType" type="EntityNamePartType" max="-2"
isValid="true" isEnabled="true" title="MIF Data Field
Properties" isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00.suffix" min="-2" isAttribute="true" />

<dataField name="integrityCheck" type="bin" max="-2"
isEnabled="true" title="MIF Data Field Properties"
isProhibited="true" isSimple="true" min="-2"
isAttribute="true" />

<dataField name="reference" type="TEL" max="0" title="MIF
Data Field Properties" min="0" />

<dataField name="qualifier"
type="set_EntityNamePartQualifier" max="-2" isValid="true"
isEnabled="true" title="MIF Data Field Properties"
isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00.suffix" min="-2" isOptional="true" isAttribute="true" />

<dataField name="inlineText" max="1" isValid="true"
isEnabled="true" title="MIF Data Field Properties"
isOptionChosen="true" isSimple="true"
```



```
parentXmlPath="Organization.contactParty00.contactPerson.name
00.suffix" min="1" />

</type>

</dataField>

<dataField name="nullFlavor" type="NullFlavor" max="-2"
isValid="true" isEnabled="true" title="MIF Data Field
Properties" isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00" min="-2" isOptional="true" isAttribute="true" />

<dataField name="inlineText" max="1" isValid="true"
isEnabled="true" title="MIF Data Field Properties"
isOptionChosen="true" isSimple="true"
parentXmlPath="Organization.contactParty00.contactPerson.name
00" min="1" />

<dataField name="delimiter" type="en.delimiter" max="-2"
isValid="true" title="MIF Data Field Properties"
parentXmlPath="Organization.contactParty00.contactPerson.name
00" min="-2" />

<dataField name="validTime" type="IVL_TS" max="-2"
isValid="true" title="MIF Data Field Properties"
parentXmlPath="Organization.contactParty00.contactPerson.name
00" min="0" />

</type>

</attribute>

</class>

</association>
... ..

</class>
```

HL7 v2 Specifications

The HL7 v2 message specification is described in four kinds of resource files, i.e. Message Structure, DataTypeSpec, DefinitionTable, SegmentAttributeTable. caAdapter

requires all four file collections to be able to parse HL7 v2 messages. *Figure 8.1* shows the directory structure where the resources files are stored.

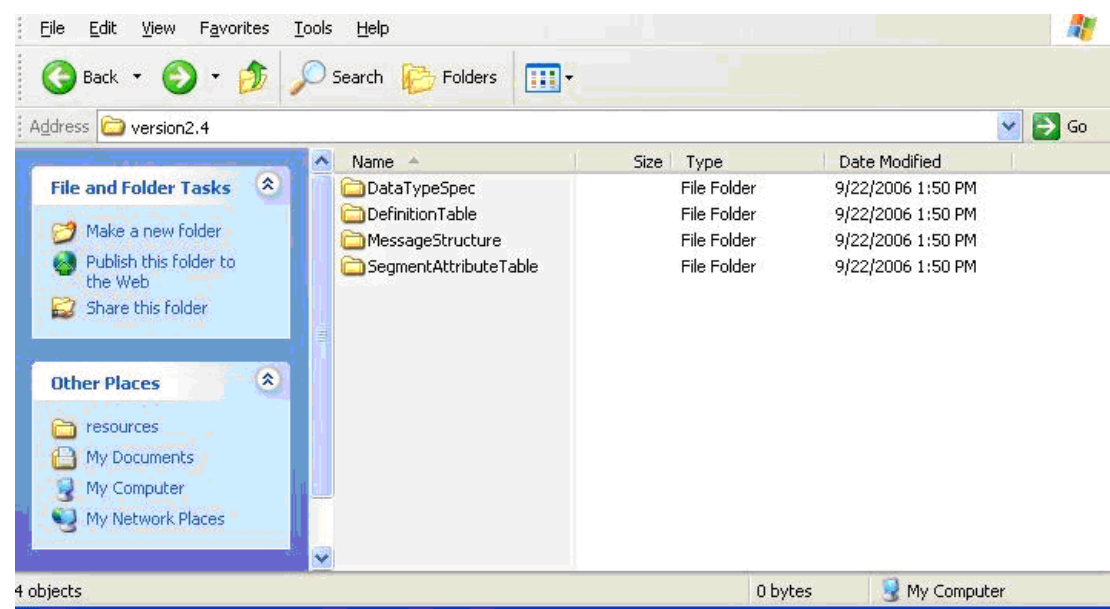


Figure 8.1 Resource Directory Structure

Message Structure

The Message Structure directory contains the information of the HL7 v2 message. The directory is organized by a collection of DAT files with file names corresponding to message type of the HL7 v2 message. 'ADT_A03' is a message type and the 'ADT_A03.DAT' is the data file. This DAT file represents the order of segments and represents the required and optional segments.

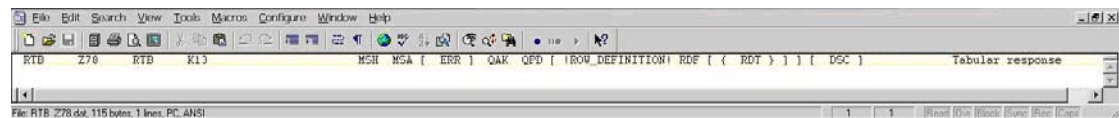


Figure 8.2 Contents of "RTB_Z78.DAT" message structure

DataTypeSpec

This directory contains DAT files with the file names corresponding to the data type. For example: AD is a datatype for representing the address object. The corresponding file in the directory has a physical file with the name "AD.DAT". The content of "AD.DAT" is shown below in *Figure 8.3*. The position, datatype (e.g. ST for String and ID for Identification), and description of each field are listed.

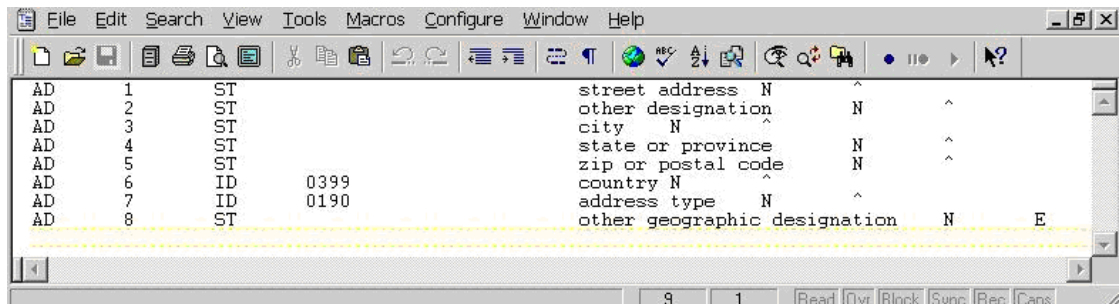


Figure 8.3 Contents of “AD.DAT” data type

Segment Attribute Table

The segment attribute table represents the structure of the Message Header (MSH) segment. It shows the fields, data types, positions, repeating fields, and index of each field for the MSH segment. *Figure 8.4* shows an example of a Segment Attribute Table.

Field	Index	Repeating	Position	Data Type	Field Name
MSH	1	-1	1	00001	Field Separator String
MSH	2	-1	4	00002	Encoding Characters String
MSH	3	-1	180	00003	Sending Application Hierarchic designator
MSH	4	0	0	00004	Sending Facility Hierarchic designator
MSH	5	0	0	00005	Receiving Application Hierarchic designator
MSH	6	0	0	00006	Receiving Facility Hierarchic designator
MSH	7	-1	26	00007	Date/Time Of Message Time stamp
MSH	8	-1	40	00008	Security String
MSH	9	0	0	00009	Message Type User Define : composi
MSH	10	-1	20	00010	Message Control ID String
MSH	11	0	0	00011	Processing ID Processing type
MSH	12	0	0	00012	Version ID Version identifier

Figure 8.4 Contents of “MSH.DAT” segment information

Definition Table

The definition table stores the HL7 v2 vocabulary information for each segment in the message. For example, in the 9901.DAT file, shown in *Figure 8.5*, ‘ABS’ segment is represented as ‘Abstract’ and ‘DB1’ as ‘Disability’.

User	Segment Code	9901	Definition
User	Segment Code	9901	ABS Abstract
User	Segment Code	9901	ACC Accident
User	Segment Code	9901	ADD Addendum
User	Segment Code	9901	AFF Professional Affiliation
User	Segment Code	9901	AIG Appointment Information - General Resource
User	Segment Code	9901	AII Appointment Information - Location Resource
User	Segment Code	9901	AIP Appointment Information - Personnel Resource
User	Segment Code	9901	AIS Appointment Information
User	Segment Code	9901	ALI Patient allergy information
User	Segment Code	9901	APR Appointment Preferences
User	Segment Code	9901	ARQ Appointment Request
User	Segment Code	9901	AUT Authorization Information
User	Segment Code	9901	BHS Batch Header
User	Segment Code	9901	BLC Blood Code
User	Segment Code	9901	BLG Billing
User	Segment Code	9901	BTS Batch Trailer
User	Segment Code	9901	CDM Charge Description Master
User	Segment Code	9901	CM0 Clinical Study Master
User	Segment Code	9901	CM1 Clinical Study Phase Master
User	Segment Code	9901	CM2 Clinical Study Schedule Master
User	Segment Code	9901	CNS Clear Notification
User	Segment Code	9901	CSP Clinical Study Phase
User	Segment Code	9901	CSR Clinical Study Registration
User	Segment Code	9901	CSS Clinical Study Data Schedule Segment
User	Segment Code	9901	CTD Contact Data
User	Segment Code	9901	CTI Clinical Trial Identification
User	Segment Code	9901	DB1 Disability
User	Segment Code	9901	DG1 Diagnosis
User	Segment Code	9901	DRG Diagnosis Related Group
User	Segment Code	9901	DSC Continuation Pointer
User	Segment Code	9901	DSP Display Data
User	Segment Code	9901	ECD Equipment Command
User	Segment Code	9901	ECR Equipment Command Response
User	Segment Code	9901	EDU Educational Detail
User	Segment Code	9901	EDZ Encapsulated Data
User	Segment Code	9901	EQ1 Embedded Query Language

Figure 8.5 Contents of “9901.DAT” segment information

SDTM Data Files

A Study Data Tabulation Module (SDTM) text file consists of the mapped data elements from the CSV file. The file has a .txt extension. This text file is created by the SDTM transformation service. For each mapped source field in a segment in the scs file, a record will be created keeping the parent-child relationship intact. This is accomplished

by prefixing the path information to each row in the CSV file. The transformation service engine will fetch values for all the fields in the specified path.

For example, the converted CSV file is transformed by the transformation service as shown below.

```
"\SourceTree\INVESTEVN\TRIGGER_5\REACTION_51\INVESTIGATIVESUBJECT_511\SUPPLY_5112\AUTHOR_51123\ASGNDENTT090000_511231\ASSIGNEDPERSON_5112311^Doeighty, Conrard, D."
```

The field name is 'ASSIGNEDPERSON_5112311' and the value is 'Doeighty, Conrard, D.' but the parent segment for this particular record are as listed below:

1. \SourceTree\INVESTEVN\TRIGGER_5\REACTION_51\INVESTIGATIVESUBJECT_511\SUPPLY_5112\AUTHOR_51123\ASGNDENTT090000_511231\ASSIGNEDPERSON_5112311^Doeighty, Conrard, D.
2. \SourceTree\INVESTEVN\TRIGGER_5\REACTION_51\INVESTIGATIVESUBJECT_511\SUPPLY_5112\AUTHOR_51123\ASGNDENTT090000_511231
3. \SourceTree\INVESTEVN\TRIGGER_5\REACTION_51\INVESTIGATIVESUBJECT_511\SUPPLY_5112\AUTHOR_51123\
4. \SourceTree\INVESTEVN\TRIGGER_5\REACTION_51\INVESTIGATIVESUBJECT_511\SUPPLY_5112\
5. \SourceTree\INVESTEVN\TRIGGER_5\REACTION_51\INVESTIGATIVESUBJECT_511\
6. \SourceTree\INVESTEVN\TRIGGER_5\REACTION_51\
7. \SourceTree\INVESTEVN\TRIGGER_5\
8. \SourceTree\INVESTEVN\
9. \SourceTree\

The transformation service checks for mapped fields in any of the parent segments. If a mapping segment exists, the corresponding value from the CSV file will be set in the same record in the resulting SDTM .txt file.

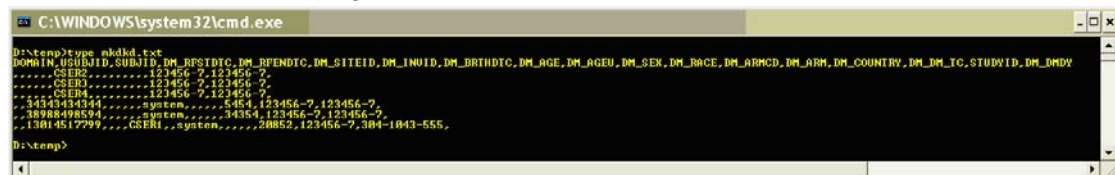


Figure 8.6 Contents of SDTM Text File

SDTM Meta Data Files

SDTM metadata file, also called Case Report Tabulation Data Definition Specification (define.xml), describes the data exchange structure for the different domains.

Sample define.xml can be found at CDISC web site: <http://www.cdisc.org/models/def/v1.0/index.html>. The following is a sample section of the define.xml file downloaded from CDISC.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
```

```

<!--
*****
**** -->
<!-- File: defineexample1.xml
-->
<!-- Date: 28-01-2005
-->
<!-- Author: Clinical Data Interchange Standards Consortium
(CDISC) -->
<!-- Description: This is an example define.xml document
which ... the Case -->
<!-- Report Tabulation Data Definition Specification
Version 1.0.0 -->
<!--
*****
**** -->
<ODM
  xmlns="http://www.cdisc.org/ns/odm/v1.2"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:def="http://www.cdisc.org/ns/def/v1.0"
  xsi:schemaLocation="http://www.cdisc.org/ns/odm/v1.2
define1-0-0.xsd"
  FileOID="Study1234"
  ODMVersion="1.2"
  FileType="Snapshot"
  CreationDateTime="2004-07-28T12:34:13-06:00">
<Study OID="1234">
  <GlobalVariables>
    <StudyName>1234</StudyName>
    <StudyDescription>1234 Data Definition</StudyDescription>
    <ProtocolName>1234</ProtocolName>
  </GlobalVariables>
  <MetaDataVersion OID="CDISC.SDTM.3.1.0"

```

Function Specification

Function Specification Overview

The function specification is used as a guide for function objects to read the function specification and determine what objects to call to execute a function (for example, the concatenation function). The function specification also stores data points for rendering the function graphical representation within the mapping tool. It uses the following types of nested elements:

```

<function>
  <group name>
    <function name>
      <inputs>
        <datapoint>

```

<outputs>

Following is an example of a function specification file (`core.fls`). See the {home directory}\map\functions directory for the entire file.

```
<?xml version="1.0"?>
<functions>
  <group name="constant" xmlPath="constant">
    <function name="constant" xmlPath="constant.constant">
      <outputs>
        <datapoint pos="0" name="constant" datatype="string" xml-
Path="constant.constant.outputs.0"/>
      </outputs>
    </function>
    <!--<function name="saveValue" xmlPath="e34f7420-09db-
11da-8gd4-io90d451x7h5">
      <inputs>
        <datapoint pos="0" name="save" datatype="string" xml-
Path="e35g7420-09db-11da-8ge5-io90d451x7k6"/>
      </inputs>
      <outputs>
        <datapoint pos="0" name="dummy" datatype="string" xml-
Path="e37i7420-09db-11da-8gg9-io90d451x7m8"/>
      </outputs>
    </function>
    <function name="readValue" xmlPath="e36h7420-09db-11da-
8gf6-io90d451x7l7">
      <outputs>
        <datapoint pos="0" name="read" datatype="string" xml-
Path="e37i7420-09db-11da-8gg7-io90d451x7m8"/>
      </outputs>
    </function> -->
  </group>
  <group name="date" xmlPath="date">
    <function name="changeFormat" xmlPath="date.changeFormat">
      <inputs>
```

```

        <datapoint pos="0" name="fromFormat" datatype="string"
xmlPath="date.changeFormat.inputs.0"/>

        <datapoint pos="1" name="dateIn" datatype="string" xml-
Path="date.changeFormat.inputs.1"/>

    </inputs>

    <outputs>

        <datapoint pos="0" name="dateOut" datatype="string" xml-
Path="date.changeFormat.outputs.0"/>

    </outputs>

    <implementation classname="gov.nih.nci.caadapter.com-
mon.function.DateFunction" method="changeFormat"/>

</function>

    <function name="countDays" xmlPath="date.countDays">

    <inputs>

        <datapoint pos="0" name="fromDate" datatype="string" xml-
Path="date.countDays.inputs.0"/>

        <datapoint pos="1" name="toDate" datatype="string" xml-
Path="date.countDays.inputs.1"/>

    </inputs>

    <outputs>

        <datapoint pos="0" name="dayNumber" datatype="int" xml-
Path="date.countDays.outputs.0"/>

    </outputs>

    <implementation classname="gov.nih.nci.caadapter.com-
mon.function.DateFunction" method="countDays"/>

</function>

</group>

... ..

</functions>

```

Adding Functions to the Function Library

The function library provides a list of system defined functions that facilitate the data transformation requirement. Functions are grouped by functional categories, e.g. math group, string group, etc. It is required that each group has a unique name across the whole function library, but the name of individual function is only required to be unique within its defined group.

The design of the function library encompasses some extensibility to support user-customized functions in the definition of the function library's XML schema. This version of caAdapter does not provide a GUI utility to allow registering custom function libraries to the Mapping Tool. However, advanced software engineers can update the function library definition file, named `core.flx`, located in the `{home directory}\etc` directory, to register or replace customized function implementations. After registration, the configuration engineer needs to make sure the corresponding customized Java library is available on the classpath. This insures that the mapping tool can locate the needed Java implementation classes during the generation of HL7 v3 messages.

HL7 v3 Message

The HL7 v3 message is the end goal of using caAdapter. It is represented in XML. Following is an example HL7 v3 message file (`ExampleOutput1.xml`).

```
<?xml version="1.0" encoding="UTF-8" ?>
- <COCT_MT090102.AssignedPerson xmlns="urn:hl7-org:v3"
classCode="ASSIGNED">
  <id root="2.16.840.1.113883.19.1" extension="12345" />
  <id root="2.16.840.1.113883.19.2" extension="23456" />
  <id root="2.16.840.1.113883.19.3" extension="34567" />
  <code code="NRS10" codeSystem="2.16.840.1.113883.19.1" />
- <addr use="WP">
  <streetAddressLine>123 Main St.Suite 500</
streetAddressLine>
  <city>Rockville</city>
  <state>MD</state>
  <postalCode>20852</postalCode>
  </addr>
- <addr>
  <streetAddressLine>456 Washington BlvdSuite 1000</
streetAddressLine>
  <city>Washington</city>
  <state>DC</state>
  <postalCode>20002</postalCode>
  </addr>
- <assignedPerson classCode="PSN" determinerCode="INSTANCE">
- <name use="L">
  <family>Shang</family>
  <given>Lee</given>
  </name>
  </assignedPerson>
- <representedOrganization classCode="ORG"
determinerCode="INSTANCE">
  <id root="2.16.840.1.113883.19.4" extension="1111GHHMO" />
  <id root="2.16.840.1.113883.19.5" extension="2222" />
  <name>Good Health HMO</name>
  <name>Good Health Radiology</name>
  <name>GHHMOR</name>
- <addr use="WP">
```



```

        <streetAddressLine>456 Washington BlvdSuite 1000</
streetAddressLine>
        <city>Washington</city>
        <state>DC</state>
        <postalCode>20002</postalCode>
    </addr>
- <addr>
    <streetAddressLine>567 Empire Ave.Suite 10000</
streetAddressLine>
    <city>New York</city>
    <state>NY</state>
    <postalCode>10118</postalCode>
    </addr>
</representedOrganization>
</COCT_MT090102.AssignedPerson>

```

CSV to HL7 v3 Map Specification

A CSV to HL7 v3 map specification describes the relationship between components via links and/or views. It has the following main elements:

1. <components>
2. <links>
3. <source>
4. <target>
5. <linkpointer>
6. <views>

A component is a reference to a resource that exists in the system prior to the mapping. A function component is an algorithm between two (or more) pieces of data.

Following is a part of a map specification file (150003.map) example. See the {home directory}\workspace\examples\150003 for the entire file.

```

<?xml version="1.0" encoding="UTF-8"?>
<mapping version="1.2">
    <components>
        <component kind="scs" location="150003.scs" type="source"/>
        <component kind="h3s" location="150003.h3s" type="target"/>
    </components>
    <links>
        <link>
            <source>
                <linkpointer kind="scs" xmlPath="ORGS.ORG_CODE"/>
            </source>
        </link>
    </links>

```

```
        </source>

        <target>

            <linkpointer kind="h3s" xmlPath="Organization.contactParty00.contactPerson.name00.inlineText"/>

        </target>

    </link>

    <link>

        <source>

            <linkpointer kind="scs" xmlPath="ORGS.ORGID.Root"/>

        </source>

        <target>

            <linkpointer kind="h3s" xmlPath="Organization.contactParty00.id00.extension"/>

        </target>

    </link>

    <link>

        <source>

            <linkpointer kind="scs" xmlPath="ORGS.ORGID"/>

        </source>

        <target>

            <linkpointer kind="h3s" xmlPath="Organization.contactParty00"/>

        </target>

    </link>

</links>

<views>

    <view component-id="source.scs.0" height="0" width="0"
x="0" y="0"/>

    <view component-id="target.h3s.0" height="0" width="0"
x="0" y="0"/>

</views>

</mapping>
```

Object to Database Map Specification

An object to database map specification describes the relationship between objects/attributes and database tables/columns via links. It has the following main elements:

```
<components>
```

```
<links>
```

A component is a reference to an XML file that exists in the system prior to the mapping. The location attribute of the component specifies the exact name and location of that XML file.

A link describes a mapping for an object, an attribute or an association. A link element has a type and datatype attribute.

If the type value is “*dependency*”, the <source> sub-element describes an object to be mapped, and the <target> sub-element describes the target table that will be mapped to.

```
<link type="dependency" parent="null">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene</source>
  <target>Logical View.Data Model.GENE</target>
</link>
```

If the type value is “*attribute*”, the <source> sub-element describes an attribute to be mapped, and the <target> sub-element describes the target table column that will be mapped to.

```
<link type="attribute" datatype="String">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene.locusLinkSummary</source>
  <target>Logical View.Data Model.GENE.LOCUS_LINK_SUMMARY</
target>
</link>
```

If type value is “*association*”, this section describes the one-to-one or one-to-many association, the <source> sub-element describes an association attribute to be mapped, and the <target> sub-element describes the target foreign key column that will be mapped to.

```
<link type="association">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene.chromosome</source>
  <target>Logical View.Data Model.GENE.CHROMOSOME_ID</target>
</link>
```

If the type value is “*manytomany*”, the section describes the many-to-many association. The <source> sub-element describes an association attribute to be

mapped, and the <target> sub-element describes the target foreign key column that will be mapped to.

```
<link type="manytomany">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Sequence.geneCollection</source>
  <target>Logical View.Data Model.GENE_SEQUENCE.GENE_ID</target>
</link>
```

Following is a part of a map specification file (example.map) example. See the {home directory}\workspace\examples\Object-2-DB-Example for the entire file.

```
<?xml version="1.0" encoding="UTF-8"?>
<mappings type="sdkintegration">
  <components>
    <component location="D:\projects\hl7sdk-new\working-
space\sample.xmi" />
    <component location="D:\projects\hl7sdk-new\working-
space\sample.xmi" />
  </components>
  <link type="dependency" parent="null">
    <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene</source>
    <target>Logical View.Data Model.GENE</target>
  </link>
  <link type="dependency" parent="null">
    <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Taxon</source>
    <target>Logical View.Data Model.TAXON</target>
  </link>
  ...
  <link type="attribute" datatype="String">
    <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene.locusLinkSummary</source>
    <target>Logical View.Data Model.GENE.LOCUS_LINK_SUMMARY</
target>
```

```

</link>

<link type="attribute" datatype="String">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene.OMIMID</source>
  <target>Logical View.Data Model.GENE.OMIM_ID</target>
</link>

.....

<link type="association">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene.taxon</source>
  <target>Logical View.Data Model.GENE.TAXON_ID</target>
</link>

<link type="association">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene.chromosome</source>
  <target>Logical View.Data Model.GENE.CHROMOSOME_ID</target>
</link>

<link type="manytomany">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Sequence.geneCollection</source>
  <target>Logical View.Data Model.GENE_SEQUENCE.GENE_ID</tar-
get>
</link>

<link type="manytomany">
  <source>Logical View.Logical
Model.gov.nih.nci.cabio.domain.Gene.libraryCollection</source>
  <target>Logical View.Data Model.LIBRARY_GENE.LIBRARY_ID</
target>
</link>

... ..
</mappings>

```

This version of caAdapter, although still supports the map file, it no longer requires it. All mapping specifications are now stored in the XMI file as shown in *Figure 8.7*.

```
<UML:ModelElement.taggedValue>
  <UML:TaggedValue tag="type" value="VARCHAR" />
  <UML:TaggedValue tag="length" value="0" />
  <UML:TaggedValue tag="ordered" value="0" />
  <UML:TaggedValue tag="precision" value="0" />
  <UML:TaggedValue tag="scale" value="0" />
  <UML:TaggedValue tag="collection" value="false" />
  <UML:TaggedValue tag="position" value="3" />
  <UML:TaggedValue tag="lowerBound" value="1" />
  <UML:TaggedValue tag="upperBound" value="1" />
  <UML:TaggedValue tag="ea_guid" value="{7F4C5830-8609-4971-8327-F0CFE011B170}" />
  <UML:TaggedValue tag="ea_localid" value="151" />
  <UML:TaggedValue tag="precision" value="0" xmi.id="EAID_15C86B99_08E9_4476_9DF8_6A1218C182ED" />
  <UML:TaggedValue tag="length" value="100" xmi.id="EAID_ID9EA187_76F2_46b5_8A0F_4B5838AB8359" />
  <UML:TaggedValue tag="ordered" value="0" xmi.id="EAID_22D57E72_9D42_41bf_9A39_B37B981C76FE" />
  <UML:TaggedValue tag="duplicates" value="0" xmi.id="EAID_34C16746_5399_4e81_A3FA_F582556FBEDE" />
  <UML:TaggedValue tag="ea_guid" value="{6400A5A5-9C5A-4c14-8603-75BB8AA16A02}" xmi.id="EAID_401F6583_
  <UML:TaggedValue tag="position" value="3" xmi.id="EAID_65FB4B3F_D1CB_446e_A46C_961C14932898" />
  <UML:TaggedValue tag="collection" value="false" xmi.id="EAID_895AC9A4_AAAE_4880_A56B_F9BF44678FA2" /
  <UML:TaggedValue tag="lowerBound" value="1" xmi.id="EAID_9447309B_5CC8_4b75_AA46_51F3679CDE9F" />
  <UML:TaggedValue tag="upperBound" value="1" xmi.id="EAID_BAC8D21C_349B_496a_B8CD_A394E2E265AC" />
  <UML:TaggedValue tag="scale" value="0" xmi.id="EAID_D78F23B1_8E8B_4064_B465_D28512F0F370" />
  <UML:TaggedValue tag="type" value="VARCHAR" xmi.id="EAID_F49E1284_DA5B_43ef_95E3_D1499440A425" />
  <UML:TaggedValue tag="stereotype" value="column" xmi.id="EAID_F6A61E25_C78A_4244_8BF0_7D09438AD381"
  <UML:TaggedValue tag="mapped-attributes" value="gov.nih.nci.cabio.domain.Clone.version" xmi.id="EAID_
</UML:ModelElement.taggedValue>
```

Figure 8.7 Mapping Specifications in the XMI File

APPENDIX

A

CAADAPTER EXAMPLE DATA

Example data are included in the caAdapter distribution. You can use the example data to become acquainted with the mapping tool or APIs before using your own data. Example data are located at the {home directory}\workspace\examples directoryexamples directory (for example, C:\caadapter\workspace\examples). The example data directory structure is shown in *Figure A.1*.

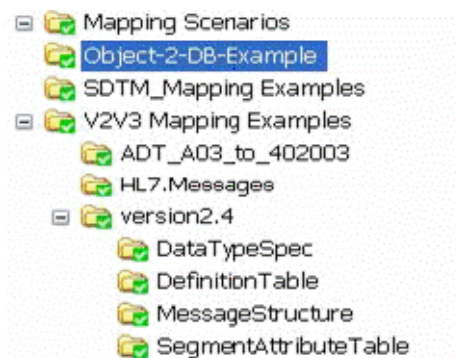


Figure A.1 Example data directory structure

The examples directory contains small (090102), medium (040002) and large (040001040011) sample HL7 v3 message files. The large HL7 v3 message example is an ICSR message. The other directories contain a subset of this data. For more information on mapping scenarios see the caAdapter Mapping Rules documentation.

The Object-2-DB-Example directory contains sample.map, sample.xmi, sample_annotated.xmi files.

The 'SDTM_Mapping Examples' directory contains define.xml, Demographics.CSV, Demographics.map, Demographics.scs, and SDTM_DM_Output.txt files.

The V2V3 Mapping Examples directory contains ADT_A03_to_402003, HL7.Messages, version2.4. The version2.4 contains DataTypeSpec, DefinitionTable, MessageStructure and SegmentAttributeTable.

APPENDIX B REFERENCES

Articles

- Java Programming: <http://java.sun.com/learning/new2java/index.html>
- Extensible Markup Language: <http://www.w3.org/TR/REC-xml/>
- XML Metadata Interchange: <http://www.omg.org/technology/documents/formal/xmi.htm>

caBIG Material

- caBIG: <http://cabig.nci.nih.gov/>
- caBIG Compatibility Guidelines: http://cabig.nci.nih.gov/guidelines_documentation

caCORE Material

- NCICB: <http://ncicb.nci.nih.gov>
- caCORE: <http://ncicb.nci.nih.gov/core>
- caBIO: <http://ncicb.nci.nih.gov/core/caBIO>
- caDSR: <http://ncicb.nci.nih.gov/core/caDSR>

HL7 Concepts and Material

- HL7: <http://www.hl7.org/>
- HL7 Tutorial: http://trials.nci.nih.gov/projects/infrastructureProject/caAdapter/HL7_Tutorial
- caAdapter: <http://trials.nci.nih.gov/projects/infrastructureProject/caAdapter>
- HL7 Reference Information Model: <https://www.hl7.org/library/data-model/RIM/C30202/rim.htm>

- HL7 Vocabulary Domains: <http://www.hl7.org/library/data-model/RIM/C30123/vocabulary.htm>
- HL7 Version 3 Standard: <http://www.hl7.org/v3ballot/html/welcome/environment/index.htm>
- UCUM: <http://aurora.regenstrief.org/UCUM/ucum.html>

Software Products

- Java: <http://java.sun.com>
- Ant: <http://ant.apache.org/>

Study Data Tabulation Model (SDTM) Concepts and Material

- Java: <http://www.cdisc.org/>

CAADAPTER GLOSSARY

Acronyms, objects, tools and other terms related to caAdapter are described in this glossary.

<i>Term</i>	<i>Definition</i>
CDMS	Clinical Data Management System.
CSV	Comma Separated Value
DMIM	Domain Message Information Model. A subset of the RIM that includes RIM class clones, attributes, and associations that can be used to create messages for a particular domain (a particular area of interest in healthcare).
DTD	Document Type Definition
EA	Enterprise Architect. UML Modeling Tool
HL7	Health Level 7 (http://www.hl7.org/) is one of several American National Standards Institute (ANSI)-accredited Standards Developing Organizations (SDOs) operating in the healthcare arena.
MIF	Model Interchange Format. An XML representation of the information contained in an HL7 specification, and is the format that all HL7 v3 specification authoring and manipulation tools will be expected to use.
MT	Message Type. The specification of an individual message in a specific implementation technology.
OID	HL7 v3 artifacts used to identify coding schemes and identifier namespaces.
NCI CBIIT	National Cancer Institute Center for Biomedical Informatics and Information Technology
RIM	Reference Information Model. The foundational Unified Modeling Language (UML) class diagram representing the universe of all healthcare data that may be exchanged between systems.
RMIM	Refined Message Information Model. A subset of a DMIM that is used to express the information content for an individual message or set of messages with annotations and refinements that are message specific.

Term	Definition
SDK	caCORE Software Development Kit or caCORE SDK, a data management framework designed for researchers who need to be able to navigate through a large number of data sources. caCORE SDK is NCICB's platform for data management and semantic integration, built using formal techniques from the software engineering and computer science communities.
SDTM	Study Data Tabulation Model. A set of standards developed by the Clinical Data Interchange Standards Consortium (CDISC).
TDMS	Translational Data Mapping Service
UCUM	Unified Code for Units of Measure
UML	Unified Modeling Language
XMI	XML Metadata Interchange
XML	Extensible Markup Language

INDEX

A

- Abstract data types
 - updating 42
- Add Clone option 38
- Add Function option 53
- Adding
 - fields in CSV 30
 - functions 81, 109
 - functions to function library 81, 109
 - function to map specification 53
 - multiple attributes on HL7 v3 specification 40
 - multiple clones on HL7 v3 specification 39
 - segments in CSV 30
- Add Multiple Clone option 40
- Adverse event
 - reporting 16
- ANY label 42
- API, caAdapter 84
- Attribute, HL7 v3 specification 34

B

- Building
 - object graph 16
- Business rules
 - HL7 v3 message 56
 - HL7 v3 specification 33
 - map specification 47

C

- caAdapter 121
 - APIs 16
 - overview 7
- caadapter.log file 87
- caBIG solution 7
- Cardinality 39
- CDMS, operational scenario 17
- changeFormat date function 54
- Changing logging properties 87
- Choice
 - boxes 43

- selected 43
 - unselected 43
- Clone
 - adding 38
 - Attribute Object Properties panel 51
 - HL7 v3 specification 34
- Clone List dialog box 39, 43
- codeSystem data type 38
- Component, defined 111, 113
- Components of caAdapter 7
- Constant function 53
- Converting data file into HL7 v3 message 57, 60
- core.flx file 81, 110
- Creating
 - HL7 v3 message 57, 60
 - HL7 v3 Specification 35
 - mapping link 49
 - map specification 48
- CSV data file format 96
- CSV Field Properties 50
- CSV specification
 - business rules 27
 - file example 97
 - format 97
 - updating 29

D

- Data type
 - element 34
 - field 43
- Date function, changeFormat 54
- Default values
 - defining 36
- Defining
 - default data 36
 - mappings 22
 - object identifiers 37
 - units of measure 36
- Delete button 31
- Deleting
 - fields in CSV 31

- map lines 50
- segments in CSV 30

Dragging-and-dropping elements in CSV 31

DTD 121

E

Edit Constant option 53

Editing

- constant function 53
- field name 31
- fields in CSV 31
- segment name 30
- segments in CSV 30

Element

- types of HL7 v3 specification 34

EVS, validation 16

Example

- CSV specification file 97
- data 83, 84
- function specification file 72, 80, 108
- HL7 v3 message file 110
- HL7 v3 specification 98
- map specification file 111, 114
- OIDs 37

examples directory 83, 84, 98, 111, 114

Excel spreadsheet 55

Extensions, file descriptions 95

F

FDA, operational scenario 17

Field properties 31

File

- New CSV Specification 28
- New HL7 v3 Message 57, 60
- New HL7 v3 Specification 35
- New Map Specification 48
- Open CSV Specification 29
- Open HL7 v3 Specification 36
- Open Map Specification 49
- Save 32, 46, 55, 59, 61
- Save As 32, 46, 55, 59, 61
- Validate 32, 45, 55

File extensions 95

File types 95

Format

- CSV data file 96
- CSV specification 97
- function specification 71, 107
- HL7 v3 message 110
- map specification 111, 113
- of files 95

Function

- component, defined 111

- group properties panel 52
- library 81, 109
- panel, defined 52
- properties panel 52, 53
- requirements 81, 109
- specification, example file 72, 80, 108
- specification format 71, 79, 107

G

Generating

- CSV Report 33
- CSV specification 22
- HL7 specification 22
- HL7 v3 messages 57, 60
- Map Report 55

Glossary 121

gov.nih.nci.hl7.map package 85

H

HL7

- assigned OIDs 37
- choice boxes 43, 44, 45

HL7 v2 to HL7 v3 Mapping 65

HL7 v3 message

- business rules 56
- creating 57, 60
- defined 56
- dialog box 57, 60
- Example file 110
- format 110
- overview 56, 60
- tab features 59

HL7 v3 specification

- attribute properties panel 51
- data type field properties panel 51
- dialog box 35
- element options 35
- example file 98
- format 103
- tab overview 33
- validating 45

I

ICSR

- operational scenario 17

inlineText data type field 36

J

JdomMessageTypeLoader 84

L

Link

- defined 47
- properties panel 51
- Log files 87
- logging.properties file 87

M

- Mandatory
 - values 37
- MapGenerateResult class 85
- Mapping
 - line 50
- Mapping tool
 - basic steps 22
 - interface 23
- Map specification
 - business rules 47
 - creating 48
 - example file 111, 114
 - format 111, 113
 - internal reference 96
 - opening 48
 - status 55
 - tab overview 47
 - updating 49
 - validating 55
- Menu bar 23
- Message types, supported 36
- Meta Data Loader 84
- MIF
 - file 84
 - format 84
 - HL7 file 17
- Move Down button 30
- Move Up button 30
- Moving a segment in CSV 31
- Multiples in HL7 v3 specification 39

N

- NCICB 7
- NCI CBIIT 121
- Next button 59, 61

O

- OID
 - defining 37
 - registry page 37
- Open CSV specification dialog 29
- Open Data File dialog box 57, 60
- Open HL7 v3 Specification File dialog box 36
- Opening
 - HL7 v3 specification 36
 - map specification 48
 - new file 25

- Open Map Specification dialog box 57, 60
- Open Source File dialog box 48
- Open Target File dialog box 48
- Optional associations 38

P

- Parsing
 - message 16
- Previous button 59, 61
- Properties
 - panel 50

Q

- QTY label 42

R

- Regenerate button 59, 61
- Registering custom function libraries 81
- Remove Clone option 39
- Remove Multiple Attribute option 40, 41
- Remove Multiple Clone option 40
- Removing, multiple attributes from HL7 v3 specification 41
- Removing, multiple clones from HL7 v3 specification 40
- Report
 - CSV example 33
 - generate map report 55
 - generate report 33
 - Map specification 55
- Reset button 31
- Resizing panels 23

S

- Saving
 - HL7 v3 Message 59, 61
 - HL7 v3 Specification 46
 - map specification 55
- Scroll bars 23
- Segment
 - options 30
 - properties 30
- Select Choice option 43
- Selected Choice for label 43
- SimpleDateFormat class 54

T

- Tab
 - CSV specification 27
 - HL7 v3 message 56, 60
 - HL7 v3 specification 33

- map specification [47](#)
- open [23](#)
- types of [25](#)
- TDMS [122](#)
- Tool bar [23](#)
- Transformation Service [85](#)
- TransformationService class [85](#)
- Transforming, into RIM object graph [22](#)

U

- UCUM, units of measure [36](#)
- Units of measure properties [36](#)
- Updating
 - map specification [49](#)
- User-defined default value [36, 37, 38](#)
- Using
 - date function [54](#)

V

- Validating
 - CSV [31](#)
 - CSV data against specialization [32](#)
 - CSV specification [32](#)
 - HL7 structural attributes [86](#)
 - HL7 v3 specification [45](#)
 - vocabulary using EVS [16](#)
- Validation Messages dialog box [55](#)
- Validation Messages panel [46](#)
- Vocabulary validation [86](#)

W

- Windows layout, mapping tool [23](#)