HL7 Version 2: XML Encoding Syntax, Release 1

```
<ORU_R01.OBSERVATION_RESULT>
  <OBX>
    <OBX.1>1</OBX.1>
    <OBX.2>SN</OBX.2>
    <OBX.3>
      <CE.1>1554-5</CE.1>
      <CE.2>GLUCOSE POST 12H CFST</CE.2>
      <CE.3>LN</CE.3>
    </OBX.3>
    <OBX.5>
      <SN.2>182</SN.2>
    </OBX.5>
    <OBX.6>
      <CE.1>mg/dl</CE.1>
    </OBX.6>
    <OBX.7>70-105</OBX.
    <OBX.8>H</OBX.8>
    <OBX.11>F</OBX.11>
  </OBX>
</ORU_R01.OBSERVATION_
```

```
<PID.5>
  <XPN.1>
    <FN.1>MASSIE</FN.1>
  </XPN.1>
```

```
<ADT_A01
  xmlns="urn:hl7-org:v2xml"
  xmlns:xsi="http://www.w3.org/2001/X
  xsi:schemaLocation="urn:hl7-org:v2xml
```

Message Structures (Syntax)
Message Content (Semantics)
Interchange Format
Management Rules

```
<!-- Message definitions -->
<?xml version = "1.0" ?>
<xsd:schema
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns="urn:hl7-org:v2xml"
  targetNamespace="urn:hl7-org:v2xml">

<!-- include segment definitions for version v24 -->
<xsd:include schemaLocation="segments.xsd"/>

<!--
  MESSAGE ACK
-->

<!-- .. message definition ACK -->
<xsd:complexType name="ACK.CONTENT">
  <xsd:sequence>
    <xsd:element ref="MSH" minOccurs="1" maxOccurs="1" />
    <xsd:element ref="MSA" minOccurs="1" maxOccurs="1" />
    <xsd:element ref="ERR" minOccurs="0" maxOccurs="1" />
  </xsd:sequence>
</xsd:complexType>
<xsd:element name="ACK" type="ACK.CONTENT"/>

</xsd:schema>
```

(intentionally left blank)

HL7 Version 2:
XML Encoding Syntax
Release 1

Control/Query Technical Committee
XML Special Interest Group

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v2.xml Contents

Preface

Chapter 2 of the HL7 Version 2.3.1 and 2.4 [rfHL7v231, rfHL7v24] specifies standard message structures (syntax) and content (semantics), the *message definitions*. It also specifies an interchange format and management rules, the *encoding rules* for HL7 message instances (see Figure 1). The objective of this document is to present alternate encoding rules for HL7 Version 2.3.1 and 2.4 messages (and a mechanism for determining alternate encoding rules for subsequent HL7 2.x versions) based on the Extensible Markup Language XML [rfXML] that could be used in environments where senders and receivers both understand XML.
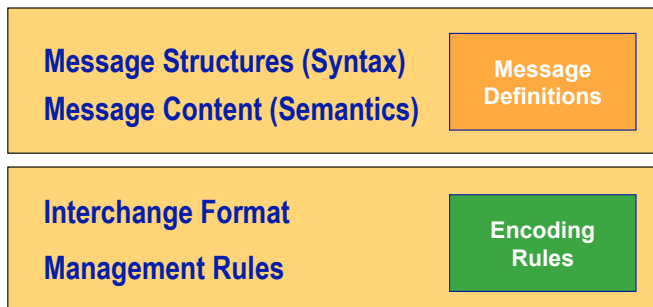
Figure 1: The standard specification specifies message definitions and encoding rules.

It is not the intent of this document to replace the standard sequence oriented encoding rules, that use "vertical bars" and other delimiters (so called "vertical bar encoding"), but rather to provide an alternative way of encoding. Furthermore, message definitions given in the Version 2.3.1 and 2.4 standard are also untouched. However, if you are going to use XML for version 2.x messages, this HL7

normative document describes how to do that. This document does **not** modify the message definitions, only the way they are encoded.

In principle, many XML encodings could serve as alternate messaging syntaxes for HL7 Version 2.x messages. This document describes the one suggested and standardized by HL7. It primarily addresses the translation between standard encoded and XML encoded HL7 version 2.x, describing the underlying rules and principles. XML schema [rfXMLSchema] definitions are provided for all version 2.x messages types, including the corresponding data type descriptions necessary for this specification. Due to their greater expressiveness, schemas are the preferred way to describe a set of constraints on message instances. Document Type Definitions (DTDs) are also provided as an informative appendix. The algorithms used for this specification to derive the database excerpts and to create schemas and DTDs are also presented in the informative appendix.

This document is the normative successor of the informative document "HL7 Recommendation: Using XML as a Supplementary Messaging Syntax for HL7 Version 2.3.1 – HL7 XML Special Interest Group, Informative Document" as of February, 2000 [rfINFO]. The former document is replaced by this specification, at the moment this document is successfully balloted.

This document assumes a basic understanding of HL7 version 2. However, some background information has been included to aid those without version 2 experience.

Acknowledgements

This standard is the result of about two years of intense work through e-mail, telephone conferences and meeting discussions. I wish to thank Bob Dolin and Paul Biron, who wrote the Informative Document.

This work was made possible by Frank Oemig, Lloyd McKenzie, Vassil Peytchev, Ralf Schweiger, Joachim Dudeck, and Wes Rishel. Valuable discussions came from James Case, Ivan Emelin, Susan Abernathy, Peter Rontey, Nick Radov, John Firl, Jennifer Puyenbroek, Chuck Meyer, Tim Barry, Jacub Valenta, Eliot Muir, Grahame Grieve, Koo Weng On, Andrew Hinchley, Dennis Janssen. Special thanks for his support to Tom de Jong.

Thanks also to all members of the XML Special Interest Group and the Control/Query Technical Committee for their input during the development process.

Remarks for this specification

General Knowledge

This specification assumes general knowledge of XML technology on the part of readers. Readers unfamiliar with XML may gain the requisite knowledge from the following standards:

XML 1.0, 2nd Edition [rfXML]

XML Schema [rfXMLSchema]

XML Namespace [rfXMLnamesapce]

Accompanying Material

In addition to this specification, a set of DTDs and XML Schemas, hereafter called "schemas" in general, is provided. They are the work product of this specification. Please refer to section 3.1.2 for further details.

The use of XML schema ([rfXMLSchema], a W3C recommendation since May 2001) is recommended by HL7 for all normative specifications. The schemas and DTDs are not part of the normative specification, but rather added as an informative appendix in order to support vendors with migration from DTDs to XML schemas

The class of message instances validated by the normative schemas distributed as part of this specification, equals the class of message instances validated by the informative DTDs.

Several example XML message instances are also part of the accompanying material.

Subject to technical corrections

The narrative segment group names described in section 2.4.1 and represented in the schema definitions are drawn from the v2.5 first membership ballot. Prior to v2.5, group names were neither present in the database nor in the specification. This specification makes use of these group names even for the schemas for v2.4 and v2.3.1. The group names are not yet finalized (balloted) by the date of this specification. There will be technical corrections to the schema definitions as soon as normative segment group names are finalized in the original standard work. Please note that some of the group names are still not determined and thus algorithmically derived placeholders can be found in the schemas.

Character set switching as described in chapter 2 of the v2.x standard cannot be addressed in XML. There will be a workaround solution for the v3 XML ITS that is not yet completely determined. The v2.xml ITS will use the same mechanism. This is considered to be a technical correction.

1   Introduction

1.1   Background

In 1993, the European Committee for Standardization (CEN) studied several syntaxes (including ASN.1, ASTM, EDIFACT, EUCLIDES, and ODA) for interchange formats in healthcare [rfCEN]. A subsequent report extended the CEN study to look at SGML [rfDolin1997]. By using the same methodology, example scenarios, healthcare data model, and evaluation metrics, the report presented a direct comparison of SGML with the other syntaxes studied by CEN, and found SGML to compare favorably.

In February 1998, XML became a recommendation of the World Wide Web Consortium (W3C). XML was further tested as a messaging syntax for HL7 Version 2.x and Version 3 messages [rfDolin1998]. In 1999, Wes Rishel coordinated a 10-vendor HL7-XML interoperability demonstration at the annual HIMSS Conference. All vendors rated the demo a success.

In 1999, the XML SIG developed an informative document in cooperation with Control/Query TC "HL7 Recommendation: Using XML as a Supplementary Messaging Syntax for HL7 Version 2.3.1 – HL7 XML Special Interest Group, Informative Document" that was approved as an HL7 Informative Document on membership level in February, 2000.

In August, 2000, at the HL7 Board Retreat meeting in Dresden (Germany), it was decided that XML will become the 2nd normative encoding for versions 2.3.1 and 2.4 and future 2.x versions, i. e., the XML syntax that will be submitted for ANSI approval and that has the same status as the traditional syntax. Another reason for a normative XML syntax is to support future Claims Attachment messages, which are currently using v2.4 encoding.

1.2   Benefits From Using XML as an Alternative v2 Interchange Format

There are several benefits using XML as an interchange format.

The ability to explicitly represent an HL7 requirement in XML confers the ability to parse and validate messages with any XML parser. Many "off-the-shelf" XML tools are available (freeware and commercial) such as parsers, transformation applications and instance viewers, which can perform much of the validation of message/document instances, so that applications don't have to. For the encoding part, trained personnel are much easier to find if using XML than experts familiar with vertical bar encoding rules. Of course explicit knowledge about the underlying semantic assumptions is still essential.

Frequently, a typical healthcare messaging application includes an in-house developed parser (message reader) and generator (message writer) to process traditional ("vertical bar" encoded) HL7 messages with an almost certain negative impact on development and maintenance costs. The only alternative to in house tool development is to choose from among the limited but often expensive commercial tool

sets. Increasing, the traditional encoding often contributes to the isolation of healthcare from the generic data interchange approaches used by other business areas. Adoption of across the board generic messaging encoding will become critical for cost and error reduction as healthcare and other areas of business increase their daily interactions. Using XML message parsers and generators will undoubtedly help to prepare healthcare for this growing challenge to increase data interchange commonality with other business areas.

Finally, an XML syntax for v2.x messages will also help vendors and providers transition from HL7 Version 2 family of standards to Version 3 by encouraging the early retooling of applications to support XML interfaces.

1.3   XML representation derivation from HL7 Database

The XML representation of HL7 messages presented here is algorithmically derived directly from the HL7 Database (see below). This is done to prevent that work has to be done by hand, which often is susceptible to errors. Furthermore deriving the XML representation algorithmically allows generating schemas/DTDs for future HL7 v2.x versions easily.

Underlying the HL7 2.x messaging Standards is a Microsoft Access database (the "HL7 Database") that contains a copy of the official definitions of events, messages, segments, fields, data types, data type components, tables, and table values. The database is designed to have the same content and is used to accurately reflect on what is given in the paper based standard documents and, in addition, on what the membership voted on and including technical correction.

This database arose as the German HL7 user group undertook careful analysis of the standard. They became aware that the chapters of the standard had been developed by different groups, and that there had been no distinct rules or guidelines for the development of various parts of the standard. They therefore defined a comprehensive database of the HL7 Standard (including Version 2.1 through Version 2.4 for now) to allow consistency checks of items and to support the application of the standard by the user. All data were drawn from the normative standard documents, largely algorithmically and to some minor amount handcrafted.

Within the HL7 Database, all data added is checked for its consistency. Referential integrity among relations assures this consistency. The side effect of referential integrity is to modify the data from the standard documents because the standard is defined in the form of a document but not in the form of a database.

While developing the analytic object model for the definition of the comprehensive HL7 Database, the German HL7 user group became aware that two problems are not handled satisfactorily in the standard:

>   the relationship between message types, event types, and the structure of a message;

>   the relationship between fields, data types, data type components, and tables.

Further details of the HL7 Database as well as known problems encountered in the construction of the database have been documented by Frank Oemig et al. ([rfOemig1996], see also [rfOemig]).

Ambiguities or errors in the standard are reflected "as is" in the XML encoding. Fixing any such errors in the XML will require making appropriate technical corrections to the HL7 Database. There have been many such fixes, both in the database and in the XML encoding since the last ballot cycle (committee level ballot). The procedures for deriving the schemas are described in the informative appendix.

It should be mentioned that the database itself or extracts of the database are not needed in order to implement or use the XML encoding of version 2 messages as described in this specification. The database and its excerpts are used for the schema and DTD creation process only. Implementers should be able to develop v2.xml interfaces having only the schemas/DTDs and the printed version of both this specification and the HL7 standard. Implementors may also choose to hand-generate or adjust existing schemas or DTDs to reflect localizations such as Z-segments.

1.4   Scope for HL7 Version 2

This specification presents XML encoding rules for HL7 Version 2.3.1 and 2.4 messages. Former versions of the HL7 Version 2 family of message standards are explicitly not covered, because a construct (MSH.9.3 – Message Structure) needed in this specification is not present in versions prior to v2.3.1. Therefore there is no XML encoding support for Versions prior to v2.3.1.

Versions after v2.4 are also not covered by this document, but will be added as soon as these versions are successfully balloted as an official HL7 standard.

If a supplier claims conformance for V2 messages in XML the messages must be valid against schemas produced from the HL7 specification by the rules in the v2.xml specification.

1.5   Version 2 Message Definitions

1.5.1   Version 2 Hierarchical Message Structure Overview

A specific HL7 version 2.x **message** is a hierarchical structure and is initiated by a trigger, representing a real world event. A message is the atomic unit of data transferred between systems and is comprised of a group of segments in a defined sequence. Messages begin with the Message Header Segment MSH and are identified by the message type and the initiating event. A three-character code contained within each message identifies its type. For example the ADT message type is used to transmit portions of a patient's Admission, Discharge and Transfer (ADT) data from one system to another.

HL7 defines the content of the message as an abstract set of data elements contained in data **segments**. Segments are ordered sequences of fields and can be declared as required or optional and repeatable or non-repeating. Each segment begins with a three-character literal value that identifies it within a message (segment identifier). For example, an ADT message may contain the following segments: Message Header (MSH), Event Type (EVN), Patient ID (PID), and Patient Visit (PV1).

The semantic content of a message is transferred in the **fields** of the segment. Fields can be of variable length. Field contents can be required or optional, individual fields may be repeated. Individual data fields are found in the message by their position within their associated segments. Multi-component fields are used for further subdivision of a field and facilitate the transmission of locally related semantic contents.

For each field or field component, a **data type** is defined. Simple data types include string of charac-ters, number, code etc. Complex data types are comprised of two or more components. Examples are the CE data type (coded elements) which components are "coded value", "code designator" and "code system", or XPN data type (extended person name), which has several components that are each comprised of several sub-components in order to express the various parts of a person's name.

1.5.2   Abstract Message Syntax Definitions

Each message is documented in the standard using a special notation that lists the segment IDs in the order they would appear in the message (see Figure 2). Braces, { ... }, indicate one or more repetitions of the enclosed group of segments. Of course, the group may contain only a single segment. Brackets, […], show that the enclosed group of segments is optional. If a group of segments is optional and may repeat it should be enclosed in brackets and braces, { […] }. Note that [{...}] and {[...]} are equivalent.

Groups with more than a single segment are handled in a special way in this specification (see section 2.4.1), because they are named. Such segment group names are uppercase (e. g. "PROCEDURE", "INSURANCE").

```
ADT^A01^ADT_A01    ADT Message                           Status    Chapter
MSH                Message Header                                   2
EVN                Event Type                                       3
PID                Patient Identification                           3
[PD1]              Additional Demographics                          3
[ { NK1 } ]        Next of Kin /Associated Parties                  3
PV1                Patient Visit                                    3
[ PV2 ]            Patient Visit - Additional Info.                 3
[ { DB1 } ]        Disability Information                           3
[ { OBX } ]        Observation/Result                               7
[ { AL1 } ]        Allergy Information                              3
[ { DG1 } ]        Diagnosis Information                            6
[  DRG  ]          Diagnosis Related Group                          6
[ {                --- PROCEDURE begin
   PR1             Procedures                                       6
   [{ROL}]         Role                                             12
} ]                --- PROCEDURE end
[ { GT1 } ]        Guarantor                                        6
[ {                --- INSURANCE begin
   IN1             Insurance                                        6
   [ IN2 ]         Insurance Additional Info.                       6
   [ {IN3} ]       Insurance Additional Info. - Cert.               6
} ]                --- INSURANCE end
```

Figure 2: Abstract message syntax definition for message type ADT_A01, drawn from chapter 3 in [rfHL7v25] with additional group names interspersed, and adopted to the corresponding style containing group names (colored/shaded here for better readability).

The brackets and braces in the Abstract Message Syntax relate to XML occurrence indicators as shown in the following :

HL7 Abstract Message Syntax	Equivalent Cardinality in XML Schema (minOccurs .. maxOccurs)	Equivalent XML DTD Occurrence Indicator
[ ]	0 .. 1	?
{ }	1 .. unbounded	+
{[ ]} = [{ }]	0 .. unbounded	*
no bracket or brace	1 .. 1	no occurrence indicator (one exactly)

Table 1: Abstract Message Syntax Notations of Cardinality and their corresponding Schema and DTD Occurrence Specifications

2   Specification

2.1   Introduction to the XML Representation

The XML encoding rules specified here represents HL7 message structures as XML elements. Message structures contain segments, also represented as XML elements. Segments contain fields, again represented as XML elements. A field's data type is stored as a fixed attribute in the field's attribute list, while a field's content model contains the data type components. Other fixed attributes are used to expand abbreviations and indicate HL7 Table value restrictions. In addition, the XML schema annotation mechanism is used to provide the same information, as represented in the fixed attributes of field and data type definition (please refer to section 2.5 and 2.6 for details).

2.2   A First Example

Here a simple message in the syntax of the standard encoding rules can be seen:

```
MSH|^~\&|LAB|767543|ADT|767543|199003141304-0500||ACK^^ACK|XX3657|P|2.4
MSA|AR|ZZ9380
ERR|PID^1^16^103&Table value not found&HL70357
```

Here is the same message in the syntax of the recommended XML encoding rules:

```
<ACK
    xmlns="urn:hl7-org:v2xml"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:hl7-org:v2xml ACK.xsd">
        <MSH>
            <MSH.1>|</MSH.1>
            <MSH.2>^~\&amp;</MSH.2>
            <MSH.3>
                <HD.1>LAB</HD.1>
            </MSH.3>
            <MSH.4>
                <HD.1>767543</HD.1>
            </MSH.4>
            <MSH.5>
                <HD.1>ADT</HD.1>
            </MSH.5>
            <MSH.6>
                <HD.1>767543</HD.1>
            </MSH.6>
            <MSH.7>
                <TS.1>199003141304-0500</TS.1>
            </MSH.7>
            <MSH.9>
                <MSG.1>ACK</MSG.1>
                <MSG.3>ACK</MSG.3>
            </MSH.9>
            <MSH.10>XX3657</MSH.10>
            <MSH.11>
                <PT.1>P</PT.1>
            </MSH.11>
            <MSH.12>
                <VID.1>2.4</VID.1>
            </MSH.12>
        </MSH>
        <MSA>
            <MSA.1>AR</MSA.1>
            <MSA.2>ZZ9380</MSA.2>
        </MSA>
        <ERR>
            <ERR.1>
                <ELD.1>PID</ELD.1>
                <ELD.2>1</ELD.2>
                <ELD.3>16</ELD.3>
                <ELD.4>
                    <CE.1>103</CE.1>
                    <CE.2>Table value not found</CE.2>
                    <CE.3>HL70357</CE.3>
                </ELD.4>
            </ERR.1>
        </ERR>
    </ACK>
```

As is always the case with XML when processed with a validating processor, the extra white space between elements (provided to make the message easier for people to read) can be removed in actual message instances, resulting in shorter messages in situations when overall message length is a factor.

The next section describes the stepwise creation of the XML representation.

2.3 Message Identification and Trigger Events

A key role is played by the Message Type that is defined in the abstract message definition of a message and also given in the MSH-9 field of the message header segment. This field contains the Message Type, Trigger Event, and the Message Structure ID for the message.

> The first component is the Message Type code containing values such as ACK, ADT, ORM, ORU etc. Allowed values are defined in HL7 table 0076 – Message Type.

> The second component is the Trigger Event code with values like A01, O01, R01 etc. Refer to HL7 table 0003 – Trigger Event for a complete listing.

> The third component is the abstract message structure ID defined by HL7 Table 0354 – Message Structure.

All mentioned tables are defined in chapter 2 of the standard.

2.3.1 Message Structure IDs

In the 2.x standard(s), many trigger events share the same abstract message syntax. This fact became standardized in v2.3.1 and was introduced in the form of the Message Structure component of MSH-9 (component 3).

The v2.xml schemas (see also section 3.1.2) are based on the described message structure ID. Looking at message definitions in 2.3.1 and later, the abstract message definition (see example a in Figure 3) and the MSH-9 field (see example b in Figure 3) contain the message type, trigger event, and the message structure ID for the message, e. g., ADT^A04^ADT_A01. This indicates that the ADT message with trigger event A04 has the message structure ID ADT_A01 (i.e., it has the same sequence and cardinality of segments). All messages with that structure ID are structurally the same, though they differ in the semantics of the event (A04 in the example case). In detail, message structure code ADT_A01 describes the single abstract message structure used by the trigger events A01, A04, A05, A08, A13, A14, A28 and A31.

As a consequence, encoding an A04 message, which has the ADT_A01 message structure, requires using the schema definition for the ADT_A01 message. The standard documents contain tables where the message structure IDs are listed (see section 3.1.1).

a) Part of the Abstract Message Syntax definition for an ADT A04 message	`ADT^A04^ADT_A01`	`ADT Message`
	`MSH`	`Message Header`
	`EVN`	`Event Type`
	`PID`	`Patient Identification`
	…	…

b) Example of a Message Header segment, with Message Type, Trigger Event, and the Message Structure ID repeated in MSH-9

```
MSH|^~\&|ADT1|MCM|LABADT|MCM|198808181126||ADT^A04^ADT_A01|M246|P|2.4|
```

Figure 3: Example for Abstract Message Syntax (fragment) in (a) and Message Header Segment (b)

The message structure ID is used as a root element for the XML instance documents. As an example the corresponding XML message fragment is shown below. The element <ADT_A01> carries the segment elements (see following section) as child elements.

```
<ADT_A01>
   ...(segment elements)
</ADT_A01>
```

2.4   Segments

Message structures contain segments, also represented as XML elements. Segments are ordered sequences of fields. Each segment begins with a three-character literal value that identifies it within a message (segment identifier). The v2.xml schema definition uses the segment identifier as XML element names. An MSH segment, for example, has <MSH> as an XML element name, a PID segment <PID> etc.

Considering the ADT_A04 example above, the corresponding XML message fragment is shown below. The element <MSH> for example carries the corresponding field elements (see following section) as child elements.

```
<ADT_A01>
    <MSH>
        …(MSH field elements)
    </MSH>
    <EVN>
        ...(EVN field elements)
    </EVN>
    <PID>
        ...(PID field elements)
    </PID>
   ...(other segment elements)
</ADT_A01>
```

2.4.1   Groups of Segments

Some segments are grouped by braces { ... } or brackets […] to denote repetitions or optionality of the segment(s). If a group of segments is optional and may repeat it is enclosed in brackets and braces, { […] }, where [{...}] and {[...]} are equivalent. Upon further consideration by both users and implementers alike (per the clarifying reasoning given below), it has become increasing persuasive to deepen the XML element hierarchy by the addition of grouping elements.

Groups containing more than a single segment are thus handled in a special way in this specification. For example in Figure 4, a group is denoted by [{ PR1 [{ ROL }] }]. This group is named "PROCEDURE" (see 2nd column in Figure 4 containing "--- *group_name* begin/end"). Another example is the [{ IN1 [IN2] [{ IN3 }] [{ ROL }] }] group which is named "INSURANCE". These names also appear in the v2.xml schema definitions of the corresponding messages and thus have to appear also in an XML message instance containing messages of that type, i.e. groups of segments are surrounded with their own tags.

There was no explicit way to express these groups in the traditional v2 "vertical bar" encoding of messages. Introduction of the explicit segment group names marks a major difference between vertical bar and XML encoding. Furthermore, this allows elements to be accessed in a reasonable manner within an X-Path expression (see [rfXPATH]). By this, an application can refer to specific XML items explicitly by name (e.g. ADT_A01/PID.5/XPN.3/FN.1) or they can refer to them by position (e.g. ADT_A01/PID.5/*[position()=3]/*[position()=1]). By taking the latter approach, one no longer has to take care what the name of the field, data element or data type is. See also section on 2.6 data types.

Segment group names are uppercase. In almost all cases the names convey the semantics carried by the group of segments itself, for example IN*x* segments are bundled by the "INSURANCE" group, PV1 PV2 segments are bundles as the "VISIT" group etc.

Please note: The narrative segment group names where this specification makes use of are neither in the paper version of v2.3.1 nor v2.4. They are drawn from the v2.5 specification.

```
ADT^A01^ADT_A01    ADT Message                     Status    Comment     Chapter
MSH                Message Header                                         2
EVN                Event Type                                             3
PID                Patient Identification                                 3
...
[{                 --- PROCEDURE begin
   PR1             Procedures                                             6
 [{ ROL }]         Role                                                   12
}]                 --- PROCEDURE end
...
[{                 --- INSURANCE begin
   IN1             Insurance                                              6
 [ IN2 ]           Insurance Add. Info.                                   6
 [{ IN3 }]         Insurance Add. Info -Cert.                             6
 [{ ROL }]         Role                                                   12
}]                 --- INSURANCE end
...
```

Figure 4: Abstract message syntax (fragment) with named groups of segments.

About 400 different groups of that kind could be identified in the standard. Some of the groups have identical content concerning segment sequence, some of the contained segments, however, have different cardinalities. As an example the group "INSURANCE" could be found in ADR_A19, ADR_A01, ADR_A05, ADR_A06 etc. but the single segments IN1, IN2 etc. have different cardinalities within these groups. Consequentially, the v2.xml XML schema segment group naming convention has adopted the use of the owning message structure id as a *prefix* for the group name to insure uniqueness in regard to content.

Considering the ADT_A04 example above, the corresponding XML message fragment with groups is shown below.

```
<ADT_A01>
    ...
    <ADT_A01.PROCEDURE>
      <PR1>
       ...
      </PR1>
      <ROL>
       ...
      </ROL>
    </ADT_A01.PROCEDURE>
    ...
    <ADT_A01.INSURANCE>
      <IN1>
       ...
      </IN1>
      <IN2>
       ...
      </IN2>
      <IN3>
       ...
      </IN3>
      <ROL>
       ...
      </ROL>
    </ADT_A01.INSURANCE>
  ...
  </ADT_A01>
```

The corresponding schema and DTD definition fragment for the ADT_A01 message is shown below.

```
<!--
    MESSAGE ADT_A01
-->
  <!-- .. groups used in message ADT_A01 -->
  <xsd:complexType name="ADT_A01.PROCEDURE.CONTENT">
    <xsd:sequence>
      <xsd:element ref="PR1" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="ROL" minOccurs="0" maxOccurs="unbounded" />
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="ADT_A01.PROCEDURE" type="ADT_A01.PROCEDURE.CONTENT"/>
  <xsd:complexType name="ADT_A01.INSURANCE.CONTENT">
    <xsd:sequence>
      <xsd:element ref="IN1" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="IN2" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="IN3" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="ROL" minOccurs="0" maxOccurs="unbounded" />
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="ADT_A01.INSURANCE" type="ADT_A01.INSURANCE.CONTENT"/>

  <!-- .. message definition ADT_A01 -->
  <xsd:complexType name="ADT_A01.CONTENT">
    <xsd:sequence>
      <xsd:element ref="MSH" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="EVN" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="PID" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="PD1" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="ROL" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="NK1" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="PV1" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="PV2" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="ROL" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="DB1" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="OBX" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="AL1" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="DG1" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="DRG" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="ADT_A01.PROCEDURE" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="GT1" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="ADT_A01.INSURANCE" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="ACC" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="UB1" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="UB2" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="PDA" minOccurs="0" maxOccurs="1" />
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="ADT_A01" type="ADT_A01.CONTENT"/>
```

```
<!--
    MESSAGE ADT_A01
-->
<!-- .. groups used in message ADT_A01 -->
<!ENTITY % ADT_A01.PROCEDURE.CONTENT "(PR1,ROL*)">
<!ELEMENT ADT_A01.PROCEDURE %ADT_A01.PROCEDURE.CONTENT;>
<!ENTITY % ADT_A01.INSURANCE.CONTENT "(IN1,IN2?,IN3*,ROL*)">
<!ELEMENT ADT_A01.INSURANCE %ADT_A01.INSURANCE.CONTENT;>
<!-- .. message definition ADT_A01 -->
<!ENTITY % ADT_A01.CONTENT
  "(MSH,EVN,PID,PD1?,ROL*,NK1*,PV1,PV2?,ROL*,DB1*,OBX*,AL1*,DG1*,DRG?,
    ADT_A01.PROCEDURE*,GT1*,ADT_A01.INSURANCE*,ACC?,UB1?,UB2?,PDA?)">
<!ELEMENT ADT_A01 %ADT_A01.CONTENT;>
```

As an example, the corresponding schema and DTD definition fragment for the EVN segment is shown below. Please note that, consistent with the processing rule for v2 whereby receivers are to ignore fields not expected, the schemas will also allow additional elements at the end of a segment.

```
<!--
    SEGMENT EVN
-->
  <xsd:complexType name="EVN.CONTENT">
    <xsd:sequence>
      <xsd:element ref="EVN.1" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="EVN.2" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="EVN.3" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="EVN.4" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="EVN.5" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="EVN.6" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="EVN.7" minOccurs="0" maxOccurs="1" />
      <xsd:any processContents="lax" namespace="##any"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="EVN" type="EVN.CONTENT"/>

<!--
    SEGMENT EVN
-->
<!ENTITY % EVN.CONTENT "(EVN.1?,EVN.2,EVN.3?,EVN.4?,EVN.5*,EVN.6?,EVN.7?)">
<!ELEMENT EVN %EVN.CONTENT;>
```

2.5 Fields

The semantic content of a message is transferred in the **fields** of the segment. Fields contents can be required or optional. Individual fields may be repeated. Individual data fields are found in the message by their position within their associated segments and are described in segment tables (see Figure 5 as an example).

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
1	3	ID	B		0003	00099	Event Type Code
2	26	TS	R			00100	Recorded Date/Time
3	26	TS	O			00101	Date/Time Planned Event
4	3	IS	O		0062	00102	Event Reason Code
5	250	XCN	O	Y	0188	00103	Operator ID
6	26	TS	O			01278	Event Occurred
7	180	HD	O			01534	Event Facility

Figure 5: Segment attribute table of the EVN segment (fragment, drawn from chapter 3 in [rfHL7v24])

Multi-component fields are used for further subdivision of a field and facilitate the transmission of locally related semantic contents.

In the v2.xml specification, individual fields are represented by three-character literal segment ID of the corresponding segment plus their individual position within the segment (sequence). The first field (Event Type Code) in segment EVN for example is named EVN.1, the second EVN.2 etc. An example of an EVN segment, traditionally encoded and v2.xml encoded is shown below. Please note that the EVN encoding contains time stamp representation (TS) in EVN.2, EVN.3 and EVN.6 which are not primitive but composite data types and which are expressed in a way described in detail in section 2.6.2.

```
EVN|A05|199901061000|199901101400|01||199901061000
```

```
...
  <EVN>
   <EVN.1>A05</EVN.1>
   <EVN.2><TS.1>199901061000</TS.1></EVN.2>
   <EVN.3><TS.1>199901101400</TS.1></EVN.3>
   <EVN.4>01</EVN.4>
   <EVN.6><TS.1>199901061000</TS.1></EVN.6>
  </EVN>
```

In the traditional sequence oriented approach, empty fields (containing no data) are denoted as two vertical bars "||" in sequence to express the empty contents. This is essential in sequence-oriented approaches. In v2.xml an element with no contents simply can be omitted (unless explicit use of the "" is required to force a data delete action by the receiving application, see section 2.7.6). In the example above there is no information for EVN.5, thus the element <EVN.5> is omitted in the corresponding XML instance.

The content model of each field is a reference to the field's data type. In the XML schemas, the component's item number, table reference, long name, and data type is provided by the <annotation> <appinfo> mechanism, in addition a <documentation> tag is given containing the long name of the field (also the language is defined by the standard xml:lang attribute) as specified in the standard. In addition, the same information is provided as fixed attributes.

The example below shows the XML schema definition of the EVN.1 field element along with its annotations. The second example shows the same definition in the DTD world. Please note that, in absence of a corresponding annotation mechanism in DTDs, the additional information mentioned above is provided as fixed attributes (and as a comment) only.

```
<!--
    FIELD EVN.1
-->
  <xsd:attributeGroup name="EVN.1.ATTRIBUTES">
    <xsd:attribute name="Item" type="xsd:string" fixed="99"/>
    <xsd:attribute name="Type" type="xsd:string" fixed="ID"/>
    <xsd:attribute name="Table" type="xsd:string" fixed="HL70003"/>
    <xsd:attribute name="LongName" type="xsd:string"
      fixed="Event Type Code"/>
  </xsd:attributeGroup>
  <xsd:complexType name="EVN.1.CONTENT">
    <xsd:annotation>
      <xsd:documentation xml:lang="en">Event Type Code</xsd:documentation>
      <xsd:appinfo>
        <hl7:Item>99</hl7:Item>
        <hl7:Type>ID</hl7:Type>
        <hl7:Table>HL70003</hl7:Table>
        <hl7:LongName>Event Type Code</hl7:LongName>
      </xsd:appinfo>
    </xsd:annotation>
    <xsd:simpleContent>
      <xsd:extension base="ID">
        <xsd:attributeGroup ref="EVN.1.ATTRIBUTES"/>
      </xsd:extension>
    </xsd:simpleContent>
  </xsd:complexType>
  <xsd:element name="EVN.1" type="EVN.1.CONTENT"/>
```

```
<!--
    FIELD EVN.1
-->
<!ENTITY % EVN.1.CONTENT "%ID;">
<!ELEMENT EVN.1 %EVN.1.CONTENT;>
<!ENTITY % EVN.1.ATTRIBUTES
  "Item CDATA #FIXED '99'
   Type CDATA #FIXED 'ID'
   LongName CDATA #FIXED 'Event Type Code'">
<!ATTLIST EVN.1 %EVN.1.ATTRIBUTES;>
<!-- Item='99' Type='ID' Table='HL70003' LongName='Event Type Code' -->
```

If a receiver receives an XML instance that is validated against the schema, the receiving parser can make use of the information that is provided in the annotations appinfo (application information) and documentation (user information) element content of the underlying schema.

2.6   Data Types

For each field or field component, a **data type** is defined. Some data types are primitive, i. e. they have no components. Composite data types are comprised of data type components, which, like fields, have a data type of their own and a long name. Some data type components also specify an HL7 Table that contains enumerated values for use in the component.

2.6.1   Primitive Data Types

Some data types are primitive, in which case they have no components. Simple data types are for example string of characters, date etc.

A field for which a primitive data type is defined simply contains the information without additional nesting or hierarchy. As an example the 4th field of the EVN segment (see Figure 5) is of type IS (a value drawn from an HL7 defined table), which is a primitive data type. The corresponding XML instance fragment looks like the following example:

```
<EVN.4>01</EVN.4>
```

The v2.xml schema definitions define all primitive data types as "string" (XML schema), in DTDs #PCDATA is used.[1]

2.6.2   Composite Data Types

Complex data types are comprised of two or more components. As an example, consider the CE data type (coded elements) which components are "indentifier", "text" and "name of coding system" etc. The standard defines the individual components of the composite data types in chapter 2 (see example below, alternatively the table shown in Figure 6, not presented in the standard[2], but used for later reference in this specification).

```
Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (IS)> ^
            <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of
            alternate coding system (IS)>
```

HL7 Component Table - CE - Coded Element

SEQ	LEN	DT	OPT	TBL#	COMPONENT NAME	COMMENTS	SEC.REF.
1	20	ST	O	-	identifier		2.A.78
2	199	ST	O	-	text		2.A.78
3	20	IS	O	396	name of coding system		2.A.38
4	20	ST	O	-	alternate identifier		2.A.78
5	199	ST	O	-	alternate text		2.A.78
6	20	IS	O	396	name of alternate coding system		2.A.38

Figure 6: CE data type components drawn from [rfHL7v25] (above) and a table representation of the same definition

---

[1] This implies that the encoding of the v2.xml data types isn't as restrictive for as HL7 limits. As an example, for data types SI, NM, DT, DTM, more restrictive definitions for the schemas (not for the DTDs) could be chosen. To keep schemas and DTDs consistent, the restriction to data types in this sense isn't used in schema either.
[2] This table is newly introduced in version 2.5, chapter 2B.

Analogous to field components, data types components are modeled by specifying the data structure name plus their individual position within the data type component (sequence). As an example, the first component of data type CE is defined as CE.1, the second as CE.2 and so on. This allows individual access to any of the components of a composite data type. The following example shows a CE data type encoded traditionally ("vertical bar") and as v2.xml fragment.

```
…|F-11380^CREATININE^I9^2148-5^CREATININE^LN|…
```

```
<CE.1>F-11380</CE.1>
<CE.2>CREATININE</CE.2>
<CE.3>I9</CE.3>
<CE.4>2148-5</CE.4>
<CE.5>CREATININE</CE.5>
<CE.6>LN</CE.6>
```

Also, empty components may be omitted in the v2.xml encoding, whereas empty components in the traditional encoding must specify an empty component by two component delimiters "^^"in sequence in order to preserve sequence.

Where a field has a data type with multiple components but only a single component is populated with information, the corresponding data type element of the component may not be omitted.

Considering the following example where a field of type CE carries information in the first component only (i. e. the identifier of a coded element), the correct v2.xml encoding is shown as in the following example with an OBX.3 field:

```
Incorrect:                               Correct:
<OBX.3>                                  <OBX.3>
   F-11380                                  <CE.1>F-11380</CE.1>
</OBX.3>                                  </OBX.3>
```

Data type components of composite data types are modeled similarly to fields. The content model of each component contains reference to the component's data type. Annotation mechanism is used to express the component's data type, long name, and table, as shown here for CE.1. In addition, the same information is provided as fixed attributes. Again, in DTDs (second example) this information is provided as fixed attributes (and as comments) only.

```
<!--
   COMPONENT CE.1
-->
  <xsd:attributeGroup name="CE.1.ATTRIBUTES">
    <xsd:attribute name="Type" type="xsd:string" fixed="ST"/>
    <xsd:attribute name="LongName" type="xsd:string"
      fixed="identifier (ST)"/>
  </xsd:attributeGroup>
  <xsd:complexType name="CE.1.CONTENT">
    <xsd:annotation>
      <xsd:documentation xml:lang="en">
        identifier (ST)</xsd:documentation>
      <xsd:appinfo>
        <hl7:Type>ST</hl7:Type>
        <hl7:LongName>identifier (ST)</hl7:LongName>
      </xsd:appinfo>
    </xsd:annotation>
    <xsd:simpleContent>
      <xsd:extension base="ST">
        <xsd:attributeGroup ref="CE.1.ATTRIBUTES"/>
      </xsd:extension>
    </xsd:simpleContent>
  </xsd:complexType>
  <xsd:element name="CE.1" type="CE.1.CONTENT"/>
```

```
<!--
    COMPONENT CE.1
-->
<!ENTITY % CE.1.CONTENT "%ST;">
<!ELEMENT CE.1 %CE.1.CONTENT;>
<!ENTITY % CE.1.ATTRIBUTES
    "Type CDATA #FIXED 'ST'
    LongName CDATA #FIXED 'identifier (ST)'">
<!ATTLIST CE.1 %CE.1.ATTRIBUTES;>
<!-- Type='ST' LongName='identifier (ST)' -->
```

2.6.3   Wildcard

In the HL7 Standard, a few data types (components) specify "WILDCARD" or "varies" in order to express an undefined type (data of any type can be specified). This data type is modeled to be any *HL7 data type*.

2.6.4   CM Data Types

A special data type, the CM data type, was used in HL7 v2.3.1 (and prior to that version) to express that the explicit data type of the content is undefined (i. e. a type="anyType" in XML Schema or "ANY" in DTD definitions). Use of this data type was deprecated beginning with v2.4 in order to allow more restricted conformance testing (no new fields would use the CM data type).

In v2.5, new data types were created for (and applied to) all existing fields/components using the CM data type. An addendum, for XML encoding, was applied to HL7 v2.3.1 and v2.4, where these renamed data types are listed. These corrected names must be used when encoding CM data types with XML.

2.7   Processing Rules for v2.xml Messages

2.7.1   XML Application Processing Rules

The original and enhanced processing rules described in chapter 2 of the v2.x standard are not affected by this specification. However, concerning the exchange of XML messages between sender and receiver, additional assumptions are made in terms of "well-formed" and "valid" XML instance documents.

The **sender** of a v2.xml XML message is required to create *both well-formed and valid* message instances. The instances created should be valid against the corresponding schema (i. e. DTD or XML schema) definitions (see section 3.1.2). However, this does not necessarily imply validation of the transaction at run time. The decision to do so and incur associated overhead should be made on a site-by-site basis or on interface development status.

The **receiver** who accepts a v2.xml XML message is required to check well-formedness of the XML instance. He may (but is not required to) validate the message against the schema.

2.7.2   Inter-version Backward Compatibility

The vertical bar encoding provides a certain amount of backward compatibility between versions of the v2.x world. For example, there is no difficulty changing data types to new data types that are backward compatible (as an example, IS to CE data type), or converting a repeating/optional segment into a repeating/optional group of segments. This helps ensure inter-version compatibility. Because the XML encoding makes explicit use of constructs touched by the changes mentioned above, inter-version backward compatibility is not a given. For example, if a data type for a field is changed from IS (primitive) to CE (composite), the CE composite data type introduces its own tags, in other words, the former IS field now has child elements drawn from the composite CE data type.

However, it should be easy to achieve XML transformations from an XML instance for one version to another using corresponding transformation rules or style sheets (which are not provided here).

2.7.3   Message Fragmentation and Continuation

Sometimes, implementation limitations require that large messages or segments be broken into manageable chunks. Message fragmentation and continuation as described in chapter 2 of the v2.x standard is not supported in this v2.xml specification. It is assumed that XML aware systems, for which this specification is written, are able to accept stream character messages of an arbitrary length, i. e. several 100k bytes of information or more at once.

2.7.4   Batch Messages

There are instances when it is convenient to transfer a batch of HL7 messages. Common examples would be a batch of financial posting detail transactions (DFTs) sent from an ancillary to a financial system, a backload of persons, admissions (ADT message batch for initial patient backload), employees, and master files.

Chapter 2 of the standard defines such a mechanism to wrap multiple valid HL7 messages by wrapping control segments in order to form a batch of messages. For that purpose specific file and batch header and trailer control segments FHS, FTS, BHS, BTS are defined.

In the XML encoding, it is also possible to wrap multiple messages with the corresponding control segments. The definitions can be found in the messages schema (*batch.xsd*, or *batch.dtd* respectively). For queries there is the need to define a QPD segment differently for one query to a different query. The only way to support batches of queries (e. g. for non time critical processing) or responses is to wrap the contents of the batch tags as CDATA. This approach has been used for the general definitions of batch message "payload", regardless of containing query segments or not.

For further information on batch messages refer to Chapter 2 and 5of the standard.

2.7.5   Message Delimiters

In constructing a traditionally encoded v2 message, certain special characters are used. They are the segment terminator, the field separator, the component separator, subcomponent separator, repetition separator, and escape character. The segment terminator is always a carriage return (in ASCII, a hex 0D). The other delimiters are defined in the MSH segment, with the field delimiter in the 4th character position, and the other delimiters occurring as in the field called Encoding Characters, which is the first field after the segment ID. The delimiter values used in the MSH segment are the delimiter values used throughout the entire message. In the absence of other considerations, HL7 recommends the suggested delimiter values.

At any given site, the subset of the possible delimiters may be limited by negotiations between applications. This implies that the receiving applications will use the agreed upon delimiters, as they appear in the Message Header Segment (MSH), to parse the message.

In the v2.xml encoding the message delimiter characters are contained in the MSH.1 and MSH.2 element of the MSH segment as well. Although the message delimiter characters are meaningless in the v2.xml encoding, they are represented as shown in the example fragment of the MSH segment. However, they can be useful when translating from vertical bar to XML representation and vice versa. They must still be sent, because MSH.1 and MSH.2 are required fields in the v2.x standard. Please note, that the special character "&" must be escaped in order to be included in an XML message instance (see also section 2.7.10).

```
<ACK>
  <MSH>
    <MSH.1>|</MSH.1>
    <MSH.2>^~\&amp;</MSH.2>   …
```

2.7.6   Null Values, Empty Values

Where a sending system can ascertain that a data field has been deleted, then the two double quote marks ("") will be used to define the state of that data field. An encoded field with a value of two double quote marks ("") would instruct the receiving system to delete the contents in the database field.

If the state of a blank or null data field cannot be determined, the sending system will send the empty value or omit the element at all. An encoded field with an empty value or a missing element would instruct the receiving system to bypass processing and does not effect an already existing value in the corresponding receiving database.

The following example carries a null value in the <XAD.6> data type component. Explicit empty (missing) values are expressed by empty (missing) element content. In the example, <XAD.2> is omitted (empty).

```
<NK1.4>
    <XAD.1>
        <SAD.1>123 INDUSTRY WAY</SAD.1>
    </XAD.1>
    <XAD.3>ISHPEMING</XAD.3>
    <XAD.4>MI</XAD.4>
    <XAD.5>49849</XAD.5>
    <XAD.6>""</XAD.6>
</NK1.4>
```

2.7.7   Repetition of Segment Groups, Segments and Fields

Repetition of segment groups, segments and fields are handled by repeating the appropriate tags. This also has to be done with fields, which are comprised of composite data types. The following examples demonstrate correct repetition in the XML encoding.

```
example 1                              example 3
<DG1>…</DG1>                            <NK1.6>
<DG1>…</DG1>                                <XTN.1>(900)545-1234</XTN.1>
                                       </NK1.6>
example 2                              <NK1.6>
<ECR.3>PARAM1</ECR.3>                      <XTN.1>(900)545-1200</XTN.1>
<ECR.3>PARAM2</ECR.3>                  </NK1.6>
```

2.7.8   Escape Character Sequences Used in v2 Data Types

Chapter 2 of the v2.x standard specifies escape character sequences to be used in fields of certain types. When a field of data type TX, FT, or CF is being encoded, these escape characters may be used to signal certain special characteristics of portions of the text field. The escape character is whatever display ASCII character is specified in the *escape character component* of MSH-2-encoding characters.

For the XML encoding we must differentiate between data type associated escape characters (text formatting), structural escape sequences and character encoding / character set switching characters. They have to be handled differently when using v2.xml.

2.7.8.1   Text Formatting Escape Sequences

\H\ and \N\ are defined in chapter 2 of the standard as indicating begin and end highlight of text in a text field. In v2.xml these characters are replaced by corresponding XML elements that can easily be processed.

Escape characters as defined in the v2.x standard	Replacement to be used in v2.xml encoding	Meaning
\H\	`<escape V="H"/>`	start highlighting text
\N\	`<escape V="N"/>`	normal text (stop highlighting)

Figure 7: Escape characters drawn from [rfHL7v24] and their replacement in the v2.xml encoding

An example, v2.x and below the corresponding v2.xml notation

```
   A \H\special\N\ word
```

```
   A <escape V="H"/>special<escape V="N"/> word
```

There is also the possibility of specifying troff commands in text fields. They are escaped accordingly. The following table just shows examples and is not complete. Please refer to chapter 2 of the v2.x standard.

Escape characters as defined in the v2.x standard	Replacement to be used in v2.xml encoding	Meaning
\.br\	`<escape V=".br"/>`	begin new output line
\.sp*n*\	`<escape V=".sp*n*"/>`	skip *n* vertical space
\.in±*n*\	`<escape V=".in±*n*"/>`	indent *n* spaces
\.ti±*n*\	`<escape V=".ti±*n*"/>`	temporarily indent *n* spaces

Figure 8: Escape characters (troff commands) drawn from [rfHL7v24] and their replacement in the v2.xml encoding

An example:

```
   \.in+4\\.ti-4\ 1. The cardiomediastinal silhouette...
```

is expressed in v2.xml as

```
  <escape V=".in+4"/><escape V=".ti-4"/> 1. The cardiomediastinal silhouette…
```

2.7.8.2   Structural Escape Sequences

The escape character sequences \F\, \S\, \T\ and \R\ mentioned in chapter 2 of the v2.x standard used to indicate the literal field, component, subcomponent and repetition separators may not be used in the v2.xml encoding. They are superfluous because the XML does not make use of these structural separator characters.

2.7.8.3   Character References

The vertical bar character encoding mechanism using \Xxxx\ as a character reference, and \Zxxx\ to refer to a locally defined character reference is deprecated in the v2.xml encoding. Instead, the standard XML character reference mechanism *&#xxx* must be used.

An example:

```
   \Xc9\ditions Lenard
```

is expressed in v2.xml as

```
  &#xc9;ditions Lenard
```

For locally defined character references outside that scope, the private area of Unicode should be addressed.

2.7.8.4　Character Set Switching

Character set switching as described in chapter 2 of the v2.x standard cannot be addressed in XML. XML has only a single character set – UCS/Unicode. Each XML entity must have a single encoding. An XML document can be made up of several entities, which each may have different encodings, but switching character sets in a single entity is thus not supported.

2.7.8.5　Escaping XML Markup

It is the responsibility of sending applications to escape all characters occurring in data that may be interpreted by an XML processor as being markup characters. Depending on context, these include all characters listed in the XML specification [rfXML]. For the receiving application, XML markup characters are normally handled by the XML parser.

2.7.9　Message Building Rules

The message building rules remain the same as described in chapter 2 of the standards. However, there are some exceptions if the v2.xml encoding is used.

> Segment, field, component and subcomponent separators are not used but represented by individual elements.

> If a value for a field is not present, the corresponding element can be omitted (if not required by the schema definition or by the v2.x standard).

> For groups of segments defined in the v2.xml specification, additional group elements are introduced. In the standard encoding, groups are not explicitly encoded.

A receiver who accepts a v2.xml XML message is required to check well-formedness of the XML instance and may (but is not required to) validate the message against the schemas. As described in chapter 2 of the standard, the receiver

> may ignore segments, fields, components, subcomponents, and extra repetitions of a field that are present but were not expected,

> will treat segments that were expected but are not present as consisting entirely of fields that are not present,

> will treat fields and components that are expected but were not included in a segment as not present,

but in terms of validating against the v2.xml schema definition, the cardinality of the components is determined by the v2.xml schema.

Please note, that, in correspondence of what the processing rules for v2 say for additional stuff after a segment, the schemas also allow any elements following after the end of a segment.

2.7.10　Special Characters in Schemas/DTDs

Certain characters within the HL7 Database must be "escaped" before inclusion in a schema. The ampersand is a reserved XML meta character.

Where an ampersand occurs in the long name of a field, it is converted to an XML entity representation "&" An example is "Critical Range for Ordinal & Continuous Obs" that becomes "Critical Range for Ordinal & Continuous Obs".

Because the Schema/DTD wraps the value of attribute LongName in single quotes, when a single quote occurs in the long name of a field, it is converted to an XML entity representation "'", e. g. "Contact's Tel. Number" becomes "Contact's Tel. Number".

The same rules apply to XML message instances.

Please note, that spelling and capitalization of all tags in the XML encoding must be the same as defined in the HL7 database (see section 1.3). Please refer to the schemas, which reflect these rules.

2.8   Translating Between Standard Encoding and XML Encoding

In environments where not all senders and receivers understand this XML encoding it may be necessary to translate instance messages between the standard encoding and this XML encoding and vice versa. This recommendation does not require that any such translations be supported nor does it prescribe how such transformations should be performed in environments where they are supported.

Because of several important differences between the standard encoding and this XML encoding, translations between the two encodings is not straightforward although it is not hard. The issues described in section 2.7 need to be taken into account when performing the translations.

3   Appendix

3.1   Normative Appendix

3.1.1   List of Messages With Equal Message Structures

As previously mentioned, the v2.xml schemas are based on the message structure ID – a concept introduced in version 2.3.1. The standard documents contain tables with the message structure IDs.

Version	Chapter	HL7 Table
v2.3.1	2.24.1.9	Message structure table 0354
v2.4	2.17.3	Message structure table 0354

3.1.2   List of Schemas and DTDs

This specification provides two sets of constraint definition files:

> XML Schema definitions (xsd), and

> Document Type Definitions (dtd),

as shown by the following table. There is a set for each HL7 version supported by the v2.xml specification (currently v2.3.1 and v2.4). In addition, HTML files are provided, one for each message structure, containing a short description of the message and links to the corresponding schemas (in directory *xsd* and *dtd*).

Please note that the use of XML schemas is recommended by HL7 for all normative specifications. The use of XML schema ([rfXMLSchema], a W3C recommendation since May 2001) is recommended by HL7 for all normative specifications. The schemas and DTDs are not part of the normative specification, but rather added as an informative appendix in order to support vendors with migration from DTDs to XML schemas. The class of message instances validated by the normative schemas distributed as part of this specification equals the class of message instances validated by the informative DTDs.

It should be mentioned that DTDs can coexist in the same interface with schemas and not cause any issues. For example, the sending interface can implement XML messages using schemas and the receiving system using DTDs. However, schemas have a much greater expressiveness and should be preferred.

HTML descriptions (in subdirectory htm)	Description
MessageStructureID.html	A set of many files in HTML format containing a short description of the message and links to the corresponding schemas.

Schema (in subdirectory xsd)	DTD (in subdirectory dtd)	Description
MessageStructureID.xsd	*MessageStructureID*.dtd	A set of many schemas each containing the schema definitions for a specific message structure specified by *MessageStructureID,* for example ADT_A01.* contains the definitions for the ADT A01 message structure, ADT_A02.* for ADT A02 and so forth. The schemas import the segments definitions.
segments.xsd	segments.dtd	schema for all segment definitions, imports fields definitions
fields.xsd	fields.dtd	schema for all field definitions, imports data type definitions
datatypes.xsd	datatypes.dtd	schema for all data type definitions for v2
batch.xsd	batch.dtd	schema containing definition of batch messages (refer to section 2.7.4)
messages.xsd	messages.dtd	schema containing all message definitions together

An XML instance of a specific message should refer to the corresponding schema. The following examples show a DTD and a schema reference within a v2.xml XML message instance fragment. In both cases <ADT_A01> is the root element of the instance.

```
<ADT_A01
  xmlns="urn:hl7-org:v2xml"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="urn:hl7-org:v2xml ADT_A01.xsd">
    <MSH>...
```

```
<!DOCTYPE ADT_A01 SYSTEM "ADT_A01.dtd">
<ADT_A01>
    <MSH>...
```

3.1.3   Localization of messages

The HL7 Standard describes the responsibilities for parties sending and receiving HL7 messages (see also section 2.7.1 of this specification). These responsibilities enable exchange of messages that contain localizations (or local variations or Z-segments, Z-fields etc.). The v2.xml specification attempts to provide full support for local encodings (see section 3.2.1.1.3). Examples to follow show how to introduce local variations. This has to be done in concordance to the v2.x standard itself, i. e. where localizations are appropriate and allowed.

The mechanism shown here is a non-normative recommendation.

3.1.3.1   DTD Localization

The sender includes differences from the standard DTD in the internal subset of a message instance. This is enabled by the fact, that all content models in the v2.xml DTDs are crafted as parameter entities, which can then be redefined in the internal subset.

Consider a sequence of segments in a message FOO as ABC, DEF, GHI, JKL. The corresponding DTD fragment would look like this:

```
<!ENTITY % FOO.CONTENT "( ABC, DEF, GHI, JKL )">
<!ELEMENT FOO %FOO.CONTENT;>
```

Please note that the content model is designed as an entity, the corresponding element FOO refers to that entity rather than defining it directly. All content models in the v2.xml DTDs are crafted that way.

A corresponding instance message fragment would look like this:

```
<FOO>
    <ABC>…</ABC>
    <DEF>…</DEF>
    <GHI>…</GHI>
    <JKL>…</JKL>
</FOO>
```

Expanding the FOO message by adding a local Z segment (with own field definitions not mentioned in detail here), let's say the new content model should be ABC, DEF, ZZZ, GHI, JKL. To achieve this, the entity of the content model describing FOO can be changed in the internal subset like this:

```
<!DOCTYPE FOO SYSTEM "FOO.dtd" [
      ---this includes the original FOO content model as shown above
<!ENTITY % FOO.CONTENT "( ABC, DEF, ZZZ, GHI, JKL )">
      ---this modifies (expands) the FOO content model entity
<!ELEMENT FOO.LOCAL %FOO.CONTENT;>
      ---and this finally defines a new element containing the new definitions
…
<!ELEMENT ZZZ  (---local definitions here to come---)> ]>
```

Now, the FOO message is redefined by the local modification. Receivers using non-validating XML processors can ignore the entire DOCTYPE declaration. Senders are not required to create or provide an explicit representation of the transformation from the localized DTD to a HL7 standard DTD.

The corresponding local message instance would look like this:

```
<FOO.LOCAL>
    <ABC>…</ABC>
    <DEF>…</DEF>
    <ZZZ>…</ZZZ>
    <GHI>…</GHI>
    <JKL>…</JKL>
</FOO.LOCAL>
```

3.1.3.2　Schema Localization

The schemas provided in this specification can be localized by a similar approach described above for DTDs. This is done by redefinitions of the existing definitions.

Again, consider the original FOO message that might be represented as follows using XML schema:

```
<!-- .. message definition FOO -->
  <xsd:element name="FOO">
    <xsd:complexType name="FOO.CONTENT">
      <xsd:sequence>
        <xsd:element ref="ABC" />
        <xsd:element ref="DEF" />
        <xsd:element ref="GHI" />
        <xsd:element ref="JKL" />
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
```

A redefinition containing the new localized content of the FOO content model can then be made on a copy of the schema definition.

```
<!-- .. message re-definition FOO (on a copy of the schema) -->
  <xsd:element name="FOO">
    <xsd:complexType name="FOO.CONTENT">
      <xsd:sequence>
        <xsd:element ref="ABC" />
        <xsd:element ref="DEF" />
        <xsd:element ref="ZZZ" />
        <xsd:element ref="GHI" />
        <xsd:element ref="JKL" />
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
<xsd:element name="FOO.LOCAL" type="FOO.CONTENT"/>
<xsd:element name="ZZZ" type="local type name"/>
```

Now, the FOO message is redefined by the local modification. The copy of the schema will be used instead of the original version. A new root element can be defined called FOO.LOCAL that serves as a localized version of the original FOO root element. The message instances shown in section 3.1.3.1 remain the same.

Please note that it is good practice to intersperse local stuff by using a different namespace. It is therefore recommended to associate Z-stuff with another namespace.

3.2   Informative Appendix

3.2.1   Design Considerations

As noted above, there are many possible XML representations of HL7 messages. This section describes those factors considered in deciding on the particular approach presented in this specification.

3.2.1.1   XML Schema Optimization

XML schema optimization means balancing functional, technical, and practical requirements. Some metrics are fairly straightforward to quantify (e. g. message length), while others are less so. There is a risk that the easily quantifiable measurements will assume significance out of proportion to other metrics. All relevant metrics must be factored together in the determination of the optimal XML representation.

3.2.1.1.1   Message Length

Message length minimization techniques are employed to decrease the total number of characters (including data and/or markup) comprising a message. The optimal techniques used to minimize SGML messages are not necessarily the same as those best suited to minimize XML messages. Techniques used here common to both SGML and XML include the use of abbreviations. In some cases modeling components as XML attributes as opposed to elements could result in further minimization. This specification represents HL7 message structures, segments, fields, components and subcomponents as XML elements. A field's data type is represented as a fixed attribute, while data type components are represented as XML elements. Full SGML provides even greater minimization capacity with the use of SHORTTAG, OMITTAG, and SHORTREF techniques, resulting in very small messages that are not valid XML, and are therefore not employed here.

The greater the percentage of data characters (as opposed to markup characters) in an average message, the less important any additional overhead imposed by changing from the standard HL7 encoding rules to XML becomes. Data from the Duke University Medical Center (DUMC) HL7 production environment suggests that on average, for standard 'vertical bar encoding', data characters comprise

about 70% of overall message length. (Data from DUMC courtesy of Al Stone, and posted to the HL7 SGML/XML SIG List Server 1998-01-15 and 1998-01-16) The XML encoding recommended here will result in messages that are approximately five to ten times longer, although this estimate has yet to be subjected to rigorous testing nor is officially published.

Message length is an issue for bandwidth requirements but also for long term archiving the original messages (as done e. g. by some healthcare providers). It should be mentioned that the use of compression is considered as a solution to deal with both bandwidth and archiving issues. It's a matter of fact, that using appropriate compression algorithms XML instances compress very well. This is for example because starting and ending tags are almost the same sequence of characters. However, describing compression methods is out of scope of this specification.

An example: the large messages shown in section 3.2.4.2 show 1,426 bytes for the vertical bar encoding and 6,442 bytes for the v2.xml encoding (4.5 times larger). After compression the v2.xml message is 1,714 bytes long. That is about 20% larger than the uncompressed vertical bar variant.

Furthermore it should be mentioned that we've learned from early v2.xml implementers that performance could be gained (along with the use of less bandwidth) if large batch files are broken into many small batch files.

3.2.1.1.2   Structural Complexity

Krueger [rfKrueger] describes the use of "structural complexity" as a metric to analyze HL7 messages. "It would be nice to be able to estimate or compare the time needed by human users to understand or implement different messages or the time needed for a parsing program to analyze different messages." The exact determinates of structural complexity were outside the scope of Krueger's work, although he comments that "empirical investigations must be carried out to monitor the effort users will take to understand and implement different HL7 messages". Potential components of this metric are listed below. In some cases, the metric will be the time and/or space complexity required to carry out the functions. We agree with Krueger that "it does not make any sense to expect absolute results. However, relative (i. e. comparable) results could also be a valuable source of information."

>   Message Creation: Encompasses the processing requirements to create a message.

>   Message Augmentation: Augmentation might include changing the format of a field or data type component or transforming the message from one syntax to another.

>   Message Debugging: Determine why an application is generating an HL7-invalid message. (actually, this is one of the most important "chewers" of development resources)

>   Message Filtering: Filtering might include sending only a subset of the message to a particular message receiver.

>   Message Routing: Routing includes extracting from the message what is necessary to determine where to send it.

>   Message Parsing: Parsing can include message validation and extraction of field values and data type components.

3.2.1.1.3   Localization Issues

The HL7 standard describes the responsibilities for parties sending and receiving HL7 messages (see also section 2.7.1 of this specification). These responsibilities also enable exchange of messages that contain localizations (or referred to as local variations or Z-segments). Consequent to these requirements, an XML representation needs to fulfill the following design considerations:

>   Senders can introduce, in a standardized manner, local variations into standard HL7 messages where necessary. The expression of local variations is formalized such that their location in a message can be algorithmically determined by receivers. This formalization expresses localizations as changes to the standard schemas within the internal subset of a transmitted message instance.

> Receivers can use well-formed XML processors or validating XML processors. Receivers using validating processors do not have to fall back to using a non-validating processor in those cases when the sender includes localized content in their messages.

The v2.xml schemas and DTDs are crafted to fulfill these requirements. Please refer to section 3.1.3 of the informative appendix for further information.

3.2.1.1.4   "Looseness" of a DTD, Conformance Testing of Other Business Rules

XML is a formal grammar that can be used to encode HL7 business rules. When an XML processor validates that a message is valid per its schema, it is also validating that a message is conformant to those HL7 rules that are explicitly represented in the XML schema.

Some HL7 rules are easy to explicitly represent within an XML DTD as well as in an XML schema, such as the optionality and repetition of a field within a segment. However, with XML schema we can express more HL7 rules explicitly and define more constraints than is possible with a corresponding DTD.

Representing such rules within a DTD, while possible, may conflict with other design considerations. Therefore, determining the "looseness" of the DTD, or the degree to which HL7 business rules are explicitly represented in the DTD, is itself a design consideration. The same design consideration applies to XML schema.

You can carry HL7-valid messages in the constructs defined by this specification, but you can also carry a lot of HL7-invalid messages. An XML processor can't validate that a message received is a valid HL7 message. The decision in the XML representation presented here is to capture as many HL7 business rules as reasonably possible, both in terms of DTDs and XML schemas. This includes enabling a validating parser to verify the optionality, repetition, and ordering of segments within messages and fields within segments; and the correct use of data types and their components within fields. Easing the burden on the application with regard to *structural* validity (e. g., are all the pieces in the proper place) is itself a big win, despite the fact that the application will still have to perform *semantic* validation (e. g., is that code really a valid SNOMED code or other business rules to be conformant to).

Some actions that are supported in vertical bar encoding, such as the forward-adoption of new data types cannot be handled by the XML encoding.

3.2.1.1.5   Automation Considerations

The XML representation of HL7 messages presented here is algorithmically derived directly from the HL7 Database. The algorithms used for this specification to derive the database excerpts and to create schemas are presented in this informative appendix.

The automatic creation process was considered in order to avoid handcrafting of the schemas, which would have involved a certain danger of introducing errors. Furthermore, necessary refinement of definitions during the development process could be achieved much easier.

3.2.2   Extracting Subsets Of The HL7 Database

The following section describes the methods used for extracting information from the HL7 database that were necessary to generate the schemas.

3.2.2.1   Messages and Their Segments

3.2.2.1.1   HL7 Database Tables Used

The following HL7 Database table is used in the creation of the message schemas. (Only those fields being queried are shown. The field names and their descriptions are taken verbatim from the HL7 Database.)

EventMessageTypes			
Primary Key	**Field Name**	**Data Type**	**Description**
*	event_code	Text-3	Code of this event
*	hl7_version	Text-8	version number
*	lfd_nr	Integer	consecutive increasing number used for 1:n relation
	message_typ_snd	Text-3	Standard Message Type (Sender)
	message_typ_return	Text-3	Standard Message Type (Recipient)
	message_structure_snd	Text-7	Message Structure (Sender)
	message_structure_return	Text-7	Message Structure (Recipient)
	chapter	Text-10	Chapter in which this message is described

3.2.2.1.2   SQL Query

The following two queries are used to gather together message structures from table *EventMessageTypes*: The first query creates a table *MsgStructv2xml* which holds all message structure IDs of senders, the second query adds all message structure information for receivers.

```
SELECT EventMessageTypes.message_typ_snd AS messageType,
EventMessageTypes.event_code AS eventCode,
EventMessageTypes.message_structure_snd AS messageStructure,
EventMessageTypes.hl7_version AS HL7version,
EventMessageTypes.chapter AS chapter
INTO MsgStructv2xml
FROM EventMessageTypes
WHERE EventMessageTypes.message_structure_snd<>"NUL";


INSERT INTO MsgStructv2xml
SELECT EventMessageTypes.message_typ_return AS messageType,
EventMessageTypes.event_code AS eventCode,
EventMessageTypes.message_structure_return AS messageStructure,
EventMessageTypes.hl7_version AS HL7version,
EventMessageTypes.chapter AS chapter
FROM EventMessageTypes
WHERE EventMessageTypes.message_structure_return<>"NUL";
```

This creates a new table *MsgStructv2xml* to hold the message structure information. The structure of *MsgStructv2xml* is shown here:

MsgStructUnion			
Primary Key	**Field Name**	**Data Type**	**Description**
*	messageType	Text-3	Message type
*	eventCode	Text-3	Event Code
	messageStructure	Text-7	Message Structure ID
	HL7version	Text-8	HL7 Version
	chapter	Text-10	Chapter in which this message is described

3.2.2.1.3   Select Message Structures

Chapter 2 of HL7 v2.x "Control/Query" describes the message header (MSH) segment. Field 9 "Message Type" (MSH.9) contains the message type, trigger event, and the message structure ID for the message. The third component of MSH.9 is the abstract message structure code defined by HL7 Table 0354 – Message structure.

From database table *MsgStructIDSegments* (see below) those message structures were extracted from *MsgStructv2xml* using the SQL query shown below.

MsgStructIDSegments			
Primary Key	**Field Name**	**Data Type**	**Description**
*	message_structure	Text-7	Message Structure ID
*	hl7_version	Text-8	version number
*	lfd_nr*	Integer	consecutive increasing number used for each field within the segment
	seg_code	Text-3	Segment-Code
	groupname	Text-10	String identifying the repetition of sub-sequent segments (logical embracement)
	repetitional	Yes/No	repetitional
	optional	Yes/No	optional

*The field names and their descriptions are taken verbatim from the HL7 Database.

```
SELECT MsgStructIDSegments.message_structure, MsgStructIDSegments.lfd_nr,
MsgStructIDSegments.seg_code, (MsgStructIDSegments.repetitional) AS Ausdr1,
MsgStructIDSegments.optional, MsgStructIDSegments.hl7_version
FROM MsgStructIDSegments
WHERE (((MsgStructIDSegments.message_structure) In (SELECT messageStructure
FROM aaav2xml)) AND ((MsgStructIDSegments.hl7_version)="version "))
ORDER BY MsgStructIDSegments.message_structure, MsgStructIDSegments.lfd_nr;
```

This resulting table is exported to `messages.txt`. This file serves as input for the transformation algorithms (see also section 3.2.3).

3.2.2.2   Segments and Fields

3.2.2.2.1   HL7 Database Tables Used

The following HL7 Database tables are used in the creation of the segments and fields schema definitions. (Only those fields being queried are shown. The field names and their descriptions are taken verbatim from the HL7 Database.)

SegmentDataElements			
Primary Key	**Field Name**	**Data Type**	**Description**
*	seg_code	Text-3	Name of the Segment
*	hl7_version	Text-8	version number
*	lfd_nr	Integer	Position within the segment
	data_item	Long Integer	Data Element ID
	req_opt	Text-5	required/optional/backward compatibility
	repetitional	Text-1	Repetitional

DataElements			
Primary Key	**Field Name**	**Data Type**	**Description**
*	data_item	Long Integer	ID of the Data Element
*	hl7_version	Text-8	HL7-Version
	description	Text-78	Field description according to the standard documentation
	data_structure	Text-20	Name of the Data Structure
	table_id	Long Integer	ID assigned table

3.2.2.2.2   SQL Query

The following SQL query extracts data from tables *SegmentDataElements* and *DataElements*:

```
SELECT SegmentDataElements.seg_code, SegmentDataElements.lfd_nr,
DataElements.data_item, DataElements.description,
DataElements.data_structure, SegmentDataElements.req_opt,
SegmentDataElements.repetitional, DataElements.table_id,
DataElements.hl7_version
FROM DataElements
INNER JOIN SegmentDataElements ON DataElements.data_item =
SegmentDataElements.data_item
WHERE (((DataElements.hl7_version)=" version ") AND
((SegmentDataElements.hl7_version)=[DataElements].[hl7_version]))
ORDER BY SegmentDataElements.seg_code, SegmentDataElements.lfd_nr;
```

This resulting table is exported to `fields.txt`. This file serves as input for the transformation algorithms (see also section 3.2.3).

3.2.2.3   Data Types and Their Data Type Components

3.2.2.3.1   HL7 Database Tables Used

The following HL7 Database tables are used in the creation of data types schema definitions. (Only those fields being queried are shown. The field names and their descriptions are taken verbatim from the HL7 Database.)

DataStructures			
Primary Key	**Field Name**	**Data Type**	**Description**
*	data_structure	Text-20	logical data type
*	hl7_version	Text-8	version number
	Description	Text-80	Description

DataStructureComponents			
Primary Key	**Field Name**	**Data Type**	**Description**
*	data_structure	Text	logical data type
*	hl7_version	Text	version number
*	lfd_nr		consecutive increasing number used for 1:n relation
	comp_nr		identifying number of the component
	table_id		Number of assigned table if different from component (overwrites table number of component)

Components			
Primary Key	**Field Name**	**Data Type**	**Description**
*	comp_nr	Long Integer	Component Number (ID)
*	hl7_version	Text-8	Version of HL7
	description	Text-50	Description
	table_id	Long Integer	reference to an assigned Table
	data_type_code	Text-3	Data type

3.2.2.3.2   SQL Query

The following SQL query extracts data from tables *DataStructures*, *DataStructureComponents*, and *Components*:

```
SELECT DataStructures.data_structure, DataStructureComponents.lfd_nr,
DataStructures.description, DataStructureComponents.table_id,
Components.description, Components.table_id, Components.data_type_code,
DataStructures.hl7_version
FROM DataStructures LEFT JOIN (DataStructureComponents LEFT JOIN Components
ON (DataStructureComponents.hl7_version = Components.hl7_version) AND
(DataStructureComponents.comp_nr = Components.comp_nr)) ON
(DataStructures.hl7_version = DataStructureComponents.hl7_version) AND
(DataStructures.data_structure = DataStructureComponents.data_structure)
WHERE (((DataStructures.hl7_version)=" version "))
ORDER BY DataStructures.data_structure, DataStructureComponents.lfd_nr;
```

This resulting table is exported to `datatypes.txt`. This file serves as input for the transformation algorithms (see section 3.2.2).

3.2.2.4   Message IDs, chapters, table 354

3.2.2.4.1   HL7 Database Tables Used

Another file is created from the *MsgStructv2xml* table containing the message structure IDs and the chapters where the message is described. In addition it merges the lists of messages with equal structures from the abstract message structure code defined by HL7 Table 0354 – Message structure. This file is used for the generation of the HTML files and for additional information.

The following HL7 Database tables are used in the creation of this definitions. (Only those fields being queried are shown. The field names and their descriptions are taken verbatim from the HL7 Database.)

TableValues			
Primary Key	**Field Name**	**Data Type**	**Description**
*	table_id	Long Integer	ID of this table
*	table_value	Text-25	Individual value for this special table
*	description	Text-255	Description
*	hl7_version	Text-8	Version of HL7

For the definition of table *MsgStructv2xml* see section 3.2.2.1.

3.2.2.4.2   SQL Query

The following SQL query extracts data from tables *MsgStructv2xml* and *TableValues*:

```
SELECT MsgStructv2xml.messageType, MsgStructv2xml.eventCode,
MsgStructv2xml.messageStructure, MsgStructv2xml.HL7version,
MsgStructv2xml.chapter, TableValues.description
FROM MsgStructv2xml, TableValues
WHERE (HL7version=" version ") AND (TableValues.table_id=354) AND
(TableValues.hl7_version=aaav2xml.HL7version) AND
(MsgStructv2xml.messageStructure=TableValues.table_value)
ORDER BY messageType, eventCode;
```

This resulting table is exported to `msgidchaps.txt`. This file serves as input for the transformation algorithms (see section 3.2.2).

3.2.2.5   Summary of Additional Files

The following table summarizes the files that, along with this document, comprise the work products of this recommendation.

HL7 Structure	Database excerpt (tab delimited)	Resulting schema
Messages	`messages.txt`	schema for all message definition
Segments	`fields.txt*`	schema for all segment definition
Fields	`fields.txt`	schema for all field definition
Data types	`datatypes.txt`	schema for all data type definition
Message Structure Ids	`msgidchaps.txt`	message structure IDs and chapter references

* `fields.txt` is used in the generation of both segments and fields schema definitions.

3.2.3   Algorithms

The mapping from HL7 Version 2.x into the XML specification v2.xml is a formal algorithm, driven from the HL7 Database described above. As mentioned above, HL7 Database extracts (ASCII files, tab delimited) are created containing definitions of messages, segments, fields, and data types.

Perl scripts are applied to the ASCII delimited files to generate XML schema definitions and additional HTML files for further information. The structure of the generated schemas follows from the design considerations described above. The algorithms instantiated in these Perl scripts are not described in detail here and are not part of this specification, but will be publicly available on the HL7 website.

3.2.4   Examples

3.2.4.1   Schema and DTD Fragments

These are actual fragments of the real schemas provided as illustrations. There is not enough of the schemas included here to allow for validation of the example messages. Messages will validate against the complete schema.

```
<!-- Data type definitions -->
…
<!--
    PRIMITIVE DATATYPE ID
-->
  <xsd:simpleType name="ID">
    <xsd:restriction base="xsd:string"/>
  </xsd:simpleType>
…
<!--
    COMPOSITE DATATYPE CE
-->
<xsd:complexType name="CE">
  <xsd:sequence>
    <xsd:element ref="CE.1" minOccurs="0" maxOccurs="1"/>
    <xsd:element ref="CE.2" minOccurs="0" maxOccurs="1"/>
    <xsd:element ref="CE.3" minOccurs="0" maxOccurs="1"/>
    <xsd:element ref="CE.4" minOccurs="0" maxOccurs="1"/>
    <xsd:element ref="CE.5" minOccurs="0" maxOccurs="1"/>
    <xsd:element ref="CE.6" minOccurs="0" maxOccurs="1"/>
  </xsd:sequence>
</xsd:complexType>
…
```

```
<!--
    COMPONENT CE.1
-->
  <xsd:attributeGroup name="CE.1.ATTRIBUTES">
    <xsd:attribute name="Type" type="xsd:string" fixed="ST"/>
    <xsd:attribute name="LongName" type="xsd:string"
      fixed="identifier (ST)"/>
  </xsd:attributeGroup>
  <xsd:complexType name="CE.1.CONTENT">
    <xsd:annotation>
      <xsd:documentation xml:lang="en">
        identifier (ST)</xsd:documentation>
      <xsd:appinfo>
        <hl7:Type>ST</hl7:Type>
        <hl7:LongName>identifier (ST)</hl7:LongName>
      </xsd:appinfo>
    </xsd:annotation>


    <xsd:simpleContent>
      <xsd:extension base="ST">
        <xsd:attributeGroup ref="CE.1.ATTRIBUTES"/>
      </xsd:extension>
    </xsd:simpleContent>
  </xsd:complexType>
  <xsd:element name="CE.1" type="CE.1.CONTENT"/>
```

```
<!-- Field definitions -->
…
<!--
    FIELD MSH.19
-->
  <xsd:attributeGroup name="MSH.19.ATTRIBUTES">
    <xsd:attribute name="Item" type="xsd:string" fixed="693"/>
    <xsd:attribute name="Type" type="xsd:string" fixed="CE"/>
    <xsd:attribute name="LongName" type="xsd:string"
      fixed="Principal Language Of Message"/>
  </xsd:attributeGroup>
  <xsd:complexType name="MSH.19.CONTENT">
    <xsd:annotation>
      <xsd:documentation xml:lang="en">
        Principal Language Of Message</xsd:documentation>
      <xsd:appinfo>
        <hl7:Item>693</hl7:Item>
        <hl7:Type>CE</hl7:Type>
        <hl7:LongName>Principal Language Of Message</hl7:LongName>
      </xsd:appinfo>
    </xsd:annotation>
    <xsd:complexContent>
      <xsd:extension base="CE">
        <xsd:attributeGroup ref="MSH.19.ATTRIBUTES"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:element name="MSH.19" type="MSH.19.CONTENT"/>
```

```
<!-- Segment definitions -->
…
<!--
    SEGMENT FAC
-->
  <xsd:complexType name="FAC.CONTENT">
    <xsd:sequence>
      <xsd:element ref="FAC.1" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="FAC.2" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="FAC.3" minOccurs="1" maxOccurs="unbounded" />
      <xsd:element ref="FAC.4" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="FAC.5" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="FAC.6" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="FAC.7" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="FAC.8" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="FAC.9" minOccurs="1" maxOccurs="unbounded" />
      <xsd:element ref="FAC.10" minOccurs="0" maxOccurs="1" />
      <xsd:element ref="FAC.11" minOccurs="0" maxOccurs="unbounded" />
      <xsd:element ref="FAC.12" minOccurs="0" maxOccurs="1" />
      <xsd:any processContents="lax" namespace="##any"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="FAC" type="FAC.CONTENT"/>
```

```
<!-- Message definitions -->
…
<?xml version = "1.0" ?>
<xsd:schema
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns="urn:hl7-org:v2xml"
  targetNamespace="urn:hl7-org:v2xml">

  <!-- include segment definitions for version v24 -->
  <xsd:include schemaLocation="segments.xsd"/>

<!--
    MESSAGE ACK
-->

  <!-- .. message definition ACK -->
  <xsd:complexType name="ACK.CONTENT">
    <xsd:sequence>
      <xsd:element ref="MSH" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="MSA" minOccurs="1" maxOccurs="1" />
      <xsd:element ref="ERR" minOccurs="0" maxOccurs="1" />
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="ACK" type="ACK.CONTENT"/>

</xsd:schema>
```

```
<!-- Data type definitions -->
…
<!--
    PRIMITIVE DATATYPE ID
-->
<!ENTITY % ID "(#PCDATA)">
…
<!--
    COMPOSITE DATATYPE CE
-->
<!ENTITY % CE "(CE.1?,CE.2?,CE.3?,CE.4?,CE.5?,CE.6?)">
…
```

```
<!--
    COMPONENT CE.1
-->
<!ENTITY % CE.1.CONTENT "%ST;">
<!ELEMENT CE.1 %CE.1.CONTENT;>
<!ENTITY % CE.1.ATTRIBUTES
   "Type CDATA #FIXED 'ST'
   LongName CDATA #FIXED 'identifier (ST)'">
<!ATTLIST CE.1 %CE.1.ATTRIBUTES;>
<!-- Type='ST' LongName='identifier (ST)' -->
```

```
<!-- Field definitions -->
…
<!--
    FIELD MSH.19
-->
<!ENTITY % MSH.19.CONTENT "%CE;">
<!ELEMENT MSH.19 %MSH.19.CONTENT;>
<!ENTITY % MSH.19.ATTRIBUTES
  "Item CDATA #FIXED '693'
   Type CDATA #FIXED 'CE'
   LongName CDATA #FIXED 'Principal Language Of Message'">
<!ATTLIST MSH.19 %MSH.19.ATTRIBUTES;>
<!-- Item='693' Type='CE' LongName='Principal Language Of Message' -->
```

```
<!-- Segment definitions -->
…
<!--
    SEGMENT FAC
-->
<!ENTITY % FAC.CONTENT
"(FAC.1,FAC.2?,FAC.3+,FAC.4,FAC.5*,FAC.6*,FAC.7*,FAC.8*,FAC.9+,
   FAC.10?,FAC.11*,FAC.12?)">
<!ELEMENT FAC %FAC.CONTENT;>
```

```
<!-- Message definitions -->
…
<!-- include segment definitions -->
<!ENTITY % HL7v24-segments PUBLIC
  "-//HL7//DTD HL7 v24 segments definitions//EN"
  "segments.dtd">
  %HL7v24-segments;

<!--
    MESSAGE ACK
-->
<!-- .. message definition ACK -->
<!ENTITY % ACK.CONTENT "(MSH,MSA,ERR?)">
<!ELEMENT ACK %ACK.CONTENT;>
```

3.2.4.2   V2 and v2.xml Example Messages

3.2.4.2.1   Short Example

```
MSH|^~\&|GHH LAB|ELAB-3|GHH OE|BLDG4|200202150930||ORU^R01|CNTRL-3456|P|2.4
PID|||555-44-4444||EVERYWOMAN^EVE^E^^^^L|JONES|196203520|F||
   |153 FERNWOOD DR.^^STATESVILLE^OH^35292||(206)3345232
   |(206)752-121||||AC555444444||67-A4335^OH^20030520
OBR|1|845439^GHH OE|1045813^GHH LAB|1554-5^GLUCOSE^LN|||200202150730||||||||
   |555-55-5555^PRIMARY^PATRICIA P^^^^MD^^LEVEL SEVEN HEALTHCARE, INC.|
   ||||||||F||||||||444-44-4444&HIPPOCRATES&HOWARD H&&&MD
OBX|1|SN|1554-5^GLUCOSE POST 12H CFST^LN||^182|mg/dl
   |70-105|H|||F
```

```
<ORU_R01
 xmlns="urn:hl7-org:v2xml"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="urn:hl7-org:v2xml ORU_R01.xsd">
   <MSH>
       <MSH.1>|</MSH.1>
       <MSH.2>^~\&amp;</MSH.2>
       <MSH.3>
           <HD.1>GHH LAB</HD.1>
       </MSH.3>
       <MSH.4>
           <HD.1>ELAB-3</HD.1>
       </MSH.4>
       <MSH.5>
           <HD.1>GHH OE</HD.1>
       </MSH.5>
       <MSH.6>
           <HD.1>BLDG4</HD.1>
       </MSH.6>
       <MSH.7>
           <TS.1>200202150930</TS.1>
       </MSH.7>
       <MSH.9>
           <MSG.1>ORU</MSG.1>
           <MSG.2>R01</MSG.2>
       </MSH.9>
       <MSH.10>CNTRL-3456</MSH.10>
       <MSH.11>
           <PT.1>P</PT.1>
       </MSH.11>
       <MSH.12>
           <VID.1>2.4</VID.1>
       </MSH.12>
   </MSH>
   <ORU_R01.OBSERVATIONAL_REPORT>
       <ORU_R01.PATIENT>
           <PID>
               <PID.3>
                   <CX.1>555-44-4444</CX.1>
               </PID.3>
               <PID.5>
                   <XPN.1>
                           <FN.1>EVERYWOMAN</FN.1>
                   </XPN.1>
                   <XPN.2>EVE</XPN.2>
                   <XPN.3>E</XPN.3>
                   <XPN.7>L</XPN.7>
               </PID.5>
               <PID.6>
                   <XPN.1>
                           <FN.1>JONES</FN.1>
                   </XPN.1>
               </PID.6>
               <PID.7>
                   <TS.1>196203520</TS.1>
               </PID.7>
               <PID.8>F</PID.8>
               <PID.11>
                   <XAD.1>
                           <SAD.1>153 FERNWOOD DR.</SAD.1>
                   </XAD.1>
                   <XAD.3>STATESVILLE</XAD.3>
```

```
                    <XAD.4>OH</XAD.4>
                    <XAD.5>35292</XAD.5>
                </PID.11>
                <PID.13>
                    <XTN.1>(206)3345232</XTN.1>
                </PID.13>
                <PID.14>
                    <XTN.1>(206)752-121</XTN.1>
                </PID.14>
                <PID.18>
                    <CX.1>AC555444444</CX.1>
                </PID.18>
                <PID.20>
                    <DLN.1>67-A4335</DLN.1>
                    <DLN.2>OH</DLN.2>
                    <DLN.3>20030520</DLN.3>
                </PID.20>
            </PID>
        </ORU_R01.PATIENT>
        <ORU_R01.ORDER_OBSERVATION>
            <OBR>
                <OBR.1>1</OBR.1>
                <OBR.2>
                    <EI.1>845439</EI.1>
                    <EI.2>GHH OE</EI.2>
                </OBR.2>
                <OBR.3>
                    <EI.1>1045813</EI.1>
                    <EI.2>GHH LAB</EI.2>
                </OBR.3>
                <OBR.4>
                    <CE.1>1554-5</CE.1>
                    <CE.2>GLUCOSE</CE.2>
                    <CE.3>LN</CE.3>
                </OBR.4>
                <OBR.7>
                    <TS.1>200202150730</TS.1>
                </OBR.7>
                <OBR.16>
                    <XCN.1>555-55-5555</XCN.1>
                    <XCN.2>
                        <FN.1>PRIMARY</FN.1>
                    </XCN.2>
                    <XCN.3>PATRICIA P</XCN.3>
                    <XCN.7>MD</XCN.7>
                    <XCN.9>
                        <HD.1>LEVEL SEVEN HEALTHCARE, INC.</HD.1>
                    </XCN.9>
                </OBR.16>
                <OBR.25>F</OBR.25>
                <OBR.32>
                    <NDL.1>
                        <CN.1>444-44-4444</CN.1>
                        <CN.2>
                            <FN.1>HIPPOCRATES</FN.1>
                        </CN.2>
                        <CN.3>HOWARD H</CN.3>
                        <CN.7>MD</CN.7>
                    </NDL.1>
                </OBR.32>
            </OBR>

            <ORU_R01.OBSERVATION_RESULT>
```

```
            <OBX>
                <OBX.1>1</OBX.1>
                <OBX.2>SN</OBX.2>
                <OBX.3>
                        <CE.1>1554-5</CE.1>
                        <CE.2>GLUCOSE POST 12H CFST</CE.2>
                        <CE.3>LN</CE.3>
                </OBX.3>
                <OBX.5>
                        <SN.2>182</SN.2>
                </OBX.5>
                <OBX.6>
                        <CE.1>mg/dl</CE.1>
                </OBX.6>
                <OBX.7>70-105</OBX.7>
                <OBX.8>H</OBX.8>
                <OBX.11>F</OBX.11>
            </OBX>
          </ORU_R01.OBSERVATION_RESULT>
        </ORU_R01.ORDER_OBSERVATION>
    </ORU_R01.OBSERVATIONAL_REPORT>
</ORU_R01>
```

3.2.4.2.2   Long Example

```
MSH|^~\&|REGADT|MCM|IFENG||199112311501||ADT^A04^ADT_A01|000001|P|2.4|||
EVN|A04|199901101500|199901101400|01||199901101410
PID|||191919^^GENHOS^MR~371-66-9256^^^USSSA^SS
  |253763|MASSIE^JAMES^A||19560129|M|||171 ZOBERLEIN^^ISHPEMING^MI^49849^""^|
  |(900)485-5344|(900)485-5344||S^^HL70002|C^^HL70006|10199925^^^GENHOS^AN
  |371-66-9256||
NK1|1|MASSIE^ELLEN|SPOUSE^^HL70063|171 ZOBERLEIN^^ISHPEMING^MI^49849^""^
  |(900)485-5344|(900)545-1234~(900)545-1200|EC1^FIRST EMERGENCY CONTACT^HL70131
NK1|2|MASSIE^MARYLOU|MOTHER^^HL70063|300 ZOBERLEIN^^ISHPEMING^MI^49849^""^
  |(900)485-5344|(900)545-1234~(900)545-1200|EC2^SECOND EMERGENCY CONTACT^HL70131
NK1|3
NK1|4|||123 INDUSTRY WAY^^ISHPEMING^MI^49849^""^||(900)545-1200
  |EM^EMPLOYER^HL70131|19940605||PROGRAMMER|||ACME SOFTWARE COMPANY
PV1||O|O/R|||||0148^ADDISON,JAMES|0148^ADDISON,JAMES||AMB||||||
  |0148^ADDISON,JAMES|S|1400|A|||||||||||||||||||GENHOS|||||199501101410|
PV2||||||||199901101400|||||||||||||||||||||||||199901101400
ROL||AD|CP^^HL70443|0148^ADDISON,JAMES
OBX||NM|3141-9^BODY WEIGHT^LN||62|kg|||||F
OBX||NM|3137-7^HEIGHT^LN||190|cm|||||F
DG1|1|19||R63.4^LOSS OF WEIGHT^I10|||00|
GT1|1||MASSIE^JAMES^""^""^""^""^""||171 ZOBERLEIN^^ISHPEMING^MI^49849^""^
  |(900)485-5344|(900)485-5344|||SE^SELF^HL70063|371-66-925||||MOOSES AUTO CLINIC
  |171 ZOBERLEIN^^ISHPEMING^MI^49849^""|(900)485-5344|
IN1|0|0^HL70072|BC1|BLUE CROSS|171 ZOBERLEIN^^ISHPEMING^M149849^""^|
  |(900)485-5344|90||||||50 OK|
```

```xml
<ADT_A01
  xmlns="urn:hl7-org:v2xml"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="urn:hl7-org:v2xml ADT_A01.xsd">
  <MSH>
      <MSH.1>|</MSH.1>
      <MSH.2>^~\&amp;</MSH.2>
      <MSH.3>
          <HD.1>REGADT</HD.1>
      </MSH.3>

      <MSH.4>
          <HD.1>MCM</HD.1>
```

```
        </MSH.4>
        <MSH.5>
            <HD.1>IFENG</HD.1>
        </MSH.5>
        <MSH.7>
            <TS.1>199112311501</TS.1>
        </MSH.7>
        <MSH.9>
            <MSG.1>ADT</MSG.1>
            <MSG.2>A04</MSG.2>
            <MSG.3>ADT_A01</MSG.3>
        </MSH.9>
        <MSH.10>000001</MSH.10>
        <MSH.11>
            <PT.1>P</PT.1>
        </MSH.11>
        <MSH.12>
            <VID.1>2.4</VID.1>
        </MSH.12>
    </MSH>
    <EVN>
        <EVN.1>A04</EVN.1>
        <EVN.2>
            <TS.1>199901101500</TS.1>
        </EVN.2>
        <EVN.3>
            <TS.1>199901101400</TS.1>
        </EVN.3>
        <EVN.4>01</EVN.4>
        <EVN.6>
            <TS.1>199901101410</TS.1>
        </EVN.6>
    </EVN>
    <PID>
        <PID.3>
            <CX.1>191919</CX.1>
            <CX.4>
                <HD.1>GENHOS</HD.1>
            </CX.4>
            <CX.5>MR</CX.5>
        </PID.3>
        <PID.3>
            <CX.1>371-66-9256</CX.1>
            <CX.4>
                <HD.1>USSSA</HD.1>
            </CX.4>
            <CX.5>SS</CX.5>
        </PID.3>
        <PID.4>
            <CX.1>253763</CX.1>
        </PID.4>
        <PID.5>
            <XPN.1>
                <FN.1>MASSIE</FN.1>
            </XPN.1>
            <XPN.2>JAMES</XPN.2>
            <XPN.3>A</XPN.3>
        </PID.5>
        <PID.7>
            <TS.1>19560129</TS.1>
        </PID.7>
        <PID.8>M</PID.8>
        <PID.11>
```

```
        <XAD.1>
            <SAD.1>171 ZOBERLEIN</SAD.1>
        </XAD.1>
        <XAD.3>ISHPEMING</XAD.3>
        <XAD.4>MI</XAD.4>
        <XAD.5>49849</XAD.5>
        <XAD.6>""</XAD.6>
    </PID.11>
    <PID.13>
        <XTN.1>(900)485-5344</XTN.1>
    </PID.13>
    <PID.14>
        <XTN.1>(900)485-5344</XTN.1>
    </PID.14>
    <PID.16>
        <CE.1>S</CE.1>
        <CE.3>HL70002</CE.3>
    </PID.16>
    <PID.17>
        <CE.1>C</CE.1>
        <CE.3>HL70006</CE.3>
    </PID.17>
    <PID.18>
        <CX.1>1019992510199925</CX.1>
        <CX.4>
            <HD.1>GENHOS</HD.1>
        </CX.4>
        <CX.5>AN</CX.5>
    </PID.18>
    <PID.19>371-66-9256</PID.19>
</PID>
<NK1>
    <NK1.1>1</NK1.1>
    <NK1.2>
        <XPN.1>
            <FN.1>MASSIE</FN.1>
        </XPN.1>
        <XPN.2>ELLEN</XPN.2>
    </NK1.2>
    <NK1.3>
        <CE.1>SPOUSE</CE.1>
        <CE.3>HL70063</CE.3>
    </NK1.3>
    <NK1.4>
        <XAD.1>
            <SAD.1>171 ZOBERLEIN</SAD.1>
        </XAD.1>
        <XAD.3>ISHPEMING</XAD.3>
        <XAD.4>MI</XAD.4>
        <XAD.5>49849</XAD.5>
        <XAD.6>""</XAD.6>
    </NK1.4>
    <NK1.5>
        <XTN.1>(900)485-5344</XTN.1>
    </NK1.5>
    <NK1.6>
        <XTN.1>(900)545-1234</XTN.1>
    </NK1.6>
    <NK1.6>
        <XTN.1>(900)545-1200</XTN.1>
    </NK1.6>
    <NK1.7>
        <CE.1>EC1</CE.1>
```

```
            <CE.2>FIRST EMERGENCY CONTACT</CE.2>
            <CE.3>HL70131</CE.3>
        </NK1.7>
    </NK1>
    <NK1>
        <NK1.1>2</NK1.1>
        <NK1.2>
            <XPN.1>
                <FN.1>MASSIE</FN.1>
            </XPN.1>
            <XPN.2>MARYLOU</XPN.2>
        </NK1.2>
        <NK1.3>
            <CE.1>MOTHER</CE.1>
            <CE.3>HL70063</CE.3>
        </NK1.3>
        <NK1.4>
            <XAD.1>
                <SAD.1>300 ZOBERLEIN</SAD.1>
            </XAD.1>
            <XAD.3>ISHPEMING</XAD.3>
            <XAD.4>MI</XAD.4>
            <XAD.5>49849</XAD.5>
            <XAD.6>""</XAD.6>
        </NK1.4>
        <NK1.5>
            <XTN.1>(900)485-5344</XTN.1>
        </NK1.5>
        <NK1.6>
            <XTN.1>(900)545-1234</XTN.1>
        </NK1.6>
        <NK1.6>
            <XTN.1>(900)545-1200</XTN.1>
        </NK1.6>
        <NK1.7>
            <CE.1>EC2</CE.1>
            <CE.2>SECOND EMERGENCY CONTACT</CE.2>
            <CE.3>HL70131</CE.3>
        </NK1.7>
    </NK1>
    <NK1>
        <NK1.1>3</NK1.1>
    </NK1>
    <NK1>
        <NK1.1>4</NK1.1>
        <NK1.4>
            <XAD.1>
                <SAD.1>123 INDUSTRY WAY</SAD.1>
            </XAD.1>
            <XAD.3>ISHPEMING</XAD.3>
            <XAD.4>MI</XAD.4>
            <XAD.5>49849</XAD.5>
            <XAD.6>""</XAD.6>
        </NK1.4>
        <NK1.6>
            <XTN.1>(900)545-1200</XTN.1>
        </NK1.6>




        <NK1.7>
            <CE.1>EM</CE.1>
```

```
            <CE.2>EMPLOYER</CE.2>
            <CE.3>HL70131</CE.3>
        </NK1.7>
        <NK1.8>19940605</NK1.8>
        <NK1.10>PROGRAMMER</NK1.10>
        <NK1.13>
            <XON.1>ACME SOFTWARE COMPANY</XON.1>
        </NK1.13>
    </NK1>
    <PV1>
        <PV1.2>O</PV1.2>
        <PV1.3>
            <PL.1>O/R</PL.1>
        </PV1.3>
        <PV1.7>
            <XCN.1>0148</XCN.1>
            <XCN.2>
                <FN.1>ADDISON,JAMES</FN.1>
            </XCN.2>
        </PV1.7>
        <PV1.8>
            <XCN.1>0148</XCN.1>
            <XCN.2>
                <FN.1>ADDISON,JAMES</FN.1>
            </XCN.2>
        </PV1.8>
        <PV1.10>AMB</PV1.10>
        <PV1.17>
            <XCN.1>0148</XCN.1>
            <XCN.2>
                <FN.1>ADDISON,JAMES</FN.1>
            </XCN.2>
        </PV1.17>
        <PV1.18>S</PV1.18>
        <PV1.19>
            <CX.1>1400</CX.1>
        </PV1.19>
        <PV1.20>
            <FC.1>A</FC.1>
        </PV1.20>
        <PV1.39>GENHOS</PV1.39>
        <PV1.44>
            <TS.1>199501101410</TS.1>
        </PV1.44>
    </PV1>
    <PV2>
        <PV2.8>
            <TS.1>199901101400</TS.1>
        </PV2.8>
        <PV2.33>
            <TS.1>199901101400</TS.1>
        </PV2.33>
    </PV2>
    <ROL>
        <ROL.2>AD</ROL.2>
        <ROL.3>
            <CE.1>CP</CE.1>
            <CE.3>HL70443</CE.3>
        </ROL.3>


        <ROL.4>
            <XCN.1>0148</XCN.1>
```

```
        <XCN.2>
            <FN.1>ADDISON,JAMES</FN.1>
        </XCN.2>
    </ROL.4>
</ROL>
<OBX>
    <OBX.2>NM</OBX.2>
    <OBX.3>
        <CE.1>3141-9</CE.1>
        <CE.2>BODY WEIGHT</CE.2>
        <CE.3>LN</CE.3>
    </OBX.3>
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3.3   References

[rfHL7v231]   HL7 Version 2.3.1, ANSI/HL7 V2.3.1-1999,
                   approved as an ANSI standard April 14, 1999
                   http://www.hl7.org

[rfHL7v24]   HL7 Version 2.4, ANSI/HL7 V2.4-2000,
                   approved as an ANSI standard October 6, 2000
                   http://www.hl7.org

[rfHL7v25]   HL7 Version 2.5, HL7 V2.5-2002,
                   Membership Ballot #1, November, 2002
                   http://www.hl7.org

[rfXML]   Extensible Markup Language (XML) 1.0. 2nd Edition W3C Recommendation
                   http://www.w3.org/TR/REC-xml

[rfXMLSchema]   XML Schema, W3C Recommendation May 2, 2001
                   http://www.w3.org/XML/Schema, http://www.w3.org/TR/xmlschema-0/,
                   http://www.w3.org/TR/xmlschema-1/, http://www.w3.org/TR/xmlschema-2/

[rfXMLnamespace]   XML Namespace, W3C Recommendation: Namespaces in XML.
                   http://www.w3.org/TR/REC-xml-names/

[rfINFO]   HL7 Recommendation: Using XML as a Supplementary Messaging Syntax
                   for HL7 Version 2.3.1 – HL7 XML Special Interest Group, Informative
                   Document as of February, 2000.

[rfCEN1993]   European Committee for Standardization / Technical Committee 251 –
                   Medical Informatics. Investigation of Syntaxes for Existing Interchange
                   Formats to be used in Healthcare. CEN/TC251. January 1993.

[rfDolin1997]   Dolin RH, Alschuler L, Bray T, Mattison JE. SGML as a message interchange
                   format in healthcare. JAMIA Fall Symposium Supplement 1997: 635-9.

[rfDolin1998]   Dolin RH, Rishel W, Biron PV, Spinosa J, Mattison JE. SGML and XML as
                   interchange formats for HL7 messages. JAMIA Fall Symposium Supplement
                   1998.

[rfOemig1996]   Oemig F, Dudeck J. Problems in developing a comprehensive HL7 database.
                   AMIA Fall Symposium 1996
                   http://www.oemig.de/HL7/hl7amia96.htm

[rfOemig]   Frank Oemig's Home Page
                   http://www.oemig.de/HL7/

[Krueger]   Krueger G. A structured approach to HL7 application development. 1996.
                   http://www.gkrueger.com/other/hl7/

[rfHL7v3ITS]   HL7 Version 3 – XML ITS, see HL7 Version 3 (Draft)
                   http://www.hl7.org

[rfXPATH]   XML Path Language (XPath) Version 1.0, W3C Recommendation
                   http://www.w3.org/TR/xpath

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