Quest Diagnostics - Lab Orders & Results interface development using nHAPI

Description:

The purpose of this document is to define the scope of the project and the solution provided to the client.

Requirements:

Our client wanted to create a solution to interface with Quest Diagnostics, to process received HL7 messages and save them in his MSSQL database and generate and transmit HL7 messages from their database, all the database related solution was to be provided using Microsoft's entity framework. The solution was supposed to support HL7's lab order and lab result messages and generating message level acknowledgments message.

Solution Provided:

After analyzing the client's requirements, the client was provided with a class library written in c# using NHapi for HL7 messages.

The library exposed certain methods to parse and generate HL7 messages and also methods to generate acknowledgments.

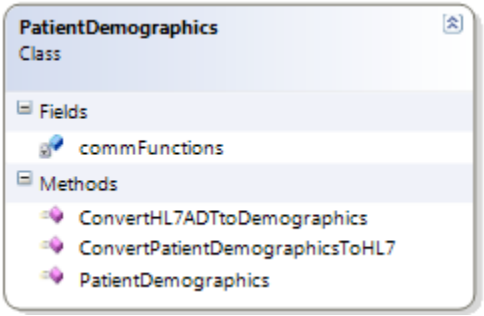
Following were the classes designed to fulfill client's requirements.

1. **Patient Demographics:**

   This class provides methods to generate messages from database as well parse the HL7 messages and save data in database.

   Methods:

   The class exposes a constructor to create its instance, a method "ConvertPatientDemographicsToHL7" to generate a message against a MRN and a method "ConvertHL7ADTtoDemographics" to parse demographic information and save it in database.



   ConvertPatientDemographicsToHL7:

   The method expects a MRN and receiving entity as parameters, the methods extracts data against MRN from the database, formats the message segments against the data, adds MLLP wrappers and converts the message to string as returned output.

   ConvertHL7ADTtoDemographics:

   The method expects a HL7 message string, parses the message string to demographic message object, and retrieves the data from the segments and save the data in the database, the method returns the status codes to determine what happened to the message.

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Following is the sample ADT_A28 message being parsed and generated by the system.

```
MSH|^~\&|sending application|shiwan||sliclient1|20061211153336||ADT^A28|msgControlID123|P|2.3
EVN|A28|199608190820
PID|1|pid123|^^^LH||Wally^SHERRY^M||20000101|F|PETRY^SHERRY||4690 Parkway Dr.^address line 2^Mason^OH^45040^USA|a2|^^^^86^999^9999999^99999|513-999-9999|
a5|||1-FOUND|444-66-9999
PV1|1|O
GT1|1|88|Smith^John^M^JR^DR^MD||3710 Emery Lake Ln^Street line2^Cincinnati^OH^45010|^^^^1^513^8888888^1234|^^^^1^238^4444444^5678|19960708112233|M|I|8|
287889999||||ABC Inc.^Limited^M |4567 Kelly Drive^address line 2^Oxford^OH^45068|55566677777|4556|FT|Guarantor Organization
IN1|1|INSID123^Insurance Plan ABC|INSCOID123|insuranceco|1800 Insurance Rd.^^Detroit^MI^45777||^^^^1^555^6667777^1234|3433|name|||||
^19960707|||||||||||||||||||||||||||||||||T|
```

The document explains the segments description for ADT_A28 and ADT_A08 message

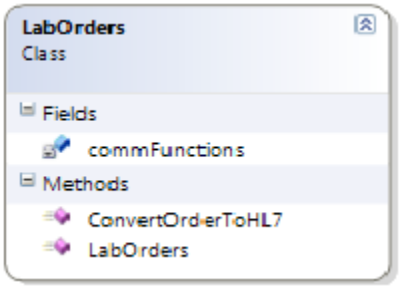
ADT Message Structure

2. **Lab Orders**

This class provides method to create lab order HL7 messages on fetched data from the database.

Methods:

The class exposes a constructor to create its instances and a method "ConvertOrderToHL7" to create HL7 OBR message.



ConvertOrderToHL7:

The method expects a lab order ID to create a message against the orderID and receiving facility ID. The method fetch data from database against the order ID, sets message segments with the data, add MLLP wrappers and converts the message to the string as returned output.

Following is the sample Lab Order (ORM_001) message being generated by the system

```
MSH|^~\&|HUBWS|2135800||THO|200609211051||ORM^O01|1234567890|P|2.3
PID|1|11111|||TEST^WIFE||19451212|M|||||3102222222|||||123456789|
IN1|1||AUHSC|AETNA|123 ANYSTREET^2^CHICAGO^IL^60305|||A12345|||||||TEST^HUSBAND^|2||123 ANYSTREET^^CHICAGO^IL^60305|||||||||||||||P123456R|||||||||||T|
GT1|1||TEST^HUSBAND^||123 ANYSTREET^^CHICAGO^IL^60305|3102222222||19451212|M|
ORC|NW|1234567890|||||||||OTH030^MICHIGAN^JOHN^^^^^UPIN|
OBR|1|1234567890||^^^6399^CBC|||20051223094800|||||||OTH030^MICHIGAN^JOHN^^^^^UPIN|||||||||||1^^^^^R|
DG1|1|ICD|0039|SALMONELLA INFECTION NOS|
```

The document explains the segment information for the Lab Order messages.

OrdersSegmentsInfo

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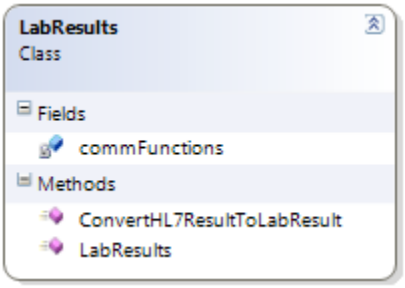
3. **Lab Results:**

This class provides method to process (parse) lab result message string and save the data in the database.

Methods:

The class exposes a constructor to create its instance and a method "ConvertHL7ResultToLabResult" to parse an HL7 OBX inbound message.



ConvertHL7ResultToLabResult:

The method expects a HL7 message string, parses the message string to an OBX message object and reads the data from the segments and saves the data in the database. The method returns the status codes to provide information about the message processing status.

Following image illustrate the sample Result (ORU_R01) message being parsed by the system:

```
MSH|^~\&|RIS|unitTestOrderProvider|F|unitTestOrderProviderAccount|20120104100000||ORU^R01|20120104100000-1|P|2.3|11
PID|||123456789^^^F|123456789|TEST^WIFE||19560101|F|||||(206)783-4||*ENGLISH^E|S||9918210003|123456789
OBR||0000002466F30070^HBOX|2466^HBOX|30070^MR CHEST W/O CONTRAST^RAD||20120104100000|20120104100000|20120104100000|||||||OTH030^DOCTOR^A^^^^^UPIN||||||
20040204095201|||F|||||||999999&Transcriptionist&The&A|999999&Transcriptionist&The&A||999999&<None>
OBX|1|FT|RAD|| |||||F|||||999999
OBX|2|FT|RAD||The findings: Frontal view of the chest compared to earlier studies of||||||F|||||999999
OBX|3|FT|RAD||12/11/2003 and 12/31/2003.||||||F|||||999999
OBX|4|FT|RAD|| |||||F|||||999999
OBX|5|FT|RAD||Again, the study was obtained and a poor degree of inspiration. There||||||F|||||999999
OBX|6|FT|RAD||is a mild prominence of the interstitial markings particularly at the||||||F|||||999999
OBX|7|FT|RAD||bases and these could easily represent atelectasis. The cardiac||||||F|||||999999
OBX|8|FT|RAD||silhouette is borderline normal. Hilar and mediastinal silhouettes are||||||F|||||999999
OBX|9|FT|RAD||normal for this degree of inspiration. There is no effusion or||||||F|||||999999
OBX|10|FT|RAD||pneumothorax.||||||F|||||999999
OBX|11|FT|RAD|| |||||F|||||999999
OBX|12|FT|RAD||Impression:||||||F|||||999999
OBX|13|FT|RAD|| |||||F|||||999999
OBX|14|FT|RAD||Poor inspiration with compression of pulmonary markings. No definite||||||F|||||999999
OBX|15|FT|RAD||acute process is identified||||||F|||||999999
```

The document explains the segment information for the Result messages.

ResultsMessageInfo

Processing Panel Results and Result value type:

Parsing result message was the most complex part of the solution, it need deep understanding for results processing system. As the results were for single lab orders as well results were being received for panel lab orders.

Panel results handling is a bit complex task to do. We may be receiving results of a panel in multiple messages or results of multiple orders in a same message. So when we receive a result set against a panel order we have to get order information from our database and store the results respective to the lab test in a panel. If we receive panel result in multiple messages then we have to store the results for the remaining lab orders in a panel.

There is one more thing to be noted, results values (OBX-5) were dependent on value type (OBX-2), either the result value be numeric or the text string, so the result values has to be placed in their respective field in the database after checking OBX-2 field value.

HL7 lab Orders & Result workflow:

When a user places a Lab order in his application, a lab order entry is created in lab order table and all the lab test included in the order are entered in laborderlabtest table (a table maintaining record for ordered tests in a Lab Order). The values for the entry in lab order table against a lab order are placed in ORC segment of ORM_001 message and all the entries in laborderlabtest table against a certain lab order are placed in OBR section of the message, then the message is formatted in HL7 format and transmitted to the Quest.

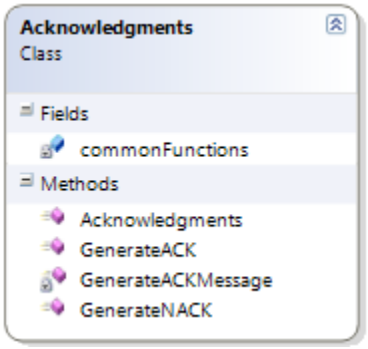
When we receive an ORU_R01 message it contains OBX segments against OBR segments in Lab Order message, on receiving a result message each OBX segment is stored against its OBR segment in database. The result message can also contain one or more note section against an OBX, these notes are stored against the OBX result, the result type is determined OBX-2 section and stored in database accordingly.

4. **Acknowledgments:**

This class provides methods to generate Acknowledgments, either positive or negative.

Methods:

The class exposes a constructor to create its instance, a method "GenerateACK" to generate an ACK message and "GenerateNACK" to generate a Negative-ACK message.



GenerateACK:

The method generates the ACK message against the original message and message type provided as parameters.

GenerateNACK:

The method generates the Negative-ACK message against the original message provided as parameters.

5. **Common Functions:**

The class provides the utility functionalities to the library's internal use. i.e setter And getters for certain HL7 message segments. Following diagram lists the methods exposed by the class.

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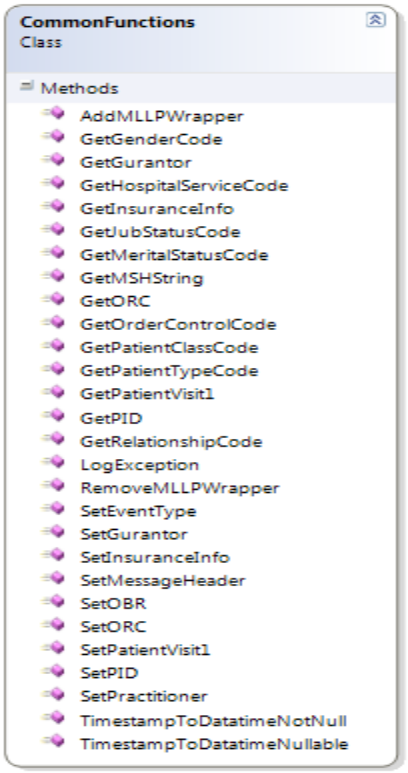

Handling lookup values:

Placing and replacing the lookup values in HL7 messages is one of the core functions of HL7 message processing systems. These coded values are chosen from tables, these lookup tables and their values may be HL7 standardized or user defined (a mutual understanding on the lookup values between the parties).

- **HL7 Tables:** An HL7 table is a set of values defined and published by HL7. They are a part of the HL7 Standard because they affect the interpretation of the messages that contain them. These values may not be redefined locally; however, the table itself may be extended to accommodate locally defined values. This is particularly applicable in the case of *HL7 table 0003 – Event Type*. The ID data type is most often used to encode values for HL7 tables.
- **User-defined Tables:** A user-defined table is a set of values that are locally or site defined. This accommodates certain fields, like *PV1-3 - Assigned patient location*, that will have values that vary from institution to institution. Even though these tables are not defined in the Standard, they are given a user-defined table number to facilitate implementations. HL7 sometimes publishes suggested values that a site may use as a starter set (e.g., *table 0001- Sex*). The IS data type is often used to encode values for these tables.

For more information please visit the link,
http://www.hl7.org/implement/standards/product_brief.cfm?product_id=59

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The document illustrates basic guides to getting started with nHAPI and a sample project.

nHAPI knowledge doc.docx

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