AN AUTOMATED MODEL-BASED TEST TRANSACTION GENERATOR
FOR HIPAA COMPLIANCE

Dr. Michel Mitri, James Madison University, mitrimx@jmu.edu
Mr. Abdul Tannir, Syssolution, Inc., abie@tannir.us

ABSTRACT

The Health Insurance Portability and Accountability Act (HIPAA) requires health care providers and insurance companies to convert their electronic transaction processing to a common format using the X12 EDI standard. In many cases, this requires organizations to substantially change their EDI procedures. The IT staffs in these organizations are under pressure to quickly develop and test software for the purpose of complying with the new standards. Often they are ill-prepared for such transformations due to lack of knowledge of HIPAA and EDI standards, entrenched information infrastructures, difficulty of converting from their proprietary representations, and time constraints. In particular, HIPAA-compliant test transactions are difficult to generate from production data since the production data is generally in the old, proprietary format. This paper presents a prototype software tool for automatic generation of compliant test transactions.

Keywords: HIPAA, EDI, test generation software, ASC X12 standard, Microsoft Access, business models.

INTRODUCTION

EDI (Electronic Data Interchange) is an application-to-application exchange of standard business documents in a standardized electronic data format between two trading partners. An essential component of EDI is the exchange of information between computers without human intervention, assuming that both organizational entities are using a computer-based application to exchange data [1]. There are a variety of EDI standards, some proprietary and some open. The most common open standard in the United States is X12, developed by the Accredited Standards Committee (ASC) under the auspices of the American National Standards Institute (ANSI).

Early EDI standardization efforts in the health insurance industry centered on the Uniform Billing (UB) format, developed by the Uniform Billing Committee of health care providers and payers. UB is a ubiquitous format, used by most health insurers throughout the 1990s and into the 21st century. Unfortunately, UB suffers from some major flaws. For example, it is not really a standard. It is instead a sort of quasi-standard that is adopted and then tweaked and refined by different companies, which in effect leads right back to the problems inherent in utilizing a multitude of proprietary standards. In addition, its flat-file structure makes it relatively inflexible. Because of these and other weaknesses, there have been efforts by health-care standards bodies to adopt a true (and flexible) standard.
Specifically, the U.S. government stepped in during the 1990s in order to attempt to enforce true industry-wide EDI standards for the health insurance industry. In 1991, the Bush administration called health care industry leaders together to discuss health care administrative cost reduction ideas. Leaders recommended increased EDI use within industry, and thus was formed the Workgroup for EDI (WEDI). Throughout the early 1990s, WEDI and the Association for Electronic Health Care Transactions (AFEHCT) worked on developing X12-based transactions for health care. By the mid-1990s, the Clinton administration’s push toward health care reform had generated the Health Insurance Portability and Accountability Act (HIPAA), which was signed into law on August 21, 1996 [3, 4]. A major component on this act is the requirement that all electronically transmitted health care transactions be submitted using X12-based standards, particularly those created by WEDI. Thus, it is now a law that health insurers use these standards [2].

HIPAA mandated X12 formats for several common health insurance transaction types. Each type is identified by a number. The transactions include:

- 270/271 – Health Care Eligibility/Benefit Inquiry and Response
- 275/277 – Health Care Claim Additional Information Request and Response
- 276/277 – Health Care Claims Status Request and Response
- 278 – Referral Certification and Authorization
- 820 – Payroll Deduction and Group Premium Payment
- 834 – Health Care Plan Enrollment/Disenrollment
- 835 – Receipt of Health Care Remittance
- 837 – Institutional, Professional, and Dental Claims and Coordination of Benefits [5]

This is no simple task. Health insurers and providers have struggled to meet the October 2003 deadline; indeed, to date many have still not succeeded in migrating to this standard. As can be expected, the cost of conversion is quite high. Although the promised long-term savings are significant, it is a major technological feat to change large-scale systems to use this new standard. Therefore, insurers and providers seek tools that can assist in the conversion effort. A major task in the conversion effort is to generate reasonable test data for software developers who are migrating from their legacy systems (usually based on UB formats) to X12-based transaction formats. This paper describes a typical problem faced by a major U.S. health insurance company, and presents a software product, called Edifice, that automatically generates X12-based transactions for software testing purposes.

THE UNDERLYING BUSINESS PROBLEM AND PROPOSED SOLUTION

The Edifice software, described below, was developed to meet a number of challenges, which are described in this section. First, the enterprise applications used in this health insurance company are old and complex. The HIPAA solution must be designed in such a way to deal with incoming and outgoing data without affecting the core applications. Therefore, the implementation of HIPAA is more than just a system upgrade. Security, privacy, and other HIPAA regulations force the enterprise to adapt a whole new way of doing business. This later became know as New Business Implementation (NBI) throughout the organization. In order to
meet this challenge, a new system was being considered for purchase, but that system could show no evidence of being able to support the types and volume of business that is supported by the enterprise.

To complicate matters, testing in general, has not been one of the enterprise's strong points. The current test environment could not be adopted for the HIPAA conversion large scale project without involving almost all system and application developers in the testing process. Some solution was necessary to create a 'final' user acceptance environment that can be operated with few people and relatively low cost while meeting the project schedule and milestones. The cost of the project was expected to be in the hundreds of millions of dollars.

The solution to this problem required an infrastructure that would address all the problems described above. Since the HIPAA implementation would impact every enterprise application, as well as applications hosted by business partners outside the physical boundaries of the enterprise, it was necessary to establish a testing platform that represents all major application within the enterprise and the major applications at the business partners' sites. This included all the mainframe, web, client/server, and desktop application platforms.

Because of the complexity of the systems, the complexity of running transaction through all affected applications, and the time it would take to restore the entire environment when backout was necessary for regression testing, new technology was introduced to facilitate and expedite this process. As one component of this solution, a new kind of hardware was purchased to allow instant capture and restoration of the entire data environment, including the major DB2, IMS, Oracle, and Sybase databases. To keep the test execution production-like, all testing was done using automated test tools similar to those used for production.

One important piece of this automated test environment is the Edifice software. Because the business partners were in the process of revamping their systems to support HIPAA, it wasn't feasible to depend or wait on them to provide test transactions at the time that the enterprise applications were being revamped and tested. A decision was made to create and fictitious test transactions, and wait for partners' readiness for joint testing for purpose of certifying partners' format and content of transactions.

The business sector of the enterprise was not familiar with HIPAA formats or able to produce the volume of test transactions that can be used to secure the Business acceptance of the new systems. Few transactions were built by the developers, and the Business agreed to use those transactions to clone others with different members, providers, billers, and services. Edifice was designed to be a tool to allow the business to apply basically correct transactions against the groups and providers that are mission-critical. The health insurer knew the members/groups and the billers and providers that should be tested, and Edifice was to use a set of model transactions and a long list of members, providers, and clinical procedure codes to produce thousands of transactions that span all the conditions and lines of business. The next section describes the Edifice software.
A DESCRIPTION OF THE EDIFICE SOFTWARE

Edifice was constructed using Microsoft Access and Visual Basic for Applications (VBA). The database table structure was constructed to (a) mirror the structure of typical X12 interface layouts, (b) provide a mechanism for business model – to – HIPAA transaction mapping, and (c) support a user interface for simple application of business models to HIPAA transactions.

Figure 1 shows an entity-relationship diagram of the X12 structure. This corresponds with the typical structure of an X12 transaction format. Each transaction consists of a set of segments, and a particular type of segment can be associated with one or more transaction; thus you see a many-to-many relationship between transactions and segments implemented by the TransactionSegment intersection table which includes, along with foreign keys binding the transactions and segments, additional data describing the role a segment plays with a transaction. Similarly, there is a many-to-many relationship between segments and data elements, implemented by the SegmentElements intersection table which defines the role played by a data element in a segment. Finally, because some data elements are composed of, or contained within, others, we see a recursive many-to-many relationship among data elements, similar to a typical bill-of-materials format.

A key problem faced by health providers and insurers is to map the data structures and business processes internal to their organizations into the X12 format; this is a highly difficult challenge, and requires expertise in both the company’s data model and EDI formats. Thus, model mapping is a key feature of the Edifice software. Business models for this health insurance company include the following: members (and patients), health providers (physicians or hospitals), claims, inpatient and outpatient services, and service lines. Each model may be associated with one or more loop (repeatable set of segments) in one or more transaction. In addition, some models may be composed of or reference other models, forming composite models. The data structures for implementing this model mapping capability are implemented in the tables shown in figure 2.
Figure 2: An ER-diagram of business model – to – EDI mapping

Figure 3: The main user input form for Edifice
Figure 3 shows the main user interface form for Edifice. This form allows a user to generate a test HIPAA transaction of any type by entering data into data elements. More importantly, using this form, one can apply any combination of business models (members, patients, providers, claims, services, and service lines) to create fictional transactions that (a) satisfy the test conditions that software developers need in order to validate their program algorithms, (b) make use of actual production data and therefore obtain maximally realistic scenarios, and (c) ensure patient privacy by separating claims, services, members and providers into disjoint units. In other words, although actual production data is used, the transactions that are created are completely fictional. Nevertheless, these transactions accurately reflect the types of business processes typically (and even atypically) performed by the insurer.

In addition to the online form, Edifice includes a number of batch operations, which assist in generating high-volume EDI data based on randomly combining business models, creation of business models from pre-existing X12 transactions, and conversion of UB92 (uniform-billing code) transactions into HIPAA-compliant transactions.

CONCLUSION: EXPERIENCES USING EDIFICE AND FUTURE DIRECTIONS

During the HIPAA conversion process, Edifice was used as a pilot tool, but was never made completely operational. It demonstrated potential in its ability to apply models (providers, services, billers, members) to X12 transactions, particularly the HIPAA 837 claim transaction. However, Edifice suffered from some technical limitations. For example, it was unable to support multiple transactions, or deal with transactions where data segments wrapped across multiple lines.

In addition, the business climate in which various groups were working independently of each other was an obstacle for widespread use of Edifice. It turned out that Edifice efforts were not in sync with other test processes. What had begun as an effort to create individual test transactions on a case by case basis (the underlying assumption behind Edifice’s design) had mutated into the need for an enterprise-wide test bed dealing with interoperability issues and system-wide performance assurance. Edifice was unable to adapt to these needs in the limited time required to meet the HIPAA compliance deadline.

Nevertheless, various features of Edifice were served useful purposes during the compliance effort. For example, Edifice was used extensively for printing and displaying transactions in a format that individuals in the organization could use despite their ignorance of EDI formats. Furthermore, it proved useful as a quick tool for compliance testing, ensuring that transactions was X12 compliant. In many cases, UB92 transactions were processed through a home-grown translator to generate X12 transactions, and then Edifice applied business models to these transactions in order to create fictional transactions for testing, which is in fact the original intent of the Edifice software efforts.

Perhaps the most important contribution of Edifice for the health insurer is in its promise for future projects. Now that HIPAA compliance has been met, the next big project is to implement transactions that do not depend on social security numbers for patient and subscriber
identification; Edifice can be used to modify existing 837 transactions so that they use contract numbers that are not SSNs.

In general, Edifice promises to become part of an enterprise-wide testing lab that supports a wide variety of test cases for all applications supporting the insurer’s business processes. This testing lab is currently under development, and Edifice will be enhanced to apply multivariate test conditions for the generation of multiple combinations of test transactions for complex application scenarios.

REFERENCES