THE GROWING NEED FOR META MESSAGES IN ELECTRONIC DATA INTERCHANGE

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ABSTRACT

The economic advantages of Electronic Data Interchange (EDI) are widely recognized. Nevertheless, the number of total users is relatively small compared to the total business in the world. This is due to the fact that the costs for setting up and running an EDI relationship are to high for small and medium enterprises (SMEs). Recently, new standardization efforts have been made to involve more SMEs in EDI. In this paper we pick up the idea of subsets with nearly null optionality as presented in Lite EDI. We distinguish standardized subsets as originally proposed by Lite EDI and subsets resulting from hub-spoke-relationships. Furthermore, we show that transmitting these subsets via meta messages will reduce the complexity of EDI standards to an absolute minimum for SMEs.

1. INTRODUCTION

Many years ago industry discovered the great benefits of electronic information transfer. In the beginning large companies developed their own format—known as proprietary standards—to interchange business data with their business partners. But the limitations of proprietary standards were soon detected when business partners using different exchange formats wanted to perform business transactions. Accordingly, particular branches of industries and some national institutions developed an exchange format which was meaningful for their focus of interest. Famous examples of these branch restricted formats are ODETTE (automotive industry) and SWIFT (banking sector). ANSI X12 (North America) and UN/TDI (United Kingdom) are successful implementations of national solutions. Due to the fact that most businesses were done intrasectorial and nationally, these standards were sufficient for many organizations. Owing to the increasing globalization of today's business trade, it became a necessity for many organizations to communicate with organizations in different sectors all over the world. Hand in hand there was a growing need for an international and branch-independent standard for electronically submitting business data. As a consequence, in 1987 the ISO published the syntax rules of

UN/EDIFACT as an international and intersectorial valid standard (United Nations, Economic and Social Council 1987). The UN/ECE agreed to maintain the EDIFACT standards, and publishes since 1990 new standard directories twice a year.

Especially large corporations (hubs) and also their dependants (spokes) became quite interested in using this standard. They started to use EDI messages for transmitting orders and invoices. In the meantime there exist more than 300 EDIFACT messages, covering a broad range of application domains. But over the years, it became clear that it was rather difficult—particularly for small and medium enterprises (SMEs)—to get started with EDI. A case study on about 60 European organizations showed that most of these organizations were not able to derive the expected benefits (more efficient personal management, faster transaction turnaround, just-in-time-production, etc.) from EDI (Bielli 1996). So the implementation of EDI was slower than originally expected.

Although it is often stated that EDI is 80% business and only 20% technique (Emmelhainz 1990, Ritchie 1995, Swatman 1993), we feel that the technical aspects of EDI are quite underestimated. The full EDIFACT message repertoire, with all its optionality and requirements for detailed trading partner agreements for each trading relationship, is far too complex for an SME to freely choose and implement in many practical situations (EBES/EWOS 1997). A more efficient method of interchanging business data would therefore reduce the costs of implementation. The fact, that 90% of the Fortune 1000 enterprises have invested in EDI, but less than 1% of the SMEs are involved in EDI, indicates that the current method of exchanging business data is not suitable for most SMEs. Consequently, there is a growing need for new methods which will allow SMEs to participate in EDI.

2. ANALYSIS OF THE EDIFACT CONCEPTS

The above mentioned problem of integrating EDI into business is a result of the generic structure approach used in EDIFACT (Steel 1994). Each EDIFACT message is a data model of a single business transaction. It is created by volunteers from the business world working in the standardization bodies who put their business sector know-how in a data model which is written down in EDIFACT syntax (Raman 1996). As a result an EDIFACT message is a data model that is intended to capture all data that may appear in any business document of the corresponding business transaction. In this sense EDIFACT is truly international and intersectorial.

The problem is that there does not exist an information system which can process all the semantics that are included in the EDIFACT messages. Therefore, there is no guarantee that a message created by a sending application in a standard conform format will be automatically processable by a receiving application. This would require the following two conditions: First, both information systems must have the same understanding of the interchanged data. Second, the receiving application must be able to process any data that might be included in a standard message. Unfortunately, none of these conditions are fulfilled. This is due to the fact that on the one hand semantics are not part of current EDI standards. On the other hand organizations use legacy systems which were not especially designed for EDI and are only able to process limited semantics that are sufficient for a particular organization.

The problem of missing semantics is handled by EDI branch organizations. They trim down the EDI standard messages to suite the requirements of business partners in a particular sector, in a particular part of the world. For the resulting subsets of EDI messages they specify the semantics in so-called implementation guidelines which govern the implementation of EDI in the specific sector of the specific local area (Raman 1996). Since there are a number of these organizations, many different implementation guidelines for the same EDI message will coexist. The international and intersectorial EDIFACT standard is split into a number of national and branch specific subsets. In addition, the standard itself as well as the corresponding implementation guidelines are updated regularly, but older versions still remain. As a result, a great number of different formats and interpreted semantics may exist for a single business transaction.

An implementation guideline also for a specific sector in a specific local area alone would be worthless if an information system of an involved business partner is not able to handle the induced semantics. Business partners willing to exchange data electronically in a structured format have first to agree on the actual data they want to interchange. The format of these data is mainly determined by the semantics the involved information systems are able to process. Hence, business partners have to sit down, discuss how they are going to interchange files and implement these specifications within specific translation software. Consequently, a detailed trading agreement is needed for each business relationship. It follows that business partners—although using the international and intersectorial EDIFACT standard—in fact, use a corresponding proprietary standard for each business relationship. Organizations with great market power (hubs) can overcome the unlucky situation by dictating their preferable interchange format to all their business partners (spokes). This might be the reason why EDI success stories are mainly reported by the 1000 Fortune organizations. But SMEs which have to struggle with a variety of different exchange formats are the losers in the current approach.

To sum it up the following problems are encountered in the current EDIFACT standardization approach (Huemer 1996a, Huemer 1997b, Steel 1994):

- Resulting structures are too complex and consequently too hard to read and to navigate.
- Multiple standards and different versions of each standard are in use.
- Semantics are not part of the EDI standard.
- Semantic interpretation of the standard is included in implementation conventions, which are different for each industry sector and/or geographical region.
- A detailed interchange agreement is necessary to establish an EDI relationship to a trading partner.

- Overhead in network costs and reduced processing efficiency due to segment tags and delimiters marking unused data.
- A change request to an EDI standard is much too time-consuming due to the bureaucracy in the data maintenance process.

3. ALTERNATIVE APPROACHES

Since the EDI community has already recognized the shortcomings of the current standardization approach, a lot of projects have been started to overcome them. In this section we give a short presentation on the most promising ones: Open-edi, Object-Oriented EDI, Lite EDI, and BSI. All these projects have in common that they try to reduce the complexity of the current standardization methods in order to attract SMEs to participate in EDI.

Open-edi (International Organization for Standardization 1991, International Organization for Standardization 1995) describes a framework for positioning and harmonizing all standards and activities used in EDI. It addresses the requirements for an Open-edi environment, intended to minimize the need for private interchange agreement and to maximize interoperability. A central aspect of Open-edi is the integration of business processes. The business operational view of Open-edi introduces standard business scenarios. On the one hand these will address the rules for business transactions, like operational conventions, agreements or mutual obligations. On the other hand they will define the semantics of business data in business transactions and associated data interchange rules. Since the business operational view standards should reflect the functional service view standards, semantics will no longer be excluded from the standard. Different semantic interpretations by various implementation conventions will cause no problems, because every interpretation will be defined as an instance of a business scenario and an interchange will refer to a concrete scenario. Consequently, there will only be a need of matching the business scenarios between business partners. But Open-edi itself describes just a framework and offers no concrete methodology.

Object-Oriented EDI (CEFACT AC.1 1997) is proposed to be an implementation of Open-edi. The use of object-oriented techniques permits the information technology requirements to be differentiated from the semantics of business data, thus providing the ability to interface different functional service view implementations (produced by software vendors) to support the business operational view. An object class is a template for multiple object instances with similar features. The business requirements will be met within the object classes. Consequently, much work is required to model business activities in order to identify the classes. Through the production of a standardized framework, which is the set of all possible functions that meet a common business goal, it will be possible to select a subset of the functions for a given situation. Accordingly, the work in Object-Oriented EDI is primarily focused on the business operational view. This means that the focus for the development of EDI standards is shifted from the interchange file to the information contained within the business process. Through the production of well-defined models it is possible to reduce the number of ways business transactions are interpreted. This will separate the analysis phase from the application design and programming phase and may lead to the production of commercially available ‘off-the-shelf’ Object-Oriented EDI software.

Business System Interoperation (BSI) (Steel 1996) completely ignores the current approaches. It describes an approach based on a common data dictionary. The sending application produces a specification file and a transfer data file via a so-called BSI server. The specification file includes the intended business process (which references a term in the common data dictionary) and the data structure of the transfer data file. The business semantics of the various data items are incorporated in the specification file, because each data unit references a semantically complete label in the common data dictionary. The transfer data file is structured according to the specification file and sent together in a control envelope to the business partner. The receiving BSI server should be able to reproduce the business semantics according to the semantically complete labels defined in the specification file. The receiving BSI server must be able to rearrange the transferred data to meet the receiving applications data structure. The BSI server must apply rules for data not or differently supplied. If this approach is shown to a practical solution then it will offer opportunities for easier EDI implementation and will come close to the ambitious goals of Open-edi.

Lite EDI is based on current technologies, not re-engineering (EBES/EWOS 1997). The availability of simple messages with clear implementation rules is a vital component of Lite EDI. The simplification of the messages is performed by choosing subsets of the current messages with near null optionality. Therefore, the full EDI users would have to accept the limited set of data upon reception and refrain from sending anything more in return. Furthermore, Lite EDI solutions would have to expand to include support for forms based Electronic Commerce. The electronic form could be based on the use of a mark-up language, such as HTML, and (possible) translation of the resulting data to the EDIFACT format for further processing. The form could also be based on the interpretation of meta messages by e.g. downloaded Java applets (in which case the data could be created directly in EDIFACT format). Although the Lite EDI solutions should have sufficient structure to enable information received to be integrated into the local application systems, many users may choose not to carry out this integration unless there is ready availability on the market of relatively low cost and easy to use software to assist integration. As a consequence, the integration of Lite EDI into application software is a key factor in the take-off of Lite EDI. Integration seems to be easy at the receiver’s side (who is the ‘owner’ of the form), but to be too complex at the sending end—exceptionally if there exists a standardized form. But why using a form if the information is automatically produced from the sender’s application and the format is standardized?

4. THE EXPRESSIVE POWER OF META MESSAGES

Object-Oriented EDI—as implementation of Open-edi—seems to be the most promising approach among the above mentioned alternatives. Owing to the fact that the modeling of the object-oriented classes covering business requirements is a very time consuming task, it can be considered as a concept for the next generation of EDI. BSI has reached a more mature level. But industry has not adopted this approach, because organizations successfully running EDI relationships still remain on the current standards. Although Lite EDI is just a framework by now, it seems to be that one which can be implemented in the shortest period. This is due to the fact that it is based on current technology. Nevertheless it is our opinion that the form based approach is not useful, but the concept of simplification of the traditional EDIFACT message structures and procedures is very promising. Accordingly, we concentrate in the following on this aspect of Lite EDI.

Lite EDI is based on subsets of the current messages with limited optionality as a basic requirement. Furthermore, there should exist only one implementation guideline per Lite EDI message. It is mentioned that the delivery mechanism for a message implementation guideline could be in the form of the EDIFACT meta message IMPDEF (Implementation Definition), which would allow them to be interpreted by a program. This means, that all organizations participating in Lite EDI must use the reduced subset of the original EDIFACT message(s). In case of information transfer between SMEs or in other words between organizations willing to accept the limited set, this approach will lead to the expected results.

However, if the SMEs communicates with a major partner who has implemented full EDI one might face some problems. Usually the information transfer is done at the initiative and on the terms of the major partner. If the hub tries to dictate an interchange format which is not compatible with the Lite EDI subset, the spoke (SME) has no other choice than to accept this unsatisfying situation.

To overcome the still existing hubs-and-spokes-dilemma, we propose to extend the concept of Lite EDI. Each hub-and-spoke-relationship, should be regarded as separate subset. Also a hub will not use all the semantics included in an EDIFACT message, and it will be easy for him to provide the spoke with the exact subset definition which it requires. This has the advantage that the spoke needs not to understand the full EDIFACT message, but only the limited set required for the specific situation. Nevertheless the full advantage of this concept can only be reached if—similarly to the proposal of Lite EDI—the subset definition is delivered in an electronic format which can be imported into the spoke's EDI translation software. In this case the spoke is able to specify the conversion tables accordingly to the reduced functionality of the hub's subset.

As mentioned above the meta message plays a central part in our concept. It is used to transfer the limited Lite EDI subset, as well as the subset resulting from an interchange agreement between partners in a hub-spoke-relationship. If the hub-spoke-subset is only provided in paper-based form, the SME still has to specify the mapping from the EDI format to the 'in-house'-format on basis of the full EDI message design by picking only those EDIFACT components which are part of the required hub-spoke-subset. If the SME is able to receive a meta message and to import it in its translation software, it has no need to store all the different versions of EDIFACT directories in its translation software. Therefore, meta messages are extremely important in case of hub-spoke-relationships, because they allow for a common understanding of non-standard subsets (in contrary to the standardized Lite EDI subsets).

Consequently, the use of meta messages results in a reduced complexity of the standard messages for SMEs. The SME is only provided with those components of EDI standard messages which are relevant for its information exchange with its business partners, whereas all unnecessary components are hidden for it. From the viewpoint of an SME the relevance of the currently standardized business messages is completely removed. But standardized business messages are still of importance for the hub to serve as a starting point for the subset definition. It is important to note that in this concept the meta message is the most important message to standardize, because it guarantees for a common understanding of the transmitted subset definition between the hub and the spoke.

One might argue that an increasing number of hub-spoke-relationships would result in a proliferation of different exchange formats. Admittedly, this does not correspond to the intention of standardization. But since hubs usually dictate the EDI relationship, it is a problem of real business which cannot be denied by theory. Thus, the strategy for a SME should be to base the information transfer on Lite EDI standard subsets whenever this is possible (usually between organizations of the same rank) and to accept a hub dictated subset only if other economic reasons will justify it. This strategy ensures that one common subset—the Lite EDI subset—is used for the information transfer with most business partners and that the additional number of hub-spoke-subsets is limited to a minimum.

The power of the presented concept is also influenced by the semantics which can be captured within a meta message. Since Lite EDI subsets are shared between more users the semantics usually included in an implementation guideline must be transmittable. Lite EDI proposes to use IMPDEF (Implementation Definition) or ESTEEM (EWOS Specification Technique for Expressing EDI Messages) as meta messages. IMPDEF itself is an EDIFACT message which purpose is to transfer a message guideline. Thus, we prefer IMPDEF to ESTEEM which serves the same purpose but not on the basis of an EDIFACT message. Nevertheless, for the purpose of transmitting hub-spoke-subsets an 'enriched' meta message would be desirable. This is due to the fact, that hub-spoke-subsets are specified for a specific business relationship (or more business relationships of one spoke with exactly the same nature). Accordingly, semantics which apply to a specific business relationship should be included in the meta message. Fixed and default business behavior will fall in this category of semantics. For example, the terms of payment can be fixed between two business partners (until a new meta message is sent) and the normal lead time can be declared as sufficient if not otherwise stated in an order message. This would require additional requirement designators in a code list within the meta message. Additional semantics to be included should be carefully analyzed in the development of a meta message for transmitting hub-spoke-subsets. Until the development of such a meta message IMPDEF should also be used to transmit hub-spoke-subsets.

The subset definition exchange via meta messages makes great demands on future EDI software. The proposed concept requires a tool for designing business messages which can be translated into a meta message format. As a consequence we call this tool *Subset Designer* (Huemer 1996b, Huemer 1997a). In addition, translation software that is able to accept standardized meta messages as valid input is needed. This is an absolute requirement for the specification of mapping tables, which serve as interface definition between an EDIFACT message and the in-house data.

5. SCENARIO FOR DEFINING HUB-SPOKE-SUBSETS

In this section we describe our proposed scenario for the definition and the following transmission of hub-spoke-subsets based on a meta message. The description of this scenario should be read in conjunction with Figure 1 which depicts the overall process.

The first step for the hub is to include the EDIFACT standard directories into the *Subset Designer*. Hopefully, this can be done by receiving a meta message from an EDIFACT reference database (1).

Now the hub specifies a subset on the basis of a standard version according to his requirements (2). The resulting subset specification will include only those components which will actually be exchanged in a business transaction with the spoke. The subset definition can be exported from the *Subset Designer* into a meta message (3). The hub provides the functional agreement specification via the meta message into its translation software (4). Note that the Subset Designer could also be an integral part of the translation software. This would remove step 4. Now the hub is in the position to design its mapping tables (5) in order to specify how data included in an EDIFACT message of the subset are mapped to the application's interface file for database import and vice versa for database export.

In order to ensure that the spoke has the same understanding on the subset definition the meta message must be sent to the spoke. Thus, the resulting meta message is passed to the communication interface (6), which is responsible for the transmission to the spoke (7). The spoke receives the meta message via its communication interface (8). Afterwards it imports the meta message into its translation software (9) in order to have exactly the same subset definition available for the specification of the mapping tables (10). Now, the process of designing and transmitting hub-spoke-subsets is finished and business transactions based on this subset definition might be processed.

A business scenario based on the hub-spoke-subset will be similar to every EDIFACT scenario. The application of the initiating business partner creates the data to be transmitted and writes them into the interface file (11). This interface file is provided to the translation software (12) which loads the corresponding mapping table and creates the appropriate EDIFACT message (13) according to the consignee and kind of business transaction. The EDIFACT message is moved to the communication interface (14) and transmitted to the responding business partner (15). The responding business partner usually receives the message from its communication interface and processes it via its translation software (16). According to the sender and kind of message mentioned in the message header the translation software loads the appropriate mapping table (17) and creates the corresponding interface file (18). Finally, the received data are imported into the application of the responding business partner (19) and are processed. Usually the application of the responding business partner answers to the received message by sending a response message. The steps of the response message (20 - 28) correspond to those of the original message (11 - 19) except for the direction of the process. Note that in this paragraph we have used the terms initiating and receiving business partner, because the hub need not always be the initiating business partner in the business transaction.

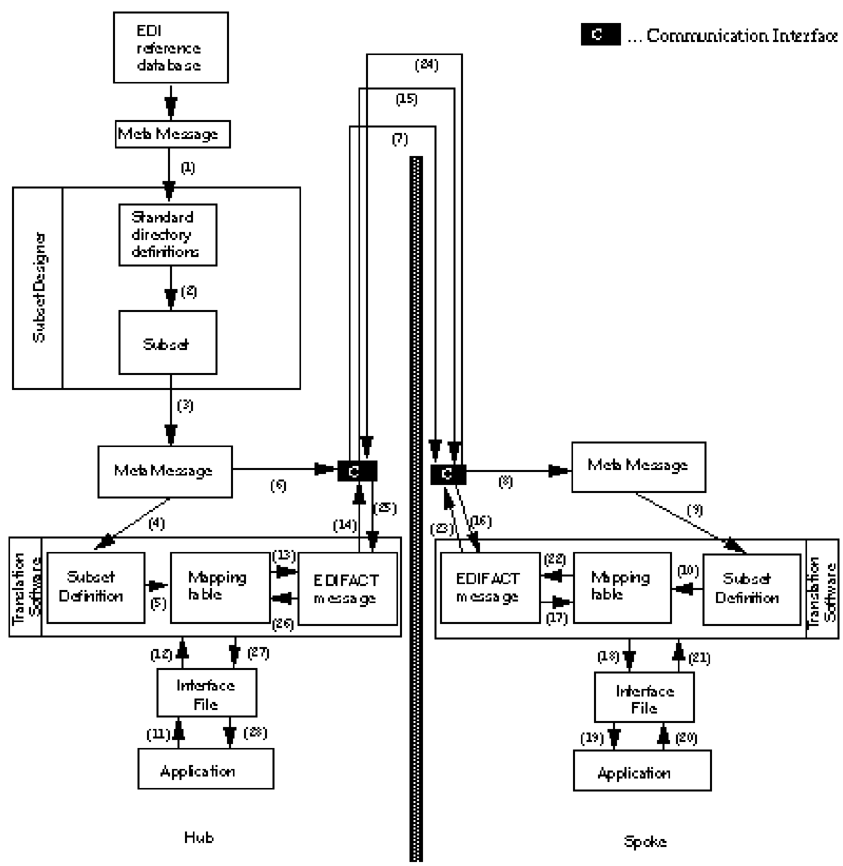

Figure 1. Scenario for defining and transmitting hub-spoke-subsets

6. SUMMARY

For attracting more SMEs to participate in EDI, development has to continue to eliminate disadvantages present in current EDI approaches. But it is not known by now how EDI standards of tomorrow will look like. It is unlikely that industry will ignore alternative approaches and their advantages. May be one of the approaches presented in this paper or a mixture of them will be the solution of the future. Object-Oriented EDI as one form of Open-edi can be considered as long-term project which is just a concept by now and thus not ready for implementation. At the moment it cannot be predicted whether the concept will lead to the expected benefits or not. From a technical viewpoint BSI is ready to take off, but it has not yet reached the critical mass to be commercially successful. The Lite EDI framework could quickly be realized in practice, because it relies on yet existing technologies. But it is our opinion that the concept of using electronic forms in Lite EDI is not promising. Because EDI acts on machine-to-machine-interfaces, whereas electronic forms are based on human-to-machine-interfaces.

Nevertheless, the concept of standardized subsets created from full standard messages with limited optionality is a promising solution for SMEs. It is a precondition for the success of Lite EDI that this subset is carefully designed to be on the one hand relevant for all (or most) SMEs and on the other hand not to complex for them to understand and to implement. Such a Lite EDI subset would guarantee that information exchange among SMEs is not only based on the same standard messages but also on a nearly identical exchange format.

The main problem in Lite EDI is that it does not consider hub-spoke-relationships. But they should not be negated, because they are reality in today's business life. Since it is very likely that hubs will not accept the Lite EDI subset, there is need for a complementary concept. One possible solution would be the transmission of the hub-dictated solution to the spoke via a meta message. If the spoke is able to take this meta message as input into its translation software, it only has to understand and work with the EDIFACT components required by the hub and need not consider the whole standard message. This complementary concept guarantees that a SME only has to understand the EDIFACT message structures only in the absolute minimum extend.

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