MODA-ML, an experience of promotion of a sectorial interoperability framework

Nicola GESSA¹, Piero DE SABBATA², Massimiliano FRAULINI², Thomas IMOLESI³, Luca MAINETTI⁴, Massimo MARZOCCHI², Fabio VITALI¹

¹ Dept. of Computer Science - University of Bologna, gessa@cs.unibo.it, fabio@cs.unibo.it
² ENEA, Italy, desabba@bolegna.enea.it, fraulini@libero.it, marzocchi@libero.it
³ FTI – Forum Tecnologia dell’Informazione – Laboratorio XML, Italy, imolesi@libero.it
⁴ Dept. of Electronics and Information – Politecnico di Milano, Italy, mainetti@mail2.elet.polimi.it

Abstract: The MODA–ML project defines a messaging architecture based on ebXML. It is based on a set of XML schemas built on top of a vocabulary of XML business components. In contrast to the many existing Application Service Provision (ASP) models, our idea is to enable direct data exchanges on a bilateral basis, without the use of ASP centres as intermediaries. This paper also presents a set of tools that has been developed to enforce this architecture and presents some results of the evaluation of the project by a group of leading Italian manufacturers from the Textile/Clothing sector.

1. Introduction

The production process within the Textile/Clothing sector is based on collaboration between a large number of small and medium sized enterprises (SMEs) to create and delivery items of fabric and clothing. Each of these enterprises is responsible for a particular aspect of the production process: such co-operation is regulated by the exchange of request/response messages necessary to carry out all the steps of which the supply chain is composed. The delivery timing of the final product is affected by the communication mechanism adopted within the supply chain. In the face of global competition, responsiveness is the key to success in this sector, especially because of the impact of fashion fluctuations on the sector.

While most organisations use the Internet today, there are still difficulties impacting on the adoption of new collaborative processes because of different attitudes. As our goal is to improve interoperability among independent industrial, commercial and business organisations, this involves defining:

1. a common interchange language for expressing business messages
2. an exchange protocol to efficiently delivery these messages
3. a simple management and a constant maintenance of the established collaboration in order to update the system in accordance with the requirements of the market.

The MODA-ML project (Middleware tOols and Documents to enhAnce the Textile/Clothing supply chain through xML) was born out of the collaboration between a number of research organizations, including ENEA, Politecnico di Milano, Gruppo SOI, Domina, Institut Francais Textil Habilliment (IFTH) and a group of leading Italian Textile/Clothing manufacturers (Fratelli Corneliani, F.Lli Piacenza, Successori Reda, Loro Piana, Vitale Barberis Canonico). Supported under the IST Programme of the Fifth Framework programme, it aimed to develop a vertical framework to provide more efficient interoperability and contributing to the establishment of a European standard for the sector (www.moda-ml.org).
The MODA-ML project ended in April 2003. As specified in section 3, by the end of the project we developed the basic structures of the proposed framework, i.e., the vocabulary of XML business components, a set of public, modular document types built out of those components, and the message switching architecture for the delivery of documents. Activities in the project, as described in section 4, continue on aspects of dictionary maintenance and security and developing a virtual partner simulator for testing purposes.

In parallel with the industrial evaluations, key players in the Italian Textile/Clothing sector have been involved in various phases of the project development, from the requirements collection to the testing of the implemented software. The experimentation is now being targeted to a larger set of enterprises. Feedback and experience to date is summarised in section 5. Section 6 provides some conclusions and recommendations for future activities.

2. Requirements for a common interoperability framework

At the start of the MODA_ML project in 2000, there was very limited experience of automating B2B processes. Most of the innovation was aimed at automating internal business processes. In many cases, even this was usually only within individual departments, leaving inter-organisational processes to manual or at best semi-automatic management systems.

The only existing interoperability solutions were based on EDIFACT technology, and EDITEX, a subset tailored for the Textile/Clothing supply chain. The inflexibility of these standards means that implemented solutions could not be easily adapted to the specific needs of organisations.

Whatever the adopted approach, the issues to consider in order to design an appropriate new architecture must include:

- user requirements expressed by the enterprises, in relation to the data and the processes that should be included in the e-business enterprise services
- the level of ICT adoption including internal data management by target enterprises
- relevant standards, whether official, de facto or under development
- interoperability with other solutions

Any new interoperability architecture must by definition, work with existing internal enterprise information systems. Usually for economic and practical reasons, there is little willingness to change these because of the implications this has to redefine all the stages of the production process.

Moreover a successful solution requires consensus from the whole community, which requires that it must work within the restraints of the ICT, economic and human resources available to all of these enterprises.

Any widely used specification defined by relevant standardisation bodies must be considered during the design phase: Internet communication protocols, the protocols used for message exchanges between organisations (e.g. SOAP on ebXML) and languages for creating documents and messages (e.g. XML).

An open-source solution would be attractive for SMEs and their technology providers because of typically limited available resources; flexibility is obviously important to win support from ERP systems, legacy systems and SMEs.

The MODA-ML project aims to address each of these issues. In contrast to the centralised architectures typically used by ASPs (Application Service Providers), the MODA-ML architecture has a peer to peer architecture, allowing each enterprise to communicate directly with its correspondents in the supply chain using simple software modules and a transport interface, without passing from any other intermediary. The only central point of reference is a repository that is used to maintain the document templates that can be adopted during the interchange processes.
The proposed architecture from MODA-ML project

3. Basic results of the MODA-ML project

The project guidelines are:
- XML technologies for defining semantic infrastructure of message based data exchange
- ebXML and SOAP to allow document interchange in an e-business scenario
- very low technological entry threshold to use the tools needed in the framework

The first output of the MODA-ML project was the creation of a vocabulary of XML business components and a modular set of public document types to support the information exchange in the supply chain: XML is used to create a sector-specific language, based upon the experience of EDITEX [2]. The resulting documents inherit many XML characteristics: they are human readable, easily customisable, adaptable and expandable. Human readability is important as it allows manual editing or checking by human personnel; since this is a common case for maintenance or in small firms, this aspect facilitates the spreading of electronic data management in the business process.

The second output was the design of a middleware architecture based on ebXML messaging service specifications and SOAP protocol for a message switching system that is supported by a simple, free, software module, (MSH), and allows messages to be send, received, validated and managed. E-mail and a simple database management system (e.g. MS Access) are the only fundamental software tools needed for exchanging MODA-ML messages. All our tools have been developed to be easy and inexpensive to integrate with complex legacy information systems.

3.1 The MODA-ML Vocabulary

Based on ebXML, the collaboration processes are composed of a set of activities each ruled and led by specific documents. The first step in the project was writing a dictionary of XML business components and defining a set of document types built upon those components.

The set of MODA-ML messages is composed of fourteen documents concerning the Textile Supplier-Clothing Manufacturer ring. Some components of these documents are specialised for particular needs, but many are shared by all the documents. Each component of the dictionary represents in fact a well-defined concept that can be specified in a message. This makes it possible to perform the necessary distinction between the syntactical model, the semantic model and the transport model of the messages. The components represent a set of common “semantic blocks” that, once defined, can be used in different circumstances while retaining the same meaning. The creation process of a new document type includes:
• selection of a set of semantic blocks defining every concept contained in the document
• assembly of these blocks and definition of rules and constraints to express the interrelations existing among the concepts they represent

Using this approach it becomes critical to correctly identify the semantic blocks related to the role of the document in the process.

The effective implementation of the vocabulary is done using a database application that provides a sophisticated and complete description of all the defined basic components: the name of the XML element, its description and the associated properties such as data format, length, range of values and so on. The vocabulary further specifies a root element for each document type and all the relations existing among the elements such as sequence, cardinality and so on. A simple application (see 4.2) will then re-create the complete set of rules (an XML Schema) for each document type by starting from the root element.

MODA-ML also provides a set of XSLT stylesheets to create HTML pages off the XML instances so that the document content can be visualised in a readable manner through any Web browser. The Vocabulary represents the core of the management of every aspect related to the MODA-ML document types, schemas and instances. We call this approach the “XML document factory”.

3.2 The MODA-ML message switching system

Once the structure of the vocabulary is defined, the next step is the implementation of a communication system to exchange XML documents directly between the enterprises.

Since the Textile/Clothing sector is characterised by enterprises with a different level of technological sophistication in terms of use of ICT, it is critical to create simple software modules that are publicly available. Thus MODA-ML provides tools to help the enterprise integrate the MODA-ML exchange mechanism to their internal processes. These tools are collectively called the “message switching system”.

The Message Service Handler interface

The message switching system defines a transport protocol based on ebXML messaging service specifications; ebXML (Electronic Business using XML) [7] is a set of
specifications from UN/CEFACT and OASIS that defines a collaboration framework over the Internet to establish interoperability between enterprises. Two relevant aspects are:

- the semantic definition of the documents: a set of “core components” is used to define the semantic value of a document. In contrast to the EDI framework, ebXML emphasises the importance of these components in the entire document structure, and this aspect gives ebXML more flexibility compared to EDI
- technical specifications on the communication protocol: MODA-ML follows ebXML transport specifications

The main component of the “message switching system” is the Message Service Handler (MSH), that acts as an email client for the transport of the documents: it takes care to validate MODA-ML documents and to send and receive them using the SMTP protocol. It is a “reference” implementation of the ebXML specifications, thus anyone could realise its own implementation being interchangeable, it is freely downloadable and is written in Ms-VisualBasic (because it is one of the most known language among the industrial users).

4. Additional services and tools of the MODA-ML framework

Besides basic aspects of document structuring and message exchanging, recent activities in the MODA-ML project included:

- security aspects for authentication and non-repudiation of MODA-ML messages
- user guides and XML Schema as automatically generated products of the vocabulary
- virtual enterprise simulator for testing new MODA-ML implementations.

4.1 Security

Business transactions need to be confidential and require a certain level of security. Given the economic relevance of these transactions, it is necessary to provide enterprises with techniques to protect them against ICT related threats. However, guaranteeing legal aspects of the transactions is fundamental to develop a service that can gain the confidence of the community.

The security module must provide a set of functionalities to guarantee:

- confidentiality: any unauthorised access to the message content must be prevented
- integrity: the receiver should always be able to verify the message integrity and point out alterations in the data
- authentication: the receiver must be guaranteed of the identity of the message sender
- non-repudiation: the receivers must be guaranteed that the senders will never be able to successfully disown any message they sent

Such requirements can be achieved using cryptography and digital signatures, for instance based on asymmetric-key algorithms and digital certificates issued by a trusted third party or Certification Authority. The basic MODA-ML message switching board does not provide security features. A separate software module has been developed that can be easily and efficiently integrated within the main modules of MSH.

The mechanism adopted to guarantee confidentiality, integrity, authentication and non-repudiation of a MODA-ML message is based on XML-Signature [6] and XML-Encryption [5], two W3C standards that allow an XML document to be signed with a digital signature and an XML document or fragment to be encrypted with an electronic key. Both standards are fully compliant with the ebXML digital signature and greatly simplify interoperability with other frameworks that adopt ebXML specifications.

The current 1.1.8 version of the MODA-ML security library implements the XML Signature protocol, while XML Encryption will be available in future versions. The MODA-ML security library is a dynamic library (dll) based on the standard cryptographical algorithms of the MS-Windows library. This library allows documents to be signed with a
X509 digital certificate. The contents of the document are thus guaranteed to have been sent from the owner of the certificate and to have been received without modification. The adoption of MS-Windows library allows the free module of MODA-ML to support encryption and digital signature without cost on any Windows XP/2000 workstation.

The security module integration was released to external MODA-ML users in May 2003. MODA–ML specifications also comprise capabilities of requiring acknowledgement messages in order to inform the sender that his/her message has been received and to implement the non-repudiation aspects of the communication mechanism.

The Message Service Handler uses five security levels, each corresponding to a different combination of cryptography, signature and non-repudiation:
1. forwarding messages with digital signature
2. forwarding encrypted messages
3. forwarding encrypted and signed messages
4. forwarding messages and acknowledgements with digital signature
5. forwarding encrypted and signed messages and acknowledgements

In order to achieve a complete interoperability among all the subjects, the security features of the MSH can be used even by applications that do not directly implement security features themselves.

4.2 Dictionary maintenance

E-business processes are subject to continuous change because of new collaboration relationships, new legal dispositions, and the adoption of new business models in specific production sectors. Document type definitions change consequently, and it becomes necessary to rearrange the structure of the messages to deal with the new situation. Even a minimum change in a particular specification can require significant time to check the correctness of the new schemas and to test their integrity. But we can minimise these costs using a set of tools for the automatic maintenance of some aspects of the documents.

Since all the documents of MODA-ML are composed starting from a set of defined elements registered in a database, we manage the operations associated with the changing of a process specifications starting from the implicit definition held in the database.

But this is not enough: we know that not only computer systems have to be updated, but also human personnel should be clearly informed about new specifications and about the use of new documents. This could result in rewriting hundreds of pages of documentation. These practical aspects of managing a system have been faced when implementing a web application that provides a set of tools to automatically generate the document schemas and complete user guides starting from the implicit definitions included in the database. These WEB based tools are:

- an automatic generator of XML Schemas for every Moda-ML document of
- an automatic generator of User Guides that explain in detail every aspect related to the usage of MODA–ML documents
- an on-line dictionary to allow accurate researches on elements, contents and definitions

MODA-ML staff and the pilot users can re-generate the XML schema and the user guides for every message, including those being defined for immediate download. A generic user seeking information about the message usage can just download all the finalised versions of the schemas and the user guides.

4.3 A virtual simulator

One of the main barriers to establishing a new solution is the different attitudes by enterprises to using and adopting them. “Why should I change my production processes?”,
“Which are the real benefits I could obtain by introducing this new method into my organization?”. These are some of the typical questions that need to be answered.

To provide a practical answer to these kinds of questions, the MODA-VIP (MODA-ML compliant Virtual Interoperability Partner) application has been developed (in the framework of the TEXSPIN project) to implement a virtual enterprise simulator. The target of MODA-VIP is to allow a potential user of the MODA-ML framework to approach it. The basic functions of the simulator are available to everyone, with no need to be an experienced user of the XML language. So it is possible, for those who never used documents for e-business, to become familiar with its advantages and functionality by following a guided tour. For more complex simulator functions however, a basic knowledge of the MODA-ML project and XML language is required.

The simulator consists of three main components:

- a web site containing all the information needed to use it, as how-to and a presentation
- a Web Service, which is the simulator engine, which receives and produces messages
- a converter between the SOAP calls of the Web Services and the ebXML protocol.

5. The experience

Following the positive conclusion of the validation phase, pilot users began to use the XML documents in their real workflow with customers and suppliers.

For the evaluation purpose each pilot user used a different approach to integrate the flow of XML documents into their company information systems: ‘ad hoc’ development of the company information systems, Oracle modules to manage XML, generalised XML to DBMS mapper, etc.

The introduction of the MODA-ML framework has suggested further evolutions of internal information systems, to automatically support the workflow and add new services for customers (such as the “advancement status report” and the “defects auto-certification”).

The second important result has been that the adoption of the data exchange framework has been very inexpensive for the industry. For example, in a company already using an ERP system (supporting the flow of incoming purchase order and outgoing order response), the additional cost to import/export each new type of XML document (purchase order, order response, etc) has been estimated at about half person-day (one person days for the first type). On the other hand, serious investment has been required for internal systems if they were not ready for the collaborative workflows. In general, sending new documents has been found to be much easier than receiving documents.

Meanwhile some companies are considering the opportunity to enhance their systems. The XML documents are exchanged between the offices by e-mail (as the XML documents are already in digital format and accessible via any Web browser).

The project results have also opened up new opportunities for technology suppliers: they have found resources and references to face the problems of inter-operability for their systems; they have reacted to the project as a resource to be embedded in their solution, rather than as a ‘competitor’.

Furthermore the project results have attracted new potential users in addition to the group of pilot users. Some trials have started between pilot users and other partners, and a consortium of about 70 firms of the textile district of Biella has chosen to adopt the framework for their exchanges.

The main benefits from the user’s perspective are the availability of simple entry point tools and the fact that their partners (customers or suppliers) have low entry costs for participation. Every night a pilot user sends XML ‘order advancement status’ documents to over 150 customers by only using the e-mail services, who can view the status report as a
'fax' sheet without any investment. When they invest, they will be able to use the XML documents as an input for their planning tools.

But the most important result obtained by the MODA-ML is that its results are an important part of the final documents of the CEN/ISSS TEXSPIN initiative. Promoted by Euratex (European association of national industry trading association of the T/C) and supported by CEN/ISSS (the department devoted to ICT standards within the European Commitee for Standardisation, CEN), TexSpin aims “to provide the Textile/Clothing sector with an open pre-normative platform for electronic data interchange based on XML documents” and represents a starting point for the standards creation for this sector.

6. Conclusions

The MODA-ML experience has not only been studied for future applications, but has already started to be adopted in the Textile/Clothing supply chain: MODA-ML has been developed involving enterprises of the sector so as to ensure a high quality of relevant market feedback. The involvement of Italian and European industry trading associations (Sistema Moda Italia, Associazione Tessile Italiana and Euratex) is a confirmation of the interest that the approach of Moda-ML has aroused.

Using XML technologies has made it possible to involve SMEs with different levels of ICT adoption, and to integrate MODA-ML with more sophisticated information systems where available. Furthermore it has been demonstrated that XML can be used to efficiently restructure their internal business processes.

Finally, from a technological point of view, the project has demonstrated the feasibility of the construction of an open community of enterprises that co-operate using open standards, and has demonstrated a path to the diffus ion of standardised approaches for both large and micro-enterprises on the same technological framework.

References
[6] XML: http://www.w3.org/Signature