

Enabling B2B Transactions over the Internet through Application Interconnection: The PRAXIS Project

Yannis Charalabidis¹, Vassilios Karakoidas², Stephanos Androutsellis-Theotokis³,
Diomidis Spinellis⁴

¹*Singular Software S.A., 23rd Km Athens-Lamia Road, Ag. Stefanos, 14565, Greece*
Tel: +30 210 6267400, Fax: + 30 210 6267410, Email: yannisx@singular.gr

^{2,3,4}*Athens University of Economics and Business, 76 Patission Str., Athens, 10434, Greece*
Tel: +30 210 8203370, Fax: +30 2108203664, Email: {bkarak, stheotok, dds}@aueb.gr

Abstract: The paper elaborates on an approach that will enable the typical Small and Medium Enterprise (SME) to carry out a large subset of its business transactions with other enterprises, the public administration or financial institutions over the internet, gaining significant resources that nowadays are wasted on editing, printing, transferring and re-typing business documents. The present approach can be characterised as a depth-first, pilot-oriented attempt to provide practical solutions to the Enterprise Application Interoperability problems of European SME's and do so in a paradigm-building way. Part of the approach stems out of PRAXIS, a project co-funded by the 3rd Community Support Framework (CSF) under the Information Society Programme. The project, coordinated by Singular Software SA, brings together software vendors, research centres, public administration bodies, banking institutions and user companies in Greece, aiming to provide a solution that will allow the automation of the aforementioned transactions with significant productivity results for all the represented communities.

1. Introduction

As the functionality and complexity of modern Transactional IT Systems is rising to meet more advanced requirements, Enterprise Application Interoperability has become a key issue for most companies, in their quest for overall productivity, effective knowledge management and information security [1,2]. Although various attempts have been made by large European organisations or Enterprises, usually addressing interoperability as a bespoke solution for legacy systems, very few attempts seem to address the issue from the aspect of a Small and Medium Enterprise (SME) or even of a Very Small Enterprise (VSE), companies that constitute the absolute majority of enterprises in the European Union [3]. What though may be the case for SME's and VSE's in the context of making their Enterprise Applications more interoperable?

Nowadays, the typical European enterprise interacts on a daily basis with a multitude of external entities, which include the administration at local or European level (e.g. Ministries of Finance, Revenue and Tax Offices, Insurance Agencies, Statistics Agencies, etc), Financial and Banking Institutions, as well as other enterprises, mainly in the roles of Business-to-Business supplier or customer. In Greece alone, there exist 723,000 enterprises, including approximately 700,000 SME's and VSE's, which constitute 97% of the total [4], the average European level being 93% [5].

Despite the rising pace at which Information Technology means are being deployed, the majority of several millions of daily transactions among the above entities are still carried out in the traditional manner: typically sending the various transaction documents through mail or fax, manually inserting data in Enterprise Resource Planning – ERP or Customer Relationship Management – CRM applications or, at best, manually filling in on-line web pages offered by Banks or Governmental Agencies. Based on the above inadequacy and on

the absence of enlightening new approaches at the SME level, most of the companies waste significant effort and resources while not entrusting the Internet and current B2B (or even B2C) applications for their transactions. But then, why the application software vendor community does not succeed in responding to the need for really interoperable, application-to-application interconnected transactional software systems?

Recent evaluations and relative research [2] has showed that Interoperability problems may become very hard to tackle in case more than one of the following patterns characterise the problem domain: existing legacy systems that were not designed to work in common; applications belonging to a variety of different vendors; not well defined legal and statutory framework; a plethora of standardisation attempts in various levels of completion or adoption; certain cost and complexity limits – to name but a few existing in the interoperability domain. As a result of the above, one should not be amazed by the fact that most of the attempts whatsoever concern large enterprises and result in bespoke, project-oriented implementations that cannot provide a repeatable solution paradigm.

The present approach can be characterised as a depth-first, pilot-oriented attempt to provide practical solutions to the Enterprise Application Interoperability problems of European SME's and do so in a paradigm-building way.

2. Motivation and Objectives

The main objective of the presented approach is to develop and apply, at least in a pilot operational stage, the required processes and IT systems that will allow the typical Greek (or European) SME to carry out typical B2B transactions through the Internet, and in particular through the seamless interconnection of their Enterprise Applications with the corresponding applications of other enterprises, the public administration, and financial institutions. Other objectives include the following:

- i. The creation and formal description of business processes, data transfer means and of a coherent overall architecture for the interconnection of transactional software applications.
- ii. The adoption of the current legal and statutory framework but also the interaction with it in the form of substantiated proposals towards the responsible governmental bodies.
- iii. The emphasis on security of the transferred data, on non-repudiation issues involving digital means of signature, and on the protection of sensitive information of citizens and companies.
- iv. The creation of an easily adoptable and financially feasible solution for the medium, small and very small enterprises, through hiding the complexity from the end-user – leading to the development of low cost, standardised solutions.
- v. The pilot application at a proof of concept level of the resulting infrastructure, in typical users (enterprises, public bodies, banking institutions)

Part of the approach stems out of PRAXIS, a project co-funded by the 3rd Community Support Framework (CSF) under the Information Society Programme. The project brings together software vendors and e-business system integrators, universities, research centres and public sector bodies in Greece, banks, as well as typical SME's from the textile, food and services sector, aiming to provide a solution that will allow the automation of the aforementioned transactions with obvious results for all the represented communities [6].

The Potential benefits for the companies that will adopt such an approach for more interoperable enterprise applications will be: (a) A significant reduction in the required time and effort for carrying out the everyday transactions. It is estimated that, for a typical SME, this effort will be in the order of several man-months per year while the gain per transaction time is enormous – from days to seconds. (b) A significant reduction in the rate of errors that are currently made due to the repeated data entry and manual interventions in these transactions. (c) A major decrease in the cost of adoption of e-Business processes for SMEs, as such productised systems are bound to be made widely available at relatively small cost.

3. Background

3.1 European Legal Framework and Business Background

The evolution of the Internet and in particular the possibility to carry out Internet-based business transactions resulted in a series of legal issues that concerned the European Union as a whole as well as the independent Member States. The main issue that needed to be addressed with respect to electronic business transactions, payments and document exchanges was the lack of a clear legal framework within which such transactions would take place, common for possibly all the EU Members. The rapid rate though, with which technological developments followed one another did not allow for a timely legal response at an international and national level [7,8].

Various regulatory steps have recently taken place in Europe and in Greece in particular to address the above issues, as the European Union is gradually progressing in a coordinated approach to address the issue of electronic business transactions by creating a legal framework within which all transactions will be carried out, and which will be eventually adopted by the business world across Europe. Central to this approach was the Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000, which placed the foundations for the development of e-Commerce throughout Europe.

In Greece, as in most of the Member States and certainly in all of the 10 new Members, newly the local authorities are struggling to adopt the European Union directives, by adapting the local legal regulations accordingly and through constantly monitoring – but not driving – local needs.

3.2 Status of SME's

In order to ensure the wide adoption of a system supporting transactions between SME's, a realistic understanding of the current situation regarding the typical operation of its users is needed. As depicted in Figure 1, a typical European SME is daily making transactions with the following main groups of legal entities, in the B2B space:

- Enterprises acting as Customers, thus receiving goods or services and paying the price or fee, in an overall transaction characterised as “sale”.

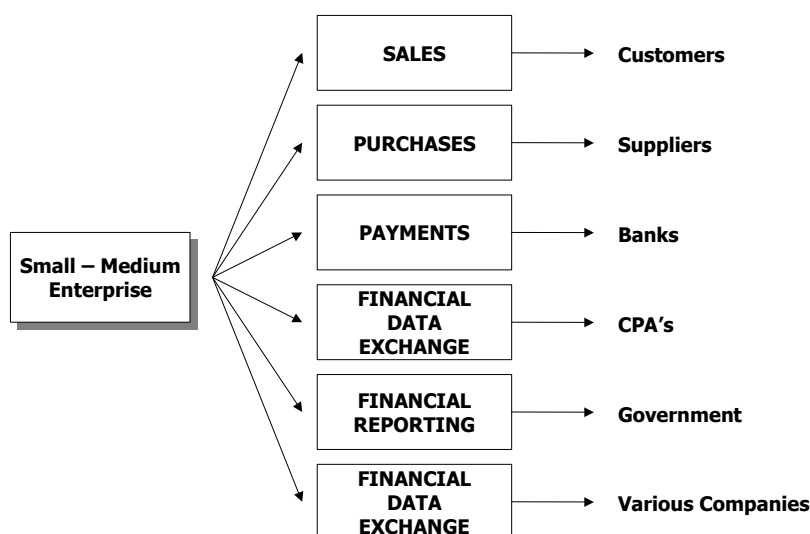


Figure 1 : SME's, their transactions and the interacting Legal Entities

- Enterprises acting as Suppliers, providing SME with goods or services, through a purchase process.
- Banking institutions, assisting in the management of the SME monetary assets and the processes of payments or receipts.
- Certified Professional Accountants that often offer services to SME's and also receive/send significant amounts of financial data from/to the enterprise, for book-keeping and tax-reporting purposes.
- The local Government, usually instantiated as a Tax/Vat Office or Ministry of Finance local authority, towards which both information and payments should be sent.
- Other Enterprises, among them SME's, for various reasons leading to exchange of business and financial data.

4. Methodology

The methodological, paradigm building approach presented here and implemented within the PRAXIS project consists of the following steps:

- i. Representation of the existing business processes relevant to the project, resulting in Computationally Independent Models (CIM) represented in various UML descriptions. More than 30 processes have been identified and described (actors, roles, flows, data, control, etc).
- ii. Partial transformation of the previous models and representation of the to-be business processes, after the introduction of an A2A Interconnection System with Servers and Clients connecting with the existing ERP applications, resulting in a relevant Platform Independent Model (PIM).
- iii. Formalisation of the data exchange, through further analysis of the business documents and the deployment of XML/B2B models, thus forming XML/XSL descriptions.
- iv. Formalisation of the needed behaviour of the system, represented in WSDL and UML formats, as another PIM description.
- v. Various design representations and model transformations at the level of Platform-Specific Model (PSM), for the system under development (client and server architectures and designs following the Service-oriented Architecture, SoA) [17], including the partial reverse engineering of already developed Enterprise Applications (commercially available mid-market ERP/CRM).

It has to be noted that the drafting of detailed specifications for the technological basis and architecture upon which the system will be based (including Web Services approaches, UDDI/SOAP standards, .NET architectures, JAVA/J2EE architectures and various development environments) form a part of the on-coming steps of the approach.

5. Technology

The technological basis for the proposed system includes the currently available standards and solutions for modelling of business processes, the modelling and description of the information exchanged among the enterprise applications (including XML-based hierarchical languages) and the current technological standards for developing Server and Peer-To-Peer applications using Service-oriented-Architectures (SoA).

5.1 Data modelling and XML representations

When developing a solution for enhancing interoperability of existing systems, one has to choose between (a) instantiating one of the existing XML/B2B standards or (b) developing a tailor-made solution adhering to the standards, but also designed to provide the required flexibility while minimizing the system complexity – a set of characteristics very important to SME's.

Extending XML standardisation reviews [9], the currently available standards for business transactions can be categorised as shown in Table 1, according to whether their main focus is on business processes / message transactions or on business documents.

Standard	Standardisation Body	Business Processes	Business Documents
ebXML	OASIS	✓	✓
RosettaNet	RosettaNet Org	✓	✓
xCBL	xCBL Org		✓
XBRL	XBRL Org		✓
ebisXML	BASDA	✓	✓
UN / CEFACT ¹	UN/ECE		(✓)
UN / EDIFACT	UN/ECE		✓

Table 1: A categorisation of Business Standards

ebXML [10] is a standard proposed and maintained by the Organization for the Advancement of Structured Information Standards - OASIS. Currently supported by the United Nations (UN) and other major bodies and organizations, ebXML covers business processes and message transactions, its strength certainly being the former.

RosettaNet [11] is an emerging standard proposing a framework to securely exchange documents between businesses. The framework is based on XML and simplifies the transaction processes focusing only in security and transport. As a result we have a client-server model of work, inappropriate for large-scale applications.

ebis-XML [12] is a standard proposed by BASDA. It provides a suite of messages for conducting electronic transactions. Covering only the ordering / invoicing processes, it provides a quick and practical way for the exchange of the core business documents among enterprises.

xCBL (XML Common Business Library) [13] focuses on business documents. The standard, supported by Microsoft, SAP, HP, Sun Microsystems and CommerceOne, provides an XML-based, comprehensive collection of documents for conducting electronic transactions.

XBRL (eXtensive Business Reporting Language) [14] is a standard proposed from OASIS, in an attempt to describe financial information for reporting purposes. Formerly known as XFRML (eXtensive Financial Reporting Mark-up Language), XBRL is a technical specification that allows for the creation of business and financial reports.

UN / CEFACT [15] is the awaited XML-transformation attempt of UN / EDIFACT business documents. Still in progress, it is bound to use ebXML as the architecture definition, extending the various messages applying the EDIFACT experience.

UN / EDIFACT [16] is the oldest and most widely used standard in application-to-application interconnection, supported by numerous organizations and businesses. Included in the present review for completion purposes, it focuses mainly on business documents and provides for an EDI-based method for message transactions.

After the initial categorisation of the various XML/B2B standards, an evaluation “objective function” was created, based on the main objectives of the PRAXIS project. Among the important factors one will find: Expressiveness (span of existing processes and documents), Maturity (adoption by industry and international bodies), Compatibility (degree of coherence with other standards in the XML/B2B context), Applicability (easiness of embodiment, provision of material and support), Expandability (ability to include more documents/processes) and Royalties Independence.

¹ UN/CEFACT full standardization not published

The above evaluation framework concluded on the differences among the standardisations and their various scores according to different weighting scenarios. However, looking at the not-yet-converging requirements from United States, Europe and Greece and due to the fact that the types of transactions the PRAXIS system is bound to support are affected by the specific details of Greek business regulations, the complete adoption of any of the above standards would offer few advantages, and would considerably aggravate the implementation process. As a result, the adopted solution consists of modelling the transactional data in a manner similar, yet not fully compatible, to xCBL, while in parallel maintaining a detailed mapping of the alterations.

5.2 System Architecture

The PRAXIS system, as shown in Figure 2 consists of two main entities, the PRAXIS Clients and the PRAXIS Server. The former provides end-users (SME's) with a way to access the system, while the latter maintains the core business logic and the various documents exchanged.

Three types of clients are supported:

- The Full (or “Fat”) Client, is a windows-based application that interconnects with the PRAXIS system and the existing ERP/CRM or relevant transactional enterprise application.
- The Thin Client is a windows-based application that provides the basic features of the system, able to work independently of existing ERP/CRM systems.
- The Web Client is a web-based, zero-client application used to access the PRAXIS server and create or view business documents.

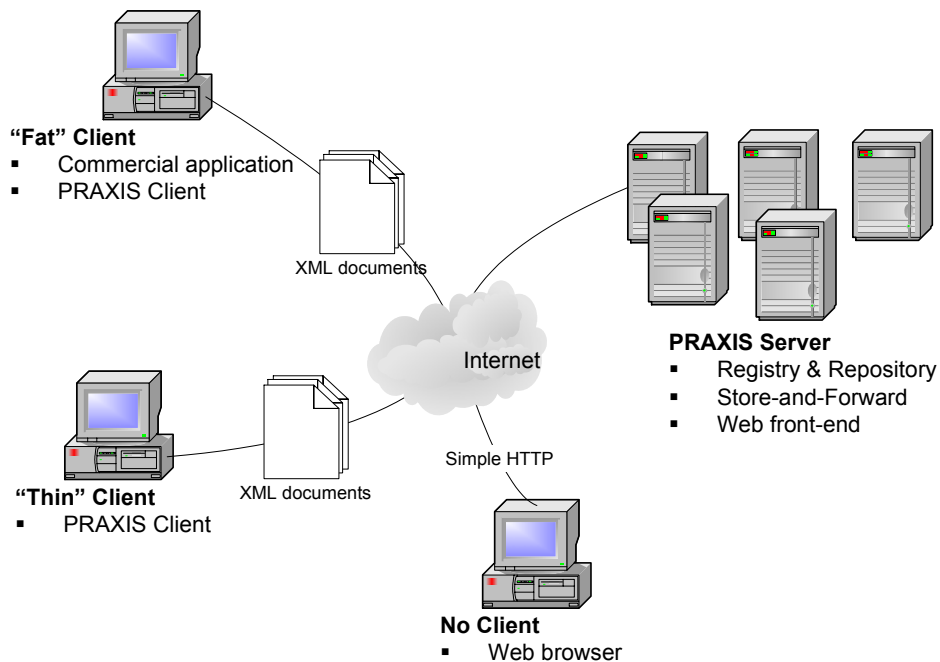


Figure 2 : The PRAXIS Architecture

The PRAXIS Server implements three major functions:

- i. Registry & Repository,
The Registry & Repository subsystem provides the means to create and manage the various user profiles, while also storing and retrieving the various process descriptions, document templates and actual transaction documents.
- ii. Store & Forward
The Store and Forward subsystem provides a mailbox-style mechanism that receives, stores and sends the various business documents among the participating enterprises

following certain time stamping, acknowledgment, security, encryption and performance requirements.

iii. Web Front - End

The Web front-end is a web-based interface for providing access to various groups of users wanting to interact with the PRAXIS Server (administrators, participating companies, candidate customers, public bodies, the public etc) each at the right level of security and permissions granted.

5.3 Protocols and Connectors

It is a vital specification for an interoperability-oriented system to be as open as possible to future extensions and interconnections. In order to comply with that demand, the system is designed so as to allow maximum flexibility in Interconnection Protocols and B2B/XML Standards. Figure 3 shows the protocol stack of the system, where higher level protocols (such as SOAP, CORBA or their ingredients) can be left transparent to the Server.

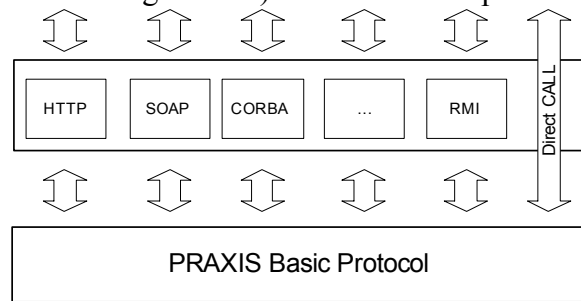


Figure 3: PRAXIS Protocol Stack

In an analogous way, as shown in Figure 4, in order to support XML/B2B standards to appear, a mechanism for the transformation of business documents will be implemented, using an XSLT (or XQuery) [18] transformation engine for this purpose.

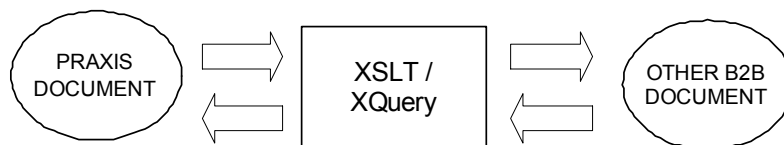


Figure 4: Business documents transformation procedure

6. Conclusions - Discussion

This paper presents an approach for making existing ERP/CRM applications of SME's interoperable over the Internet. Due to the nature and complexity of the problem, various methods and techniques are being deployed: Model Driven and Services Oriented Architecture (MDA / SoA) provide the methodological framework for research on B2B/XML schemas, assessment and deployment of existing and emerging standards and final creation of novel implementations – so standardised that will be affordable and easy to use by the typical European SME.

Although goal-driven approaches like the PRAXIS project are likely to provide some practical, exploitable results within short time frame, this is not the case when someone envisages a legally compliant, standardised solution that will function easily within any EU Member State and any sector of the economy. In this case, the maturity of Legal and

Statutory Frameworks, of Business Process and Documents Standardisation as well as of Information Technology means is something sought-for.

Towards this direction, next steps to our approach include further analysis and formalisation of the MDA steps, classification and structuring of the various design decisions and patterns, as well as work on the ontological aspects of the paradigm.

References

- [1] Interoperability Development for Enterprise Application and Software (IDEAS, IST project, 2002). Available online at <http://www.ideas-roadmap.net>
- [2] M. Lenzerini, "Data integration: A theoretical perspective", in Proc. of the 21st ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS), pages 233-246, 2002.
- [3] The e-Business W@tch, European Commission, Enterprise Directorate General, 2004. Available online at <http://www.ebusiness-watch.org>
- [4] "VAT Statistics 2002 – 2003", General Secretariat of Information Systems (GSIS), Ministry of Economy and Finance, Greece, 2003. Available online at <http://www.gsis.gov.gr>
- [5] "Information and Communications Technology (ICT) Yearbook", European Information Technology Observatory (EITO), 2003
- [6] Y. Charalabidis, S. Pantelopoulos, Y. Koussos: "Enabling Interoperability of Transactional Enterprise Applications", Workshop on Interoperability of Enterprise Systems, 18th European Conference on Object-Oriented Programming (ECOOP), Oslo, 14–18 June 2004
- [7] European Commission Enterprise Directorate General. Report of the expert group on B2B internet trading platforms, July 2003. Available online at <http://europa.eu.int/comm/enterprise/ict/policy/b2b/wshop/fin-report.pdf>
- [8] "EU VAT legislation on electronic invoicing & electronic storage of invoices (overview of all the Member States)", PriceWaterhouseCoopers, Final Report to the European Commission, 2002
- [9] Uche Ogbuji, "A survey of XML standards. The core standards - a foundation for the wide world of XML", IBM DevelopmentWorks, 2004. Available on line at <http://www-106.ibm.com/developerworks/library/x-stand1.html>
- [10] Mathew MacKenzie. ebXML messaging services specification v2.1. Draft, ebXML, March 2004. Available Online at http://www.oasis-open.org/committees/download.php/6130/wd-ebMS-2_1-04.pdf
- [11] Rosetta Implementation Framework (RNIF): Core specification. Technical report, RosettaNet, March 2002. Available online at <http://www.rosettanel.org/>
- [12] BASDA, eBIS-XML, online at <http://www.basda.org>
- [13] XCBL (XML Common Business Language), available online at <http://www.xcbl.org/xcbl40/xcbl40.html>
- [14] Phillip Engel, Walter Hamscher, Geoffrey Shuetrim, David vun Kannon, and Hugh Wallis. Extensible business reporting language v2.1. Draft, XBRL, December 2003. Available online at <http://www.xbrl.org/>
- [15] UN / CEFAC: United Nations centre for trade facilitation and electronic business, online at <http://www.unece.org/cefact>. Available online at <http://www.unece.org/cefact/>
- [16] United Nations Electronic Commission for Europe. UN / EDIFACT: United Nations directories for Electronic Data Interchange for administration, commerce and transport. Available online at http://www.unece.org/trade/untdid/texts/d100_d.html
- [17] David Booth, Hugo Haas, Francis McCabe, Eric Newcomer, Michael Champion, Chris Ferris, and David Orchard. Web services architecture. Technical report, W3C, February 2004. Available online at <http://www.w3.org/ws-arch/>
- [18] James Clark. XSL Transformations (XSLT). Technical report, W3C, November 1999. Available online at <http://www.w3.org/TR/xslt/>