A FRAMEWORK TO SUPPORT INTEROPERABILITY AND MULTI-CHANNEL DELIVERY AMONG HETEROGENEOUS SYSTEMS: TRAME PROJECT

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Abstract: The e-commerce has become a point of strength for the companies that desire to increase their billing enlarging their clients park and reducing the management costs. Therefore the demand has been born to use platforms able to support the interoperability between heterogeneous systems and the multi-channelling with variegated devices to access different services in reliable manner and to allow, so, a spread of the market toward partner with particular needs. Furthermore, many available services have been typically designed for a single channel the web one. In a real world scenario, an ever-growing number of users take advantage of different kind of communication channel and devices. In this paper we propose a B2B oriented framework able to support the interoperability among heterogeneous systems developed according to the ebXML reference model for the business messages interchange suitable to any B2B marketplace that foresees the commercial interaction among partners with different roles and profiles (including channel and device). Such framework has been developed and experimented for the TRAME research project that has as objective to create a room of district compensation of the peaks of productive ability demands within the Textile/Clothing sector and to give the needed infrastructure for the business messages exchange among the partners of the productive spinneret.

1 INTRODUCTION

The evolution in ICT opens new perspectives in the development of multi-channel applications that enables the access to operative information systems via different devices or media format. An objective is therefore the development of augmented services that enhance their effectiveness by adapting the behavior to different devices and communication means. The use of different devices determines technological requirements that concur to the definition of different interaction modes (called sometimes conversations (Boualem Benatallah, 2004)). Therefore, multi-channel delivery is progressively more integrated to support seamless channel switches. For example, a cellular phone and a personal computer introduces new issues because of not only screens and keyboards of different sizes, but also because a personal computer is statically located on a office desk, while a cellular phone dynamically changes its spatial position with the user. Consequently, the phone channel enables for contextualized interaction that requires

location-aware services. In the enterprise applications the database provides the medium to the applications to save and to share data and metadata. Nowadays, the enterprise applications are evolving towards Web Applications or Web Services that have, also them, the need to save and to share data and metadata. The ebXML Registry (OASIS, 2005) is a powerful and flexible registry and it is the implementation of a repository founded on a generic and extensible informative model; it provides a set of services that allow the sharing of information among different commercial party in order to integrate their business processes founding itself on the ebXML specifications. The registry makes available the needed information to accomplish a typical service application. The shared information (as a file, application, multimedia data or XML document) are kept as objects in a repository and managed by the ebXML Registry services. The ebXML registry provides advanced services of information management and through ebXML Collaboration Profile (OASIS, 2005) specifications, it allows the high level of formalization of the cooperation.

ebXML Registry Services can seem a simple registration service according to Web Service specifications similarly to UDDI, however, it allows, besides, to publish and share the data that formalize completely not only the service interface proposed by a public administration, but also the possible sequence of information exchanges among two or more actors. UDDI (OASIS, 2005) is an initiative born for creating a global registry of companies, organizations or, generically, suppliers of good and services, organized for services and products: a medium through which to be able to find suitable partners with which to integrate own productive chain in automatic and efficient manner. The lack of centralized systems through which to get information around the potential commercial partner, has involved to drastically limit the potentialities that the interconnection offers. In order to obviate such a problem, various attempts have been developed as marketplaces and online address books, although these have not produced exhaustive results in the search of potential commercial counterparts. In this paper we propose an extension of the concept of registry and its implementation in terms of multi-channelling and multi-modality. Therefore, we have structured this paper in three parts. In the first one is exposed a survey of software system for the B2B integration and the interoperability. In the second one is exposed the motivation for the new architecture and the detailed explanation of the proposed framework. In the last one, the project experimentation is presented explaining the reached objectives.

2 RELATED WORKS

In this section we will analyze tools and software systems proposed by suppliers of marketplace solutions proper for the B2B integration and the interoperability. BEA WebLogic platform (WebLogic, 2005) is a software foundation for the development and the management of enterprise applications. BEA WebLogic platform tries to simplify the processing allowing the IT organizations to develop theirs application infrastructure providing an understanding of the business guidelines to follow. BEA WebLogic Platform combines three core products (Server, Integration, and Portal) to provide a platform for developing and deploying enterprise applications and services. BizTalk Server 2006 (BizTalk, 2006) is the Microsoft server for the development of solutions for the business processes integration. BizTalk doesn't represent a new solution, but it is born from a collection of existing tools, besides Microsoft guarantees the full adhesion of these to the XML 1.0 spec-

ifications (XML, 2006). BizTalk Server is able to elaborate the followings formats: EDI (EDI, 2006) (ANSI X12 and EDIFACT (EDIFACT, 2007)), well formed XML documents, Document Type Definitions (DTD, 2002), hierarchical Flat File, delimited and positional (for instance, SAP (SAP, 2007) and IDOCS (IDoc, 2007)). BizTalk conforms to Business Process Execution Language (BPEL) standards. CommerceNet's eCo architecture (eco, 2007) provides an interoperability framework that consists of an Architectural Specification and a Semantic Specification. The Architectural Specification presents information about an e-commerce system in seven different categories. The Semantic Specification, on the other hand, provides a simple set of business documents that can be used inside the eCo framework. RosettaNet framework (RosettaNet, 2007) consists of Partner Interface Processes (PIPs), a master dictionary and an implementation framework, the relationship among these parts can be expressed with the following analogies: RosettaNet dictionaries provides the words, the RosettaNet Implementation Framework (RNIF) acts as the grammar and RosettaNet Partner Interface Processes (PIP) form the dialog. Commerce XML (cXML) (cxml, 2007) is a standard for facilitating exchange of catalog content and transaction information between trading partners. The cXML catalog definitions consist of three main elements (Supplier, Index, Contract). Seller organizations create catalogs so that buying organizations' procurement applications can see their products and service offering (Dogac and Cingil, 2001). The Sun Service Registry is an open source implementation based on the ebXML Registry specifications. Besides this implementation supports UDDI specifications providing a discovery interface of the services through requests developed using this standard specifications. The combined support for both these standards in an only package, offered by the Sun Service Registry, provides wide management capability of the Web Services, for a solution that tries to become a point of reference for the Service Oriented Architecture (SOA). The freebXML Registry project (freebXML, 2006) is a open source project that provides a free implementation of the ebXML Registry 2.0 specification. The project is managed by many authors of the same standards of OASIS and is introduced therefore as "the first mostly compatible implementation of the ebXML Registry specifications". Usability, flexibility and multi-channelling, key issues for our approch, seem to be weak points of previous systems.

3 TRAME PROJECT

Global economy improves cooperation among enterprises. Effective cooperation is important for the enterprises to create and better respond to the valuable market opportunities. Virtual enterprises (VEs) are an appropriated cooperation alternative and a way of gaining competitive advantage for enterprises. VE consists of independent enterprise, which share the costs and technologies to catch fast changing opportunities. One of the main goals of the TRAME Project is to overcome the limits due to the localism of some "self-centered close-enterprises" industrial districts especially in terms of flexibility of response the market requests, proposing a dynamic reconfigurable collaborative networked structure based on cooperation among different actors. Recent approaches in such a field goes under different names: Intelligent Enterprise (Quinn, 1992), the Extended Enterprise (J. Browne and Wortmann, 1995), the Agile/Virtual Enterprise (Cunha, 2000) and other models, each with its characterizing nuances. Cooperation is a key aspect in the VE paradigm (Camarinha-Matos and Afsarmanesh, 1999) (Camarinha-Matos and Afsarmanesh, 2001). In a VE, autonomous enterprises cooperate with each other to form a dynamic alliance in order to meet the changing market rapidly and achieve a common goal. Because a VE is built according to the changing business opportunity, the cooperative partners in a virtual enterprise may be different. These partners may have different behaviors, different motivations, and different priorities. They can efficiently utilize complementary capabilities and resources to achieve their goal in this temporary alliance, optimizing the utilization of resources, reducing high investments and risks. In this scenario, TRAME projects aims to define a flexible technological framework, that, exploiting the ebXML specifications, allows the cooperation of the enterprises of T/C industrial sector, enabling each of the to share their productive capacity providing a multichannel delivery of the business information.

3.1 History

Our experience in the field of VEs started with MODA-ML project (Moda-ML, 2007). The MODA-ML project was funded by the European Commission (IST Take-Up Action Line IV.2.5, V Framework Program). The project aimed to facilitate the flow of technical and operational information between the firms of the T/C supply chain thanks to the exchange of XML documents via Internet. The concrete objective of the project was the definition of a common data

format, suitable for the exchanges of information via Internet along the supply chain: a format with features enable to simplify the legacy systems integration. The quality of the documents was thought to be high enough to propose their formalization as a part of an international standard for the T/C sector in TextWeave initiative. TexWeave (Moda-ML, 2007) is a standardization initiative of CEN (European Committe for Standardization), promoted by Euratex (European Association of the T/C Industry). The aim of TexWeave is the definition of a common reference model for the data exchange (and enterprise networking) in the European T/C industry. In the past another initiative, TexSpin, was promoted by CEN and Euratex in order to start the construction of an European common language; then, with TexWeave, Euratex and CEN intended to improve that experience, covering new aspects of the supply chain and beginning to face the issues of cross-sectorial collaborations (towards footwear, furniture and automotive industry). Starting from the previous results, during the DISCoRSO project (Discorso, 2005) we investigated "Inter-marketplace interoperability". It had its main result deploying a new and innovative ICT platform for brand new processes and technologies in order to coordinate enterprises belonging to the T/C sector but being member of different marketplace, thus using a different formats and operations for their electronic data interchange transactions. The TRAME project is the last step in our research activity.

3.2 Motivations for a New Architecture

The central problem on which the TRAME project wants to operate, is to create a district compensation of the peaks of productive ability demands. For this purpose it is needed to guarantee not only the quality and the format of the exchanged information, but also the information compatibility among different systems. Multi-channel and multi-modal delivery can offers the proper interoperability to make available all the needed elements to the business manager to optimally plan the production. From the instant of the business message (i.e. a textiles purchase order of fabric supplying process) reception in electronic format, the companies have to be able to answer in brief times on their own capability to satisfy it in optimal manner, also resorting to external available resources absolutely in transparent way. Needed condition is that such information have dynamically and accurately been made available. Practically every company on the one hand, publish for all partners the own productive ability (capability to effect well defined manufactures with suitable characteristics) and

the own availability (real availability of the machinery for new orders of production in a well defined period). On the other hand, after the production planning, the company can indifferently see own machinery and the external resources and optimally allocate the own loads. From an architectural point of view in an informative collaborative system as TRAME, the cooperation among different organizations is gotten sharing and coordinating online services (usually called e-service). These services must be flexible not only in the deploy mode(distributed and centralized system), but also in the access channels.

3.3 Reference Model

After a deep analysis of the various standards, we have considered the specifications proposed by ebXML as the more flexible and the more extensible reference model. The United Nations (UN/CEFACT) and OASIS sponsored the ebXML specifications for use in e-business frameworks. ebXML Business Process Specification Schema (BPSS) (OASIS, 2005) is a proposed standard for specifying collaborations for use in exchanging business documents through a set of choreographed transactions. A business transaction is an atomic unit of work between trading partners. Each business transaction has one requesting (incoming) document and an optional responding (outgoing) document. BPSS also supports business signals, or application-level documents that communicate a business transaction's current state (i.e. an acknowledgment document). Each actor that takes place to the business transaction is described by a CPP (Collaboration Protocol Profile) (OASIS, 2005) which describes IT capabilities in terms of supported transport protocols, messaging, security constraints, and bindings to the business process. ebXML also provides the CPA (Collaboration Protocol Agreement) (OASIS, 2005) which describes the capabilities that two parties have agreed to use to perform a business collaboration. Aligned to this ebXML approach there is a set of federated electronic Registry services, that allow partners to discover each other and, more importantly, to store central definitions and the components that are needed to configure the interchange between them. These can then also be catalogued and shared across an industrial community. The last feature of ebXML is to provide secure and reliable communications across the Internet. A special XML based messaging transport system based on XML SOAP server foundation was developed. This is known as ebMS (ebXML Messaging Service) (OASIS, 2005) which is universally the most common component used by implementers of ebXML. The ebMS server has now

evolved into a sophisticated component that, not only exchanges messages but also checks trading partner profiles to ensure that the exchanges conform to the business agreements are being routed accordingly. In the latest version ebMS can also perform business rule checking.

3.3.1 Hermes Platform

In order to facilitate and promote the use of ebXML, several implementations have been provided to help companies taking full advantages of the technology. One of the most used implementations is Hermes (freebXML, 2006) which is an electronic message transfer gateway that enables the exchange of ebXML messages. Hermes is developed as a platform for execution of ebMS that ensure a secure and reliable information transmission. Hermes (Figure 1) provides individual listeners in handling different message types, but all of them can be operated simultaneously in the common platform. Hermes also allows to send ebXML message only invoking the endpoint needed and letting the programmer mainly focus on the business logic. Hermes operates as a Java web application; the ebMS messaging capability is operated by the corresponding plugin, written according to the ebXML specification. The messaging operation requires a database with JDBC connectivity in keeping track of the messaging status. The message transmission can be secured by using SSL or electronic certificates, which are provided by the public standard.
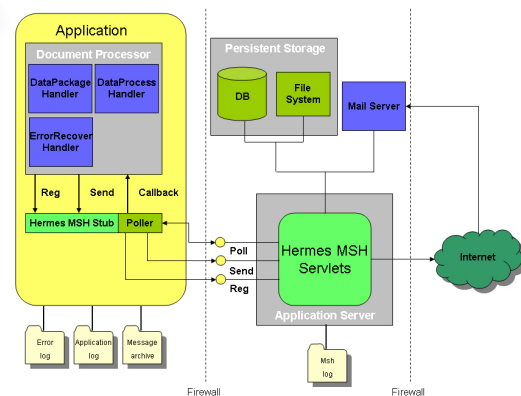

Figure 1: Hermes components diagram (freebXML, 2006).

3.3.2 Limits and Lacks

Even though Hermes is a robust and performing architecture, already at its second major release, it only supports P2P messaging. In a real and complex enterprise scenario often the degree of informatization as well as business needs are very differentiated. Many

business sectors, for example the Italian T/C supply chain are based on a multitude of small and medium enterprises with very heterogeneous information systems, different business profiles and practices, and very different connectivity degrees, going from cases of poor presence over the Internet, usual in the familiar micro enterprise, to the bigger company with several servers always connected and reachable. In such a situation it's not technically always possible to set up the Hermes architecture in all the enterprises that potentially could belong to the marketplace. It is thus needed to relax the strict requirement of having a Hermes client/server installed in the company domain in order to perform a P2P message exchange, and to allow also the smallest and not informatized companies the access to the marketplace services (partner discovering, B2B messaging, etc.). To overcome this limits TRAME project provides an extension of the Hermes architecture toward two main targets:

- **Multi-modality:** TRAME architecture introduces a service centre that works as mediator between companies not provided with the Hermes system through a web application, in a "webmail fashion", able to send and receive message to a generic Hermes server.

- **Multi-canality:** TRAME architecture is able to dynamically select and use different delivery channel (es. SMS, fax) in order to auto adapt itself to the specific business transaction as well as to the particular Collaboration Profile of business partner.

3.4 TRAME System Architecture

Following the guidelines offered by ebXML and using the experiences on Hermes platform, a logical architecture of inter-company communication system has been defined, exploiting the specification related to the Message Service v2.0 (OASIS, 2005) and ebXML Registry. This system is able to give support to the electronic management of the documental flow. It manages processes and structured information (documents) beyond to implement an e-procurement system that works as electronic broker to mechanize the buying and selling processes of productive ability. The TRAME architecture (Figure 2) is based on the following components:

- Transport System: it manages the information transmission from a business party to the central database and vice versa through communication client called MSH (Message Service Handler) for the companies supplied with informative system, moreover it provides a web application for the companies without informative system.

- Central Infrastructure: it manages the search, the retrieval and the reservation of productive abilities and it attends to the advertising of the business profiles and the business agreements between the companies.

- Supporting Tools: they automate the creation of own profiles according to the CPP ebXML specifications and the generation of agreements documents between two different companies according to the CPA ebXML specification.

- The Dictionary: it provides messages schematization that describe the most common marketplace production processes according to the needs and the roles of the several companies (tertiary, manufacturer, and so on).

In the next paragraph we'll explain in detail the used approach for the creation of a multi-modal and multi-channel architecture and its main components.

3.4.1 Multi-modal and Multi-channel Approach

The lack of a "de facto" standard for the specific problem of the Supply Chain Management has lead to a proliferation of approaches and proprietary solutions suitable to satisfy the requirements of specific applicative domains. P2P is a widespread model. This paradigm is characterized from a multitude of actors with different informatization level and availability degree on web. A weak point of the P2P model is the need of the companies not equipped with informative system "to make use", for the interaction with the counterpart, of the services with which any company must interact, forcing every spinneret partners to provide outside accessibility of these services and increasing so, data security risks. Another widespread model in this area, is the HUB one. In this paradigm, every interaction between two organizations is mediated from a central entity, a kind of service center, that manages different supporting tasks as: to carry the business messages exchanged between the sender and the buyer, to maintain a copy of the attached data to every transaction, to expose the spinneret services through a web application, to work as documents repository, to work as central authority agency. The weak points of the HUB model are the following:

- The presence of a central archive containing business information is viewed with distrust from the actors.

- The operation of the entire system is strongly dependent from one only node of the architecture, the central HUB.

The problems deriving from the previously described models, have raised the need to use a multi-modal ap-

proach for the definition of the TRAME architecture, trying to take advantage from the strength points of the previous models (P2P and HUB) and giving adequate guarantees to the business partner. So, TRAME system is based on a hybrid model, and is therefore composed of two functional distinguished parts: the peripheral systems and the central infrastructure. The first one are composed essentially from the message transport system, called "Message Service Handler" (ebXML MSH) that interacts with Company Information Systems. The central infrastructure stores the information on the companies, such as their profiles (CPP) and other general information. Furthermore, for the development of the TRAME architecture it has been considered the need to give support to the multichannel delivery and therefore it has been foreseen the business messages transmission not only through the transport protocols that, by now, are consolidated such as HTTP and SMTP, but also through more specific protocols able to interface with different devices such as SMS and fax.

3.4.2 Transport System

The transport system has been developed as an ebXML message based applications that allows the business documents dispatch and reception. Such system can ensure the interoperability among all the partners, providing for the needs of all the companies of great and small dimensions. We made a separation among:

- Companies of big dimensions that have an informative system: the message system needed to exchange business documents, does not have nowise to force to eventual changes or updating. These companies can develop a driver that extracts information from own informative system and sends business message through MSH. The driver is the interface with MSH application.

- Companies of small dimensions without informative system: they must not have the need to equip itself of an informative system for being able to use the message system with own partners.

The interoperability among companies is obtained making reference to the OASIS ebMS v2.0 specifications. The business documents come, therefore, enclosed inside a ebXML envelope and transmitted to destination, respecting the agreements, defined according to CPA specification. The communications among the companies follow the P2P paradigm, but there is also a central system on which the applications are installed that allow to the companies without informative system of being able to use the message system. Thus, a P2HUB communication joins to the

P2P ones between two companies: it is possible, however, to consider the central system as a "special" peer to which a company does not correspond effectively, but an automated system.
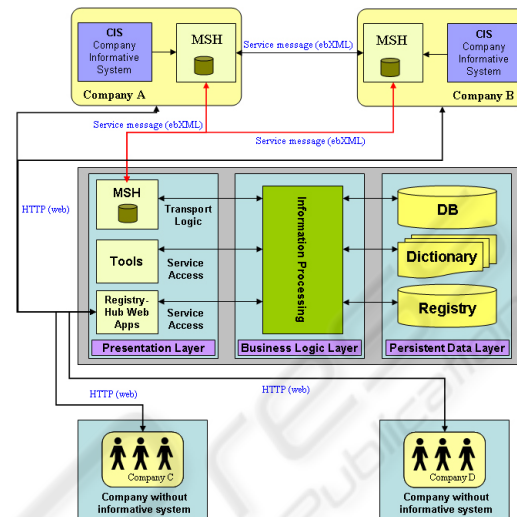

Figure 2: TRAME architecture.

The general TRAME architecture is showed in the figure 2.

Companies with Informative System. A company that has an informative system, does not have to be forced to modify it: in order to make it compatible with the ebMS v2.0 specifications it is needed therefore to add a module, called MSH (Message Service Handler), and a MSH connector, that allows to interface the business informative system to the MSH. To simplify the integration with the enterprise informative system, the MSH connector is composed by a driver that interface itself with the enterprise database through a polling mechanism. The development of this driver is delegated to the companies, because it's closely correlated to the internet database structure. So the driver doesn't became nowise invasive for the business informative system and moreover extends his potentialities, making it able to communicate with the outside. All that implies to three types of considerations:

- The business informative system has only the responsibility of the creation of the business documents and its storage in the "sending" documents. The driver must extract from database such documents, but it cannot access to other information.

- The business informative system doesn't know of the MSH existence, not even in phase of messages reception: the received documents are saved in the business database from the driver.

- Any other information, from the notification of communication errors by MSH to the validation errors, cannot be communicated directly by MSH to the business informative system.

The figure 3 shows the components if the transport architecture for the companies that already have an informative system. The business informative sys-
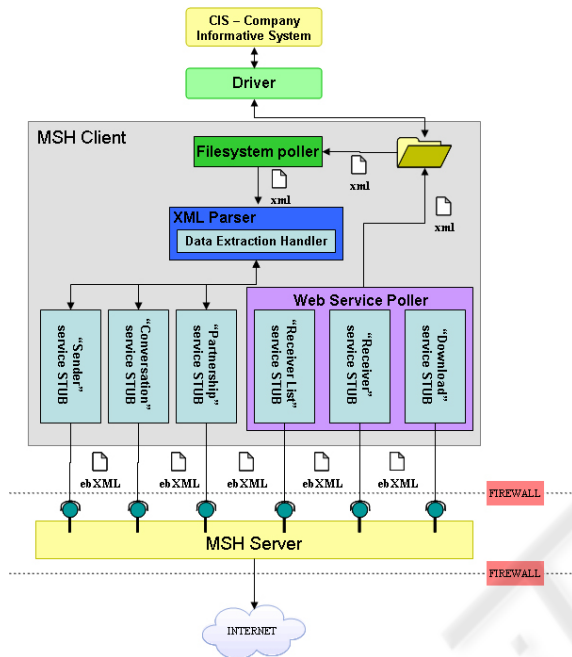

Figure 3: MSH communication modules.

tem is not nowise altered and, in order to maintain a high level of generalization, the only obligatory assumption is that the business informative system has a database. The driver is taken care to put in communication the business informative system with the MSH Client in the both directions. In sending phase, the driver is taken care to carry out a periodical polling on the business database. Beginning from contained information into the database, the driver creates business documents in XML format according to chosen and shared schema by all the companies that use TRAME system, and stores them into file system shared with MSH Client. In the receiving phase, MSH Client sends a document to the driver that carry out the polling in the shared file system and takes care to insert it into the business database. In the MSH Client architecture we can identify the following modules:

- Filesystem poller: it controls XML outgoing files, inside of the shared filesystem. It is, therefore, an interface between business informative system and MSH Client.
- XML Parser: it extracts the message content, veri-

fies the data correctness and takes the needed data for the transmission.

- Web Service Poller: it cyclically controls the presence of new messages on the server. Such operation is developed through the Axis Stub for the Web Service invocation.

The MSH Server is composed by the Hermes server opportunely configured. It will usually find beyond a firewall, inside of a DMZ. The communication between MSH Client and MSH Server takes place using a MSH Stub object.

Companies without Informative System. A company that haven't an informative system must be able to access to the service supporting the lower possible cost. The solution that better answers to such requirement is the web application, that allows the companies to access the service through any device provided with an Internet connection. The central system results the perfect candidate in order to accommodate such a web application, because it already has all the needed logic to communicate with the companies (thanks to its MSH module): the web application will have therefore to interact with the MSH on the central system (Figure 2). This system provides several functionalities for every preventively registered company such as an own private area. From the private area it can be reached the ebXML messages exchange functionalities with the other companies. There is a database for the storage of the messages exchanged among companies in which there are the needed information for the proper working of the overall system, such as the documents that describe the agreements between parts (CPA). The Web application uses a typical logic of the web-mail through which the deputy person can send, receive, examine the exchanged messages with the counterpart, controlling also that if there are errors found during the transaction.

3.4.3 Central Infrastucture

Central infrastructure offers the discovery service of business partners. It can be a useful support in the selection of the companies using the database containing the presumptive productive abilities of the bidder companies. Using these information, the target companies will be able to define contract contests and, through the transport system, to opportunely select the companies with which to establish a partnership. Therefore, the infrastructure centers is based on a registry that contains the companies' productive abilities and manages the negotiations among the companies. Moreover the registry acts as remote repos-

185

itory to which making reference for being able not only to discover new company, but also, to find business documents usable in spinneret for the B2B messages exchange. The system flexibility can give support to all the actors of productive spinneret (supplier, buyer, and tertiary) allowing their identification in the system as bidder and target companies. The registry, moreover, is perfectly integrated in the transport system providing the capability to send service messages on the contests defined by target companies through the creation of CPA between bidder companies and registry. In this context, the registry, considered as guarantee authority, takes care of the sending and the receiving of the messages about negotiations among the companies through a integrated adapter in the web application that allows the communication with the transport system. The registry architecture has been thought in order to decouple the presentation layer from the business logic layer (Figure 4). The presentation layer has been designed according to MVC pattern using struts as reference framework. The business logic layer is composed, besides DAO module for interconnection to the database, also by the transaction manager module that manages the interaction with the MSH Server, and the CPA manager module that manages the CPA creation between company and registry.

3.4.4 Supporting Tools

Two applications, named CPP-Editor and CPA-MatchMaker, have been developed to allow the creation and editing of the collaboration ebXML protocols documents. CPP-Editor allows the creation and modification of ebXML CPP profiles; CPA-MatchMaker allows the creation and editing of CPA agreement. Such tools have been integrated inside of the central infrastructure, providing the offered services access through the registry. The CPAs obtained using the CPA-MatchMaker describe Company to Company communication agreement according to formalized business processes with the ebXML ebBP (OASIS, 2005) standard.

3.4.5 Dictionary

For the TRAME project has been used the acquired experience with TexWeave (Moda-ML, 2007) in order to identify and to use dictionaries of business documents for the B2B transactions between companies of the T/C sector. The (template of) documents of each release are represented by:

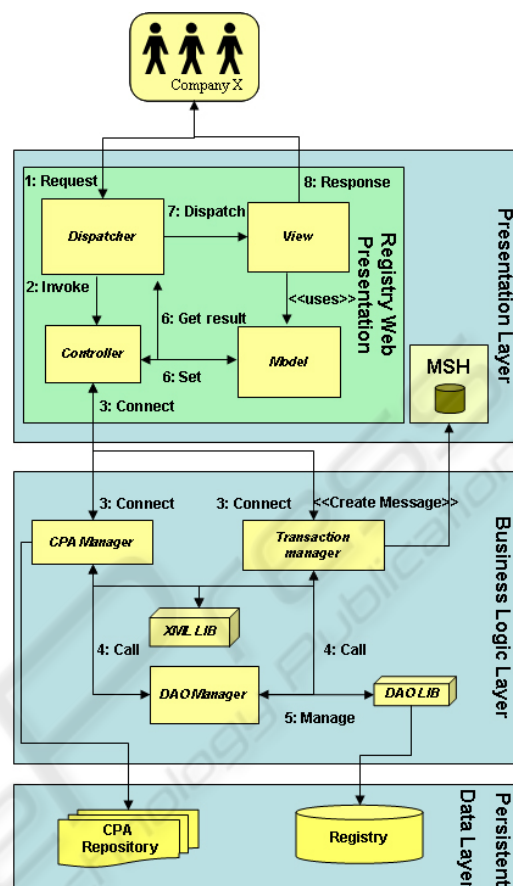- XML Schemas, that are used to validate the XML documents.

Figure 4: Registry architecture.

- User Guides, that completely describe the structure and the aim of the business documents, together with the elements and their coding rules.

- In some cases, Samples and Stylesheets XSL (XSL, 2007) might be available and can be used to visualize with a browser the content of the XML documents. The proposed stylesheets should be considered as a sample or a reference to be used directly or customised or ignored at all and substituted with custom stylesheets.

4 EXPERIMENTATION

TRAME project is born from the textile district of Biella, Italy; its participants are 23 companies, usually localized in the district of Biella. They are leaders in woollen sector and their tertiary. They are interested to share and to optimize the use of own productive ability for a inter-business collaboration while the clothing companies are interested to implement with their suppliers, a fast answer strategy to the evolutions

Table 1: The supported processes by XML documents.

Process	Activities
Fabric Supply	Selection of fabrics, Purchase of fabrics, Despatch of fabrics with groupage, Fabric delivery and Quality reporting activities
Subcontracted Fabric Manufacturing	Subcontracted warping, Subcontracted weaving, Subcontracted fabric dyeing-finishing, Subcontracted fabric printing, Subcontracted fabric darning activities
Subcontracted Yarn Manufacturing	Subcontracted yarn twisting, Subcontracted yarn dyeing activities
Yarn Supply	yarn products, Delivery of yarn activities

of market and improvement of the performances in the cloth supply. To obtain concrete feedbacks on the proposed platform, it has been foreseen and carried out a validation and experimentation phase with the companies that had the following objectives:

- Prototype functional validation (trasport system and central infrastucture).

- Loading of the participants' registry office and filling of the archives with technical content.

- Inner test to the companies verifying the integration and the supporting procedures for the company informative systems interoperability and combined test of the centralized services.

From a functional point of view, the centralized services structure has been thus delineated:

- Central service: "Repository of the productive abilities and the availabilities", accessible via web, but fed from the business systems thanks to electronic messages (XML).

- Reservation service of the accessible productive abilities via web or directly from the company informative systems.

- Development of advanced business front-end for the management of automatic answer and sucure communication mechanisms.

In this phase has been foreseen the use of specific messages in order to test possible benefits in real conditions. The use cases tested during the experimentation are the "normal" and "short" search. In the first one, the target company defines a first selection (anonymous) of prospective tertiary according to type

of service identified, selecting a number of parameters (first level parameters) about manufacture, machinery and service. This pre-selection can help the target company to define a subset of bidder companies able to potentially satisfy the demands. In the next step, the target company can select other specific parameters (second level parameters) to define a contract contest. Instead, the short search is used by target company to find the bidder company and define a contract contest in the same step. In order to clarify the previous use cases and to understand better the cental infrastucture, the figure 5 shows the sequence diagram of "short" search describing the registry components interactions (Figure 4). The figure 6 shows the bid request message schema and a fragment of bid request message instance. This message is generated when the target company begins a contract context (for exampale through a "short" search) as shown in the figure 5.

For giving support to the several companies, Domina, a project partner, it has been taken care to guide and to check up on the companies for the all experimentation activities, creating the customized adapter in order to allow the interconnection between the company informative system and the transport system. At last, Domina has been taken care to manage through a district server, all the information regarding the registry and the trade transactions, deploying the central infrastucture on aforesaid server. Still, the services pre-industrialization feedbacks are being collected with the experimentation of a final pre-competitive version of the system. The first result have shown a effective benefit for the companies partner giving thus encouraging feedbacks for the future. The TRAME project is currently in the experimentation phase. Estimable results could be evaluated at the end of such phase.

5 CONCLUSIONS AND FUTURE WORKS

In this paper has been introduced a B2B oriented framework able to support the interoperability among heterogeneous systems developed according to the ebXML specifications. The illustrated architecture bases its strength and effectiveness on technological solutions of proven value (Hermes), and on marketplace standards that have caught up a wide spread level (ebXML, J2EE). Moreover, such framework supports the multi-modal and multi-channel delivery through a P2P and P2HUB architecture, and the use of different communication protocols such as HTTP, SMTP, SMS, and fax. In this framework it has been
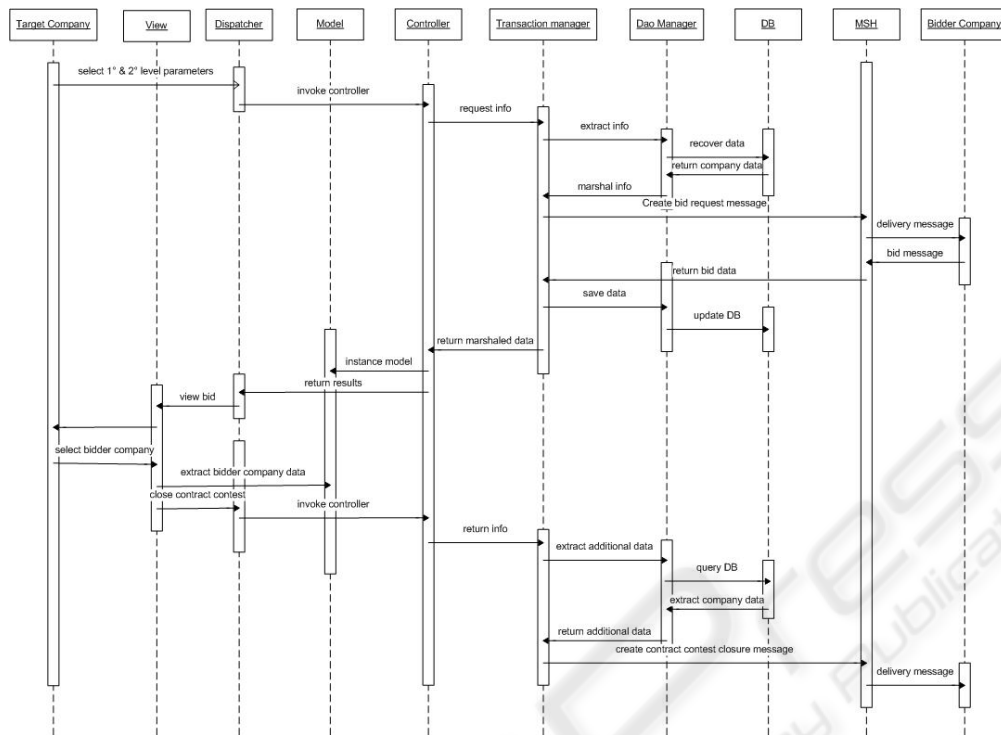
Figure 5: Sequence diagram of "short" search use case.

developed a central infrastructure able to give support to the peaks of productive ability demands within the T/C sector and to give the needed infrastructure for the business messages exchange among the partners of the productive spinneret. The future works foresees to extend the framework supplying greater flexibility to the all system and extending the multi-channel abilities. This system has been moreover used also for the FIM project experimentation in the furniture sector. At last, a system evolution foresees its use in the footwear sector through an experimentation with the companies localized in the area of Casarano (Lecce, Italy).

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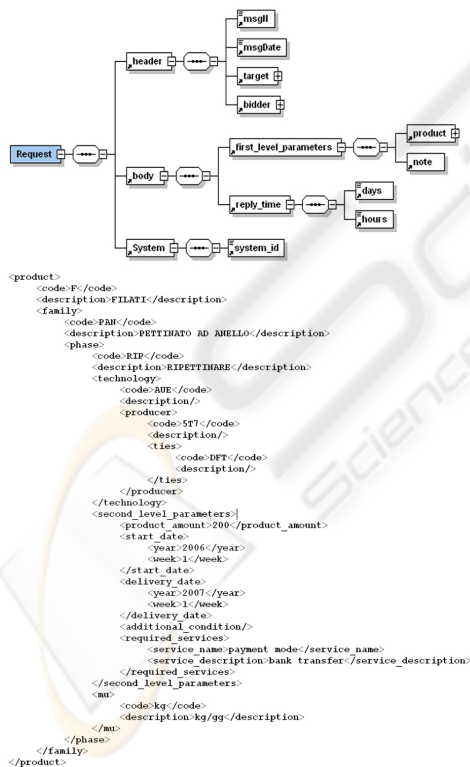
Figure 6: Bid request message.