Realising the Perspective Inter-Domain Interoperability: The Practical Power of Hybrid Architectural Approaches in Integrating Processes, Data and Services Between Businesses and Administrations

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Abstract. Escalating economic and societal demands of today, along with the continuous advancements in ICT, push enterprises and administrations to move towards networked paradigms and leverage electronic transactions in their everyday practices. Although technical solutions providing the necessary interoperability means to enable such practices have been rigorously provided during the last years, their adoption and application by the foregoing stakeholders still remains limited. Several qualities of the existing solutions in technical and business level concerning the way the manage workflows, data mappings, business and legal rules along with the use of proprietary technologies and their inability to be readily set up and deployed, act as the main inhibitors for any potential users. The present work discusses the characteristics of the predominant centralized and decentralized architectural patterns for eTransactions, identifies the weak points of every case and proposes a hybrid architectural approach that brings together the "best of breed" of both paradigms. Additionally, specific insights, methodologies and underlying technologies are proposed with an objective to support the effective implementation of the proposed architecture and its basic components.

Keywords. Interoperability architectures, electronic transactions, service integration

1. Introduction

Today, escalating economic and societal demands, along with the continuous advancements in Information and Communication Technologies (ICT), set a growing agenda for enterprises and administrations and challenge the capabilities of their underlying technical infrastructures to support them effectively in their struggle to gain steam against their competitors or provide better services to their end users.

Novel business practices such as the paradigm of electronic transactions (eTransactions) are constantly taking up momentum. Worldwide the number of stakeholders, from 10person Small-Medium Enterprises (SMEs) to global 2000 companies or local and regional administrations to national and federal governments, who are currently in the process of implementing eTransaction infrastructures, is ever growing. Proportionally to Porter's statement in 2001 that it was not a question for enterprises whether or not to move to the Internet but when and how to do it in order to create new value [27], today the "silver bullet" decision for businesses and organisations does not lie any more in the dilemma of adopting or not ICT enabled eTransaction practices but how to integrate them as quickly and effectively as possible to their operation to achieve the biggest possible benefits.

Despite though the willingness of stakeholders to proceed to such networked enterprise paradigms and although technical solutions providing for the necessary organisational, semantic, and technical interoperability to enable e-transactions have been thoroughly justified during the last years their adoption and application into the everyday business practice by enterprises and administrations still remains limited.

Specific technical and business characteristics of the proposed solutions, such as inflexible workflows, predefined formats for the exchanged data, predefined business and legal rules, exchange of business information through third party systems, use of proprietary technologies and inability to be readily set up and deployed act as the main inhibitors for the potential users. This renders current solutions costly, rigid and difficult to adapt to meet the requirements of evolving enterprises [34].

Many of these drawbacks can be largely attributed to the two widely adopted predominant architectural patterns, fully centralized (server based) or purely decentralized (peer to peed), and the restrictions these patterns bring about in terms of rigidity, operational philosophy, technological maturity and cost.

In section 2 we outline the characteristics of what constitutes an eTransactions paradigm from the enterprises and administrations viewpoint. Following, in section 3, we present a view on the underlying state of the art in enabling technologies and platforms, discuss the advantages and disadvantages of the two architectural paradigms and establish the characteristics and preliminary design of a novel hybrid architectural approach. In section 4 we present the basic components of this hybrid architecture and provide insights on the creation of a corresponding platform by introducing specific methodologies and underlying technology to support the effectiveness of the architecture and its components in integrating processes, data and services.

2. Realising the Business Perspective of eTransactions: The Enterprises and Administrations Viewpoint

Enterprises and administrations realize the entire spectrum of their everyday transactions or provided services through a series of consecutive cycles of requesting, receiving, filing, issuing and sending business documents (i.e. order forms, invoices, shipping notes, payment responses, VAT statements, INTRASTAT statements, etc) that take place in parallel with a set of corresponding physical activities (i.e. shipping products, receiving products, rendering services, submitting statements to tax authorities, etc).

Table 1 depicts two such examples of exchanging the necessary business documents to fulfil an ordering procedure between a buyer and a seller [19] and to submit an INTRASTAT statement in a governmental agency [4].

Buyer A Places an Order to Seller B	**Enterprise E Submits Intrastat to Government G**
A: issues an Order Form	E: issues the INTRASTAT Statement
A: places the Order Form to B	E: submits the INTRASTAT Statement to G
B: receives the Order Form	G: receives the INTRASTAT Statement

B: issues an Order Response B: returns the Order Response to A A: receives the Order Response	G: acknowledges the receipt

Table 1: Two Simple Examples of Exchanging Business Documents in the Scope of an eTransaction

In the back-end of the above stakeholders there are a number of internal processes whose business logic defines the flow of the above activities – i.e. approving the order within buyer A before submitting it, checking with the warehouse in buyer B to ascertain the stock of the requested products, consulting with the accounting department in enterprise E to produce the INTRASTAT statement, etc. However it is through the aforementioned endpoints (issuing Order Form, placing Order Form to B, issuing INTRASTAT Statement, submitting INTRASTAT Statement to G, etc) that the two stakeholders communicate with their outside environment.

In both the above examples the business logic of the internal processes is entirely confined within the interior of the enterprise thus producing a straightforward workflow of consecutive activities. In real life business scenarios however this is hardly the case, especially when long successive cycles of send-receive business documents between the partners are required to finalise a transaction. In such cases the internal business logic inevitably intervenes during the execution time in the way send-receive endpoints are sequenced making the “a priori” knowledge of the complete workflow virtually impossible.

This is illustrated in the following example [20] where during a transaction the invoicing procedure between the two stakeholders may be supplemented either by a Credit Note or a Debit Note. Such a case is very often when there are discrepancies between the items stated in the Invoice and the items actually received (prices, volume, etc). The following example illustrates such a case where Buyer A receives a different set of goods than the ones stated in the invoice that accompanies the fulfilment of the order he placed to Seller B, there are two options:

1. A pays for the items he received (the amount he pays is different from the one stated in the Invoice), he then sends a response to B for the amount paid and B issues a corresponding credit to A (Credit Note).
2. A sends a note to B (Debit Note) for the items he received, B re-issues the Invoice, A pays the proper amount according to the new Invoice and sends a response to B for the amount paid.

Invoicing Between Buyer A and Seller B with a Credit Note	**Invoicing Between Buyer A and Seller B with a Debit Note**
B: issues an Invoice	B: issues an Invoice
B: sends the Invoice to A	B: sends the Invoice to A
A: receives the Invoice	A: receives the Invoice
A: arranges for payment (internal process)	A: issues a Debit Note
A: issues a Response	A: sends the Debit Note to B
A: sends the Response to B	B: receives the Debit Note
B: receives the Response	B: re-issues the Invoice
B: issues a Credit Note	B: sends the Invoice to A

B: sends the Credit Note to A A: receives the Credit Note	A: receives the Invoice *A: arranges for payment (internal process)* A: issues a Response A: sends the Response to B B: receives the Response

Table 2: Fulfilling the Invoicing Procedure Either with a Credit Note or a Debit Note

During the transaction life-cycle all the exchanged business documents are produced by data that exist within the stakeholders' infrastructures – information systems, custom-made software applications or ever mere office automation applications. Consequently the heterogeneity of the stakeholders' infrastructures mandates a corresponding heterogeneity in the way business documents are represented by every partner in terms of semantics and format of their content.

Table 3 illustrates an example of how a segment of the same data in an invoice that is sent from partner A to partner B is represented differently when the invoice is stored inside each stakeholders' systems.

System of Partner A		**System of Partner B**	
Company Name	Sui Generis S.A.	*Partner Name*	Sui Generis S.A.
Billing Address	7 Panepistimiou str,	*Street Name*	Panepistimiou
	Athens, Greece	*Street Number*	7
		City	Athens
		Country	Greece
Postal Code	13713	*Zip Code*	13713
Customer ID	7130713	*Partner ID*	7130713
Invoice Number	1370137	*Invoice ID*	1370137

Table 3: Different Representations of the same Segment of Data within two different Trading Partners

Based on the foregoing analysis it becomes obvious that any two potential business partners that aspire to engage in eTransactions need to find an ICT-based systematic way to address the following challenges:

- Define and execute workflows of repeated send and receive business document activities. These send and receive activities need to map to corresponding functionalities of the underlying systems that have been externalised as web services in order to be automatically called by each system – process integration and dynamic service composition challenges.
- Transform business documents between different formats based on a mapping between the semantics used by the underlying systems – data integration challenge.

Based on the status of the underlying technological state of the art, today the above challenges are feasible to be realized in a one-to-one basis between two stakeholders, by the custom development of all the necessary technical infrastructures. However the application of such an approach in a one-to-many basis by an enterprise or administration is something that is feasibly impossible due to its exponential complexity and corresponding cost. Furthermore as the nature of the engaged partners becomes more heterogeneous (businesses transacting with governments) and their geographical location dispersed (enterprises engaging in cross-country transactions) this venture becomes even more difficult to be realised and sustained due to arising issues that have to do with the enforcement of rigid unilateral practices, policies and specifications that originate from the nature of the partners and underlying legal framework.

Following on the definitions of interoperability, as a key driver to improve an organization's synergy in achieving its mission and vision in effective and efficient manner [14], this paper focuses in solving the interoperability problem of eTransactions in the semantic and technical level by introducing an architecture capable of dealing with the aforementioned process, data and service integration challenges based on underlying models of processes and data of the engaged business partners.

3. Discussion on the Underlying State of the Art

Interoperability as a driver for eTransactions constitutes a challenging field where scientific advances are very often accompanied by significant benefits for the adopting stakeholders. According to Gartner ICT interoperability products alone constitute a thriving market that surpasses 200 M€ per year worldwide. The underlying state of the art appears to be quite progressed, incorporating from methodologies, frameworks and standards for process, data and service integration to commercial of the shelf (COTS) solutions and integrated platforms.

3.1 Interoperability Enablers: Enterprise Modelling, Data Modelling, Service Integration

Enterprise Modelling (EM) can be defined as the art of externalizing enterprise knowledge, which adds value to the enterprise or needs to be shared [39]. The prime objective is to describe the things of the enterprise. This usually concerns function, behaviour, information, resource, organization or economic aspects of a business entity, be it part of a single enterprise, one enterprise or a network of enterprises. [40]. The goal is to make explicit, knowledge that adds value to the enterprise or can be shared by business applications and users for improving the performance of the enterprise. Currently the field in enterprise modelling comprises enterprise frameworks and architectures (Zachman, GERAM, GRAI, ARIS, CIMOSA, DoDAF, TOGAF, TEAF, AKM, ISO MISSION), industry initiatives and standardisation bodies (BPMI, OAGIS GIS, OASIS BPEL OASIS BCM, UN/CEFACT Rossetta Net, etc) and a large number enterprise modelling languages (IEM, Metis ITM, Metis BPM, UML, MEML, CIMOSA, GRAI, BPML, BPMN, UEML, etc).

Data Modelling is the process of structuring and organising data. Data models exist at multiple levels including high level conceptual data models, more detailed logical data representations and physical data structures that incorporate the actual information [31]. Currently the field in data modelling comprises core technologies (XML and UML), initiatives and frameworks (ebXML, RosettaNet, UN/CFACT CCTS and UMM, Dublin Core) and ontology representation languages (RDF, OWL, DAML+OIL, Topic Maps).

Service Integration is a broader concept that refers to a series of activities such as service creation, service description, service publishing to Intranet or Internet repositories, service discovery, service invocation, service binding and service un-publishing [35]. Currently the underlying state of the art includes standardisation organisations and initiatives that deal and regulate specific issues around the aforementioned activities (W3C, OMG, Global Grid Forum, Peer-to-Peer Working Group, OASIS, ebXML, UN/CEFACT, BPMI) and technology frameworks that aim to provide the means to develop specific solutions (Service Oriented Architectures, P2P Services, Grid Services).

3.2 Products and Platforms for eTransactions: The Pros and Cons of Peer to Peer and Server Based Architectures

Several approaches emerge today with the objective to help the integration of business partners and provide them with capabilities for eTransactions, among them commercial products of major IT vendors but also open source initiatives based on open standards. The present analysis will not go deep into examining all available solutions as this would be out of scope, but instead will present some of the most prominent cases of such systems outlining their basic features.

Microsoft BizTalk Server is a business process management server that enables companies to automate and optimize business processes. It includes tools to design, develop, deploy, and manage business processes. The environment also provides the ability to design, build, and execute dynamic business interactions that span applications, platforms, and organizations. The current version of BizTalk supports the XLANG specification for modelling business processes and incorporates an orchestration engine for executing and monitoring processes. BizTalk adopts a server based architecture where the all execution of business logic and the exchange of business information is controlled by a central point.

Oracle Application Server is a new release of the core service oriented architecture platform underlying Oracle Fusion Middleware. It is designed to provide a standards-based, mission critical platform for organizations to deploy service oriented solutions. Oracle Application Server is designed to address three challenges, service oriented development of applications, event-driven business process optimization and a unified workplace with pervasive multi-channel access. Like Biztalk Server Oracle Application Server similarly adopts a centralized architecture.

SAP Netweaver Platform is an application builder platform for integrating business processes across various systems, databases and sources. SAP NetWeaver is a service oriented application and integration platform that is designed to interoperate with various proprietary technologies and commercial platforms like Microsoft .NET, Sun Java EE, and IBM WebSphere. Although SAP Netweaver is also server based it can also facilitate a decentralized approach by being able to interconnect with several other commercial platforms.

Freebxml is an open initiative that aims to foster the development and adoption of ebXML related technology through software and experience sharing. In contradiction to other initiatives around ebXML, Freebxml does not define specification, but instead provides implementations of already existing ebXML specifications. Its vision is to create a virtual community, dedicated to ebXML and related technology that will facilitate the sharing of code, applications and experience among developers and users.

As it appears from the previous indicative analysis, hitherto integration platforms have mostly been realized on the basis of centralized, client-server, models [1]. Different flavours of client-server constellations exist today, ranging from centralized hub-and-spoke systems to point-to-point links between two trading partners [32]. In all cases a central instance mediates between one or several users and provides the necessary functionality for seeking, negotiating and binding services between the trading partners. The engaged stakeholders simply provide their mapping to the mediator (server) and he assumes the burden of resolving any inconsistencies among any trading partners. Therefore the centralized character of this architectural approach provides a paramount advantages to business users by alleviating them of considerable effort.

In server based architectures a central instance is also responsible for orchestrating the business logic entire collaboration and handling all message exchange between the trading partners. In central systems business services out of numerous different partners are inevitably assembled and executed on the central server's runtime, thus consuming a significant amount of its computation power that may diminish the performance of the overall system. Additionally, such systems present by design reduced scalability since any changes in the server are propagated and affect all the interconnecting clients. Finally the existence of a single, central point of failure makes this architectural approach even more inappropriate for business transactions.

In contrast decentralized, peer to peer (P2P), architectures do not present the latter problem. P2P networks typically do not have the notion of clients or servers, but only equal peer nodes that concurrently work as both clients and servers to the other nodes that are part of the network. Instead of a central instance being responsible for the setup and control of business relationships, P2P transactional systems enable users to dynamically and autonomously negotiate and establish an agreement for the automatic execution of business processes. Therefore, theoretically, P2P provides paramount advantages in many respects for business transactions through this decentralized execution of the transactions business logic. The improved scalability and ability to deal with transient populations of users can be considered as a further important argument for deploying distributed systems. Furthermore two trading partners do not have to exchange documents via a third-party with the risk of having sensitive data intercepted but have the benefit of direct, unmediated and potentially synchronous communication.

However in practice, P2P based architectures are too compensated by a number of drawbacks. Such environments consist of numerous autonomously acting peers and require sophisticated and reliable mechanisms for partner retrieval, negotiation and service binding that can cope with quickly changing network topologies, whereas in the opposite side a central server could easily maintain one single catalogue indexing all currently connected users. A second issue is the assurance of user authentication and access control. As opposed to a centralized architecture, in P2P there is no single entity that can act as a neutral mediator, maintaining certificates of the respective participants' identities. Apart from that, the negotiation and establishment of collaboration protocol agreements (CPAs) is more complex than in the case of central system since there is no central instance available that maintains all the necessary mappings, instead these need to be maintained and updated by all the engaged peers. Accordingly, the progress and state of the conducted transactions must also be mirrored to all the engaged peers, since the orchestration of services is performed in a decentralized way.

3.3 Models for Semantic Interoperability

SOA technologies and standards provide designers with a variety of solutions for achieving semantic interoperability leveraging the advantages and disadvantages of the adopted architectures. The selection of a specific architectural approach depends upon the business environment in which the service infrastructure is deployed. These possible approaches are based on a classification criterion that captures what is essential from the perspective of semantic integration and that addresses the main issues in managing semantics in service-oriented distributed systems. According to [41], the different models for semantic interoperability can be classified based on two fundamental dimensions:

1. By distinguishing between the two possible ways of integrating mappings – each schema is either mapped to any other (any-to-any) or each schema is mapped to a single central schema

(any-to-one)

2. By choosing whether the integrated logic is executed in a single, distinguished node (centralized) or the execution is distributed among multiple, functionally equivalent nodes (decentralized).

By applying these criteria to the aforementioned architectural approaches derive the following table that illustrates the strong points (o) and weaknesses (x) of each case in integrating the mappings and logic of the interconnected trading partners.

	Model for Integrating Mappings		**Model for Integrating Logic**	
	Any-to-One	**Any-to-Any**	**Centralized**	**Decentralized**
Server-Based	o		x	
P2P		x		o

Table 4: Classifying Advantages and Disadvantages of Server-Based and P2PArchitectures According to the Different Models of Achieving Semantic Interoperability

According to table 4 in a Server-Based system the advantages lie with the fact that trading partners are required to do the mapping of their processes, data and services in a Any-to-One way (each partner maps only against the Server). However the Server resumes the entire burden of executing the necessary logic i.e. service workflows and document transformation in a centralized way, which is the main disadvantage due to the created high workloads that increase the possibilities for reduced performance and single point of failure situations. On the other hand, in a P2P platform, the main disadvantage is that business partners are required to perform and maintain an Any-to-Any mapping of their processes, data and services which leads to a very high level f complexity (each partner maps against every other partner in the environment). The advantage though is that there can be decentralized execution of the necessary logic, i.e. every two partners can define mutual service workflows and document transformation mappings.

Leveraging the pros and cons of every approach, the ideal situation would be an approach "somewhere in the middle" of both paradigms. Such an architecture would allow business partners to integrate their mappings in a Any-to-One way (each partner mapping against one central instance) in order to keep the level of complexity low and then enable them to proceed to the execution of the integrated logic in a decentralized way (any two partners being able to engage in a transaction directly among themselves without any third-party mediation).

These two assertions are the fundamental design principles of the architecture that is proposed in the following section of this paper.

4. Hybrid Architectural Approaches for eTransactions

According to [7] monolithic, centralized architectures that focus only within the enterprise, and not on business partners and customers, are worthless. Newer architectural models need to put us on a track to make real the loosely coupled enterprise, and push for an increasing capability to collaborate among all kinds of applications. Modern enterprises need to align into virtual alliances, while responding effectively and swiftly to competitive challenges. Therefore, they are required to streamline both internal and external business processes by integrating the various packaged and home-grown applications found spread throughout an enterprise [26]. Proportionally, [13] defines the concept of interoperability service utility to denote an overall system that provides enterprise interoperability to its users as a utility-like capability in a "plug-n-play" way.

The proposed architecture embraces this general philosophy for extroverted, easy to use applications by specifying an environment with the ability to promote peer-to-peer e-transactions between business partners through a centralized support – hybrid architecture. The architecture provides the necessary semantic interoperability features to facilitate the direct exchange of business documents between the partners through the provision by a central instance (server) of customized service workflows and data mapping schemas.

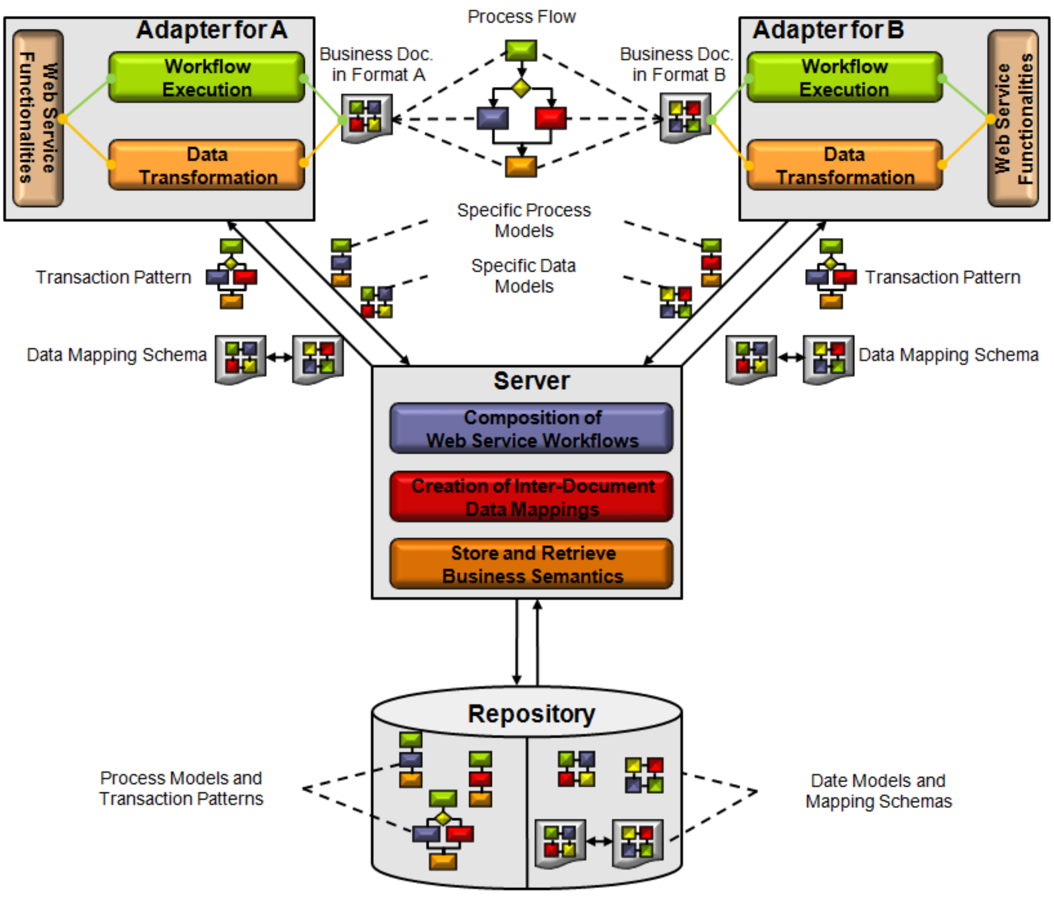

Fig. 2: Architectural Overview

The architecture comprises three distinct components – the repository, the server and the adapters. Collaborating together these components constitute an integration platform that enables stakeholders of heterogeneous nature (enterprises and administrations) to engage and sustain networked enterprise paradigms based on dynamically composed, end to end integrated services.

The *Repository* stores semantic information about the characteristics of the platform users in the form of models about the processes, corresponding service endpoints and data models each user can support based on its underlying infrastructures. Additionally the *Repository* may even store higher level models of business and legal rules about the followed business practices and underlying policy framework guidelines according to business nature of the engaged partners.

The *Server* acts as the integrating component among the users providing them with the necessary capabilities to engage in eTransactions directly among themselves. Specifically, for every transaction between two stakeholders the *Server* makes use of the information in the *Repository* in order to synthesize specific workflow based on the process models and the existing service endpoints supported by the partners, provides specific data mappings based on the underlying data models of the partners to enable the transformation of business documents between different system formats, and may also provide for the necessary monitoring and management of the transaction flow where required .

The *Adapter* which is the only component in the architecture that depends to some extend on the configuration of the users' infrastructures provides the technical capabilities for the direct exchange of information among the users. The *Adapters*, based on the input by the *Server*, execute dynamic workflows, perform document transformation and interconnect to the users' internal infrastructures by calling the supported externalised service endpoints.

In order to support the *Server's* integrating capabilities the repository incorporates a series of semantic models of processes and data, specifically:

- Generic process models in the form of XML descriptions – i.e. in XMI-based representations of UMM models [23], [22], [37], BPMN models depicting user collaborations [21] or ebXML BPSS [17]. At the moment, BPMN appears to be the most preferable specification due to the fact that there is already a considerable amount of work on how to transform such models into BPEL [16] which is an XML-based executable description of service workflows.
- Generic business documents in an XML-based format – using the readily available UN/CEFACT Core Components [36] and Naming and Design Rules [38].
- XML descriptions of the users profiles and their mutual agreements that apply during their transactions – ebXML Collaborations Protocol Profiles and Agreement.

In order to create such a diverse semantic *Repository* a multidisciplinary modelling methodology that will provide a holistic view upon processes, data, services and rules is required. Although several successful approaches do exist, such as in [30] and [10], they address only one or two aspects of the problem.

The modelling approach that is proposed in this paper covers the entire spectrum of needs by incorporating two dedicated modelling levels, one for business processes and services and one for business documents. In-between these two there is another modelling level dedicated to creating models of business and legal rules that reference models of processes and. This is required to the fact that rules, by nature, are either structural or operative [33] – i.e. they either affect processes or documents.

The business process level comprises three distinct categories of process models – private, public and collaboration or generic – each one of which captures a specific description view of a business process [15]. Private process view shows all activities which are performed within the process. The focus is set on as-is organisational process modelling, it means activities like internal decisions or internal administrative work are also included. Such activities usually provide rich information on business rules that impact the process design. Public process view only shows activities that are useful to understand the relevant process outputs and communication with an external entity. The significant process logic has to be indicated as well. Activities of the external entity (i.e. the other collaborating partner) are not described. The public process model for a business partner reveals its corresponding service endpoints for exchanging business documents [12]. The collaboration process model which constitutes of abstract, generic models that derive from the appropriate consolidation of the public processes models of the collaborative parties that participate in a business transaction. These generic process models are designed at the highest abstraction level possible, so as to be able to fit easily to different countries without interfering with the internal private processes of the parties involved.

At the business document level, document models are created through syntax independent blocks of data – i.e. by utilising the UN/CEFACT Core Components Technical Specification that already implements a considerable number of readily available data components. The overall business document structure is modelled either according to existing data components (UN/CEFACT or UBL core components of business documents) or from scratch (which is the case especially for documents for governmental transactions). The internal structure is assembled out of common components which are restricted according to the specifics of the respective country, system or business role. Finally each business document is modelled into two distinct facets, the specific business document (SBD) which is a model of the document within a specific country and the generic business document which is a generalized model of the document capable of covering the requirements of every country [29].

The cross-cutting business and legal rules level contains models with the ability to reference both process and document models. To this end a specific rules metamodel needs to be created in order to define a vocabulary of all the entities referenced by the rule models. The metamodel must incorporates concepts such as events and conditions that trigger the rule, action that the rule bears during its execution, application fields that the rule effects (i.e. external process and document models) and finally originating legal structures in the case of legal rules [9].

Figure 2 presents an overview of the entire modelling methodology.

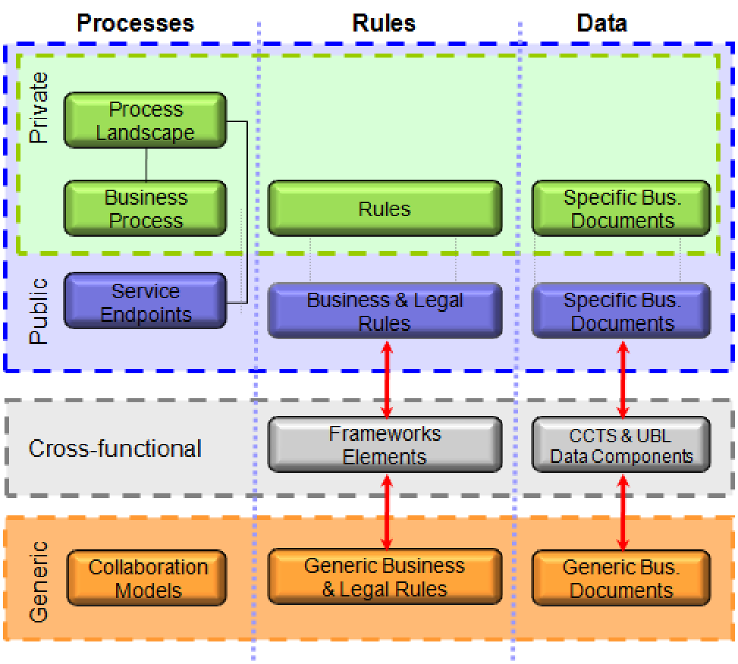

Fig. 2: Overall Modelling Approach

In the hierarchy of proposed hybrid approach the *Server* is a component that is layered between the repository and the adapters with an objective to provide a series of supportive services that eventually enable business partners to engage in electronic transactions without ever assuming the burden of exchanging the entire transactional load like in pure server based approach. To fulfil its purpose it must comprise mechanisms for:

- Generating executable service workflows for any transaction between two specific partners. This is achieved by retrieving the corresponding public process models from the repository, matching their service endpoints in order to define a common collaboration model and finally transforming this model executable sequence of services. From a technological perspective the final service workflow can be produced by converting a collaborative BPMN process model to its corresponding BPEL script [12].

- Synthesizing generic business documents that fulfil both partners' data requirements based on their underlying business document models in the repository and providing dedicated XML mapping to transform the generic business documents into specific business document to be stored in each partners' system.

Every *Adapter* in the client side of the proposed architecture assumes the burden of conducting the transaction by executing the workflows and applying the transformation schemas provided by the server. To achieve this functionality it requires a dedicated component capable of executing the workflows by calling the prescribed services [11] in our case a BPEL engine will do since the execution script is in BPEL and one simple function from transforming XML documents from one format to another based on a predefined transformation schema.

The proposed modelling methodology as well as a subset of the overall architecture comprising prototype components for the repository, server and adapters have already been implemented within the scope of GENESIS [8], an EU-funded research project aiming at the development and pilot application of the needed methodologies, architectures and software components that will allow the typical, usually small and medium, European enterprise to conduct its Business transactions over Internet, by interconnecting its main transactional software applications and systems with those of collaborating enterprises and governmental bodies. To acquire the necessary information for the models more than 15 end user companies and governmental agencies from 8 different countries (Greece, Cyprus, Italy, Turkey, Lithuania, Romania, Bulgaria and Czech Republic) have been interviewed by the GENESIS consortium in order to provide the necessary data across a series of business transactions spanning the entire B2B and B2G spectrum, specifically:

- Their internal business processes and procedures for conducting transactions.

- The format and content of their business documents.

- The followed business and legal rules according to the underlying business practices and statutory framework which was also reviewed at EU and national level.

All corresponding model for the abovementioned information have been created based on the previous mentioned emerging standards

5. Conclusions and Future Work

Today enterprises and administrations need to respond effectively and swiftly in streamlining their internal infrastructures, processes and data to embrace novel networked paradigms that will bring them closer to their customers, service-recipients and partners. In this paper we have outlined the characteristics of what signifies the Business Perspective of full scale ICT enabled e-transactions both for enterprises and administrations. We presented the main challenges in terms of service and data integration that need to be overcome and underlined the necessity for this to be realized in a systematic way across the entire chain of collaborating stakeholders.

Furthermore we presented an overview of the underlying state of the art in terms of enabling technologies, products and platforms for service, process and data integration. Additionally we discussed the advantages and disadvantages of the two most common architectural paradigms, namely centralized and decentralized, and established the characteristics of a hybrid architecture that brings together the “best of breed” from both approaches in providing for a centralized mapping of business semantics and a distributed execution of process logic.

Following we analysed the features of this hybrid architecture in supporting process, data and service integration and roadmapped the creation of a corresponding platform by introducing specific insights, methodologies and underlying technology to support the effectiveness of the architecture and its components in integrating processes, data and services.

Next steps in this work include the specification, in design and technological level, of additional features in the proposed architecture such as the capability to provide for online contract negotiation between the partners, authentication of new users of the environment, non-repudiation of the conducted actions and logging and time-stamping of the exchanged business documents in order to constitute a full scale collaboration platform.

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