

# Reference Architecture for Lending Industry in ULS Systems

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## Extended Abstract

### 1. Introduction

Vertical industries have been developing e-business standards to improve their business-to-business interoperability, and to foster efficient and organically-grown industry-wide systems. Such systems and their horizontal interactions with even larger ecosystems are effectively an Ultra-Large-Scale (ULS) system. E-Business standards are essentially a set of governing rules for these ULS systems. It is critical that these governing rules address the socio-technical ecosystem (rather than system of systems) challenges recognized for ULS systems [3], promote overall system quality, and cope with long-term, self-regulating, continuous evolution.

Until recently, most e-Business standards have been composed of XML-based business data models and message exchange patterns [2]. Some more sophisticated standards have also included business process models. Data and process models alone have limited power to regulate the healthy evolution of a ULS system. This has resulted in problems in overall quality of ULS systems, gaps between business standards and particular implementations, and interoperability problem among applications even when they claim to be in compliant.

National ICT Australia (NICTA) has been working with a leading Australian e-Business industry standardization body – Lending Industry XML Initiative (LIXI) that serves the lending industry in Australia. LIXI initially developed a XML-based data centric standard, later complemented by a process model described in BPMN (Business Process Modeling Notation), jointly developed with NICTA. To further bridge the gap between business standards and technical implementation, and to promote technical interoperability, NICTA was asked by LIXI to help devise a Reference Architecture (RA) and associated development guidelines to supplement their e-Business standards.

The overall ecosystem in the lending industry and beyond has many of the characteristics of a ULS system. A RA for such a system should not only address immediate concerns from the perspective of the

standardization body, but also broader issues recognised for ULS systems. The role of RA in this case is significantly different from traditional technical reference architecture which exemplifies a possible arrangement of structural components and connectors. In order to address both the business perspective and ULS system challenges, the RA needs to balance consistency and variety, address competing needs from different parties and consider trade-offs between prescriptive guidance and an ability to evolve. The RA should provide governing quality-centric rules rather than structural prescriptions.

In the remainder of the paper, we will outline characteristics of the system, the role and focus of a RA in e-Business standards and the techniques we have used so far in solving the problems.

### 2. Characteristics of the System

The lending industry has many parties, ranging from large banks, mortgage houses, property valuation companies, insurance companies and technical solution companies to individuals such as brokers, independent valuers and borrowers. There are thousands of systems already running and constantly evolving. They not only interact with each other in the vertical lending industry but also with the larger financial and government ecosystem (e.g. through the NECS (National Electronic Conveyancing System) initiative). It has the following characteristics which resemble those for ULS systems [3]:

- 1) Decentralization: Data, development, evolution and operational control are all decentralized. LIXI is a non-profit organization with no standard enforcement power. Its membership is voluntary.
- 2) Inherently conflicting requirements: Most parties want complexity to reside in others' parts of the overall system, want information to be shared, but do not want to share their own information. Technical solution companies provide and favor intermediary gateways and custom-built applications, while smaller players typically want commoditized applications and to remove intermediaries.

- 3) Continuous evolution with heterogeneous elements: The whole ecosystem can't be stopped and re-engineered. Day-to-day lending activities have to go on, and horizontal interactions with the larger financial and government systems also exert constant influence.
- 4) No clear people/system boundary: The scale of the companies involved varies widely. Some companies have sophisticated systems that can automate most tasks while others still rely on fax and manual processing. Messages and activities in the e-Business standards can map to systems or people depending on the specific parties and the characteristics of individual transactions.

### 3. RA in e-Business Standards

From the perspective of an industry standardization body, problems lie in the gap between standards and implementations. Different interpretations of a standard result in less interoperability between systems. The risk is that an application will have to be changed significantly whenever it needs to interact with a new system, even though both parties could reasonably claim to be in compliance with the e-business standards. Such standards usually give little guidance beyond business data and process, and so can increase the barrier of entry for smaller parties. A RA can partly address such problems.

However, there are broader challenges beyond this industry perspective if we consider the overall system as a ULS system. The quality of the ULS system is not addressed in business data and process models. This may cause a growing ULS system to become less stable, unnecessarily complex and consequently harm the value of the system.

The overall "health" of a ULS is not a simple measure, because the multiple parties within the system may have competing business goals and strategies, which give rise to different measures of value and quality. Perhaps the best ultimate measure in the context of the lending industry would be the extent to which the ULS contributes to economic growth, or more immediately, growth of the lending industry.

Thus, the role of RA should go beyond filling the gap between business standards and implementations. It should provide guidance to actively promote healthy evolution of the lending industry ULS system.

#### 3.1. Focus of RA

Considering the characteristics of a ULS system and the problems we face, we propose that a RA for e-Business standards should focus on the following issues and differentiate itself from a technical architecture:

- Focus on rules for governing the quality of systems providing services rather than providing prescriptive architectural structures for systems. Elements and structures should be highly adaptable to handle continuous and long-term evolution of the ULS system, and so these quality rules will often relate to interoperability, robustness, and adaptability. Just as in urban design planning, the rules have an economics rationale and a quality focus, with little formal control.

- Balance technical issues and business issues. Any rules or structures should explicitly consider implications to business value [1]. They should encourage competition and allow new business models to appear. The values and financial/technical capabilities of all parties should be considered. For example, we cannot expect small companies to build large technical infrastructures.

- Balance consistency and variety. There is always a tradeoff between order and incident, prescriptive guidance and flexibility, immediate technical needs and long term evolution. The general rules embodied in the RA should try to be technology agnostic, but exemplar bindings to existing technology should also be provided.

### 4. Technical Solutions for e-Business RA

For the RA for the LIXI ULS, we have been able to provide concrete and immediate guidance, offer mappings to current technologies and consider existing expertise. This has limited us to employ entirely new techniques or revolutionary designs for such ULS systems. Our RA and associated development guidelines for LIXI can be summarized as a set of rules along the following aspects:

#### 4.1. Semantic Alignment

Semantic alignment rules provide two alternative mechanisms for minimizing the effort needed to integrate components built independently. LIXI standards have provided an ontology vocabulary for all the messages it defines. The purpose of the rules is to link technical elements with business semantics so that: 1) it gives enough flexibility to technical elements, and 2) interoperability between technical elements can be achieved by consulting the business meaning at both design and run-time. The RA provides two ways of achieving semantic alignment in the context of service oriented architecture. Both also act as suggestive enforcement mechanisms for adhering to business standards:

**4.1.1. Semantic annotation (lightweight)** This allows the service architecture to be developed without initially considering business standards. Developers can then annotate technology elements by referring to the common

vocabulary through XML reference or semantic web service mechanisms. This is a bottom-up approach and relatively lightweight. When two systems communicate, they know what each other means business-wise even though labels might differ.

**4.1.2. Model Driven (heavyweight)** Another approach is to use a top-down approach. For example, we provide rules to translate the standardized BPMN model into a technical BPEL (Business Process Execution Languages) model through semi-automated model transformation. A similar approach can be used to translate business messages into web service messages. The transformation rules then can be exposed for interoperability purposes.

#### 4.2. Minimum Service Interface

The business world is essentially a service oriented world. The technology world has recently been catching up by introducing the “service” concept, either as SOAP-based Web services, REST-ful services and other forms. It is crucial to provide governing rules for service interface designs. The set of rules we propose in the RA for LIXI use a loose message-centric interface approach. Messaging behaviors are specified by content structure and exchange protocols. Service interfaces should not expose abstractions as remote procedures. Essentially, we advocate the use of a single operation on a service – ProcessMessage – but allow more complicated interfaces to exist. This rule encourages maximum flexibility in the face of constant evolution. Shared contexts are carried within messages. Message processing can either be hidden behind the service or exposed as metadata.

The mapping from e-business standards to such minimum service interfaces is pleasantly straightforward because e-business standards are typically defined as messages and message exchanges with no explicit reference to methods and parameters.

#### 4.3. Avoid Explicit Intermediaries

We do not introduce the role of an intermediary explicitly in the RA. However, we allow such intermediaries to appear in the ULS system organically. This is very different from existing e-Business meta-standards such as ebXML, which have an explicit concept of registry and repositories through which companies post business processes, capability profiles and collaboration protocol agreements. Technically, this is appealing and simplifies some business scenarios. However, we found it to be very difficult to push such a structure within LIXI because of complex business issues such as agreeing on intermediaries, legal issues such as confidentiality concerns, and practical issues such as the difficulty of semi-automated agreement negotiation. Thus, in the RA

for LIXI, interacting directly with another business party or through an intermediary are treated as the same. Dynamic binding and proxy solutions can help to achieve various relationships in practice.

#### 4.4. Share Metadata and Context

Metadata is usually described in service contracts. Contexts are more instance-specific. Through rules specified in the RA, we encourage metadata and contexts to be shared in all possible ways. Such metadata can be related to policies (e.g. security requirements or encryption capabilities), quality of service characteristics (e.g. required response time), and semantic descriptions. Through the sharing of metadata and context, interoperability can be achieved at both design time and run-time with little top-down prescriptive planning.

#### 5. Conclusion

The ecosystem within the lending industry and beyond is a ULS system. Existing business data and process centric standards have very limited governing power over the quality and evolution of such ULS systems. We have helped to develop an initial reference architecture and associated development guidelines for a lending industry e-Business standard, to assist in solving current problems and to promote more sophisticated use of the standard in the context of the LIXI ULS system. The nature of such RA should be quality-centric rather than structure-centric. We have proposed a few technical solutions to help achieve this.

#### 6. Acknowledgements

Thanks for Len Bass and Paul Mackie for helpful comments. National ICT Australia is funded by the Australian Government's Department of Communications, Information Technology, and the Arts and the Australian Research Council through Backing Australia's Ability and the ICT Research Centre of Excellence programs.

#### 7. References

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