Web-services architecture : A solution for e-government applications

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Abstract - *Last few years, several projects under the E-government initiative have emerged; they are aiming to bring public administration such as for i.e. taxation service, closer to citizens and industrials. Today most of governments are aware that the use of information communication tools represents a powerful means to increase collaboration and cooperation between different public institutions. The aims are to provide better and more efficient services to citizens. The ambitions of governments are to facilitate and encourage development of homogenous web-platforms providing to citizens just with one single authentication, access to several public services such as taxation service, social service, health care, etc. However most of the governmental bodies are running their own information systems and connecting them together is not an obvious task. The main challenge relies on integrating efficiently all those heterogeneous public information systems by providing a unified environment. Our project intends to define an integration applications model based on service oriented architecture (SOA). The project is based on real enterprise information systems developed and maintained by a Norwegian public organisation.*

Keywords: WEB service, E-government, SOA, Enterprise information systems integration.

1 Introduction

The last decade, public administrations have invested extensively in developing and using enterprise information systems. However it has been done without a global strategy. As a result, municipalities or governmental bodies for example, are using different information systems. Today the general trend is to connect some of the existing or legacy systems together in order to provide a homogenous and standardized platform for users. The evolution of Internet and new technologies such as web services are seen as a means to achieve the desired integration level between those systems.

Nowadays it is usually agreed that integrating existing software applications is a must although it is recognised that it represents as well a daunting task. This complexity is due to larger diversities of hardware, middleware, language, interfaces, data storage and lack of accepted standards, creating a heterogeneous environment. Furthermore, applications were in many cases not designed to interoperate with other applications [1].

Our project aims to provide an integration applications model for a public organisation which is the Norwegian statistic agency (SSB).

This governmental organisation provides statistical data for citizens, government bodies and industrials. By collecting, processing, analysing and disseminating statistics, SSB contributes to a more informed public debate by ensuring that economic and social policy management are based on the best possible factual basis. The Norwegian Statistic agency (SBB) is driving by the ambition to be leader in data acquisition and statistic processing in the community of European statistic agencies. In order to achieve this goal and to increase work efficiency between all divisions of the agency and other public or private organisations, the IT department has started an ambitious project aiming to delineate a global IT infrastructure integrating several information systems. The specified architecture is intended to facilitate in the one hand the integration of their business information systems and in the other hand to align the IT infrastructure with the business processes.

At SSB, there are two different information systems *Kostra* and *Idun*. These systems support data acquisition processes and encompasses functionality to process data.

However each information system is intended for different type of users such as citizens, companies. However, analysis shows that those systems have a great number of common functionalities.

Kostra dedicated to municipalities, is an off-line reporting system mainly linking the central and local government administration. It supports co-ordinated set of business processes related for i.e. to communication of key statistics from municipalities to SSB and others interested

administration bodies. One goal is to collect economic data about use of resources, production of services for each municipality. Comparison of results will help Norwegian ministry to define the required budget for each municipality.

Typical data acquisition process encompasses the following business routines: methodical design of questionnaires for data collection, data registration, control and auditing.

Idun is an internet based reporting system gathering statistics and key statistics from the private businesses to the central administration. The system provides a high level of real time interaction/communication between the administration body and the Industry. For example, users get immediate relevant feedbacks after reporting some data.

Kostra and *Idun* have been independently developed by SSB. Both systems are not connected to each other and do not share any database.

The figures 1 and 2 represent the architecture of the *Kostra* and *Idun* systems.

Kostra consists of three layers: data acquisition by using specific applications such for example fb filling forms generated by a special module called “form generator”. The second layer encompasses applications and their interfaces for data processing such as “mining” or “auditing”. The last level corresponds to storage of structured or unstructured of various data from statistic to emails.

Idun system is using more recent technologies such as java or internet technologies and is rather a Webportal. Acquisition of data process is simpler and more flexible than in Kostra application.

Today it is well recognized that running and maintaining two different information systems having some overlapping functions and some similar underlying business processes such as data acquisition, are quite consuming in terms of resources and efforts.

Additionally, the current solution requires from users to enter the same data each time they have to use different systems.

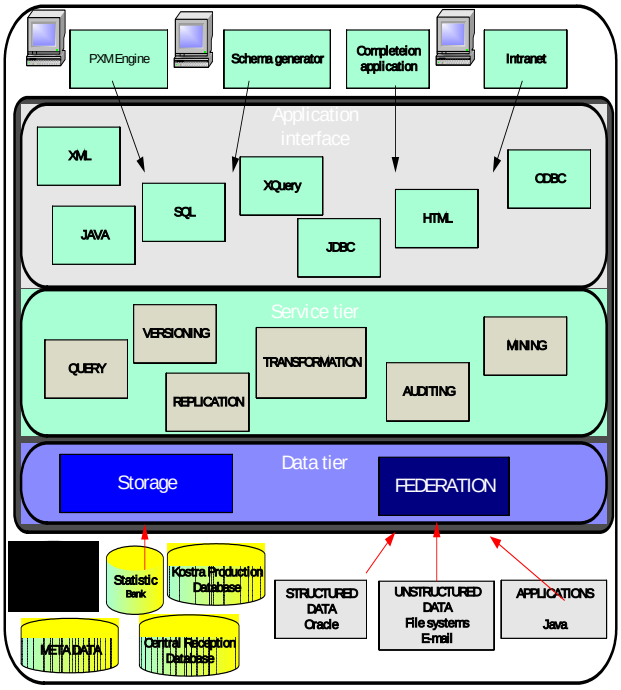

Figure 1: Kostra Architecture

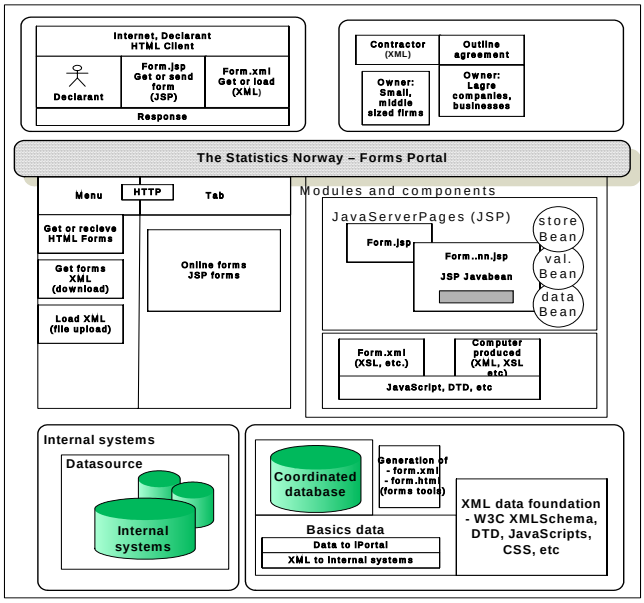

Figure 2: Idun architecture

Our project aims to investigating and analysing different approaches and methodologies in order to provide a common reference model integrating *Idun* and *Kostra* systems. Of course, the model should not only reflect that applications integration is solely technological in focus, but significant social/organizational issues involved should be highlighted.

The next sections outline the requirements and issues and emerging technologies while delineating a common reference model integrating both architectures and part of the related business processes

2 Requirements & Challenges for systems integration

Integration of enterprise applications with each others and with existing or legacy business applications needs standardized integration architecture in order to achieve better flexibility while implementing new business processes across organisation's division and information systems [2].

By integrating information systems, it is meant to establish communication between them. The task is quite daunting due to several challenges. One of them is related to the new integration dimension that is more and more adopted by organisations. Communication should be enabled between business and information technology and transforms IT from a technology provider to a business enabler [3]. In testimony of the difficulty of this challenge, the last few years have seen a large number of papers mostly from practioners investigating several new approaches and new technologies in order to achieve the desired level of integration [4, 5].

In the mid-90, commercial integration package were intensively used in an attempt to build large, cross business process. However the growing complexity due to the increasing number of endpoints has showed the limitations of such approaches. Furthermore the early systems integration was tied directly to low-level API's at the endpoints by using specific adapters. However the lack of standards required a high number of adapters to be co-located with the target system, meaning that each time the endpoint changed, interface had to be redefined [6].

Today the trend is to view application integration at high level of abstraction or more through business processes. Driven by the above the migration of legacy systems toward new network-centric operating framework and their integration with other back end applications using WEB technologies have become a very effective strategy for many organisations to maintain their competitiveness [7].

Technologies allowing access and enterprise information systems integration with the World Wide Web are based on the following approaches such as Common Gateway interface (CGI), service registration languages (UDDI, WSL), Web service (WSFL).

Web services are considered the most flexible medium for cross platform communication in order to realise dynamic e-business by bridging the gap between Web browser, existing information systems and legacy databases [8].

Web services is XML based technologies for sending and receiving messages, describing and retrieving services. Based on open standards to distribute interfaces and documents by messages, Web services offers extensibility to different service attributes like security, reliability and transactions, including that Web Services supports composite applications. Today Web services are widespread used, due to its simplicity to learn it and to use it. Additionally, Web Services provide tight bondages to business processes. However the coupling between the interfaces and the technical implementation is so loose that cooperation with different partners with different software solutions is simpler than using for example client/server solutions [9].

Today most IT organizations are looking at the adoption of Service-Oriented Architecture (SOA), moving away from application-centric development processes to a new methodology that offers advances in software reuse, flexibility, and connectivity to customers, partners, and suppliers [10].

SOA is not really new, it has been around more than 20 years but the Web Service generalisation has opened new horizons and new integration possibilities. An SOA is considered one of the most cost-effective and efficient ways of integrating different information systems. The use of an SOA allows organizations to continue to use existing systems and applications, lower transaction costs and optimize business processes control and transparency [8].

Defined on open standards, and with most technology vendors and partners lining up to back the architecture, SOA adoption is extending quickly across the business landscape [2], [11]. Indeed, there is a rising focus on adopting SOA for public administration systems integration [12]. For example, the Ministry of Science, Technology and Development in Denmark have made a report [12] stating expressly that nowadays in order to increase efficiency of a digital administration, it is vital that information systems in public sector should cooperate in a way that data can be used across administration departments, the country and that citizens, enterprises and executive officers do not have to report and control the same data twice. This requires a common set of data definitions and that security and users are treated equally. Gartner Consulting [11] suggests that the use of service oriented architecture is the best strategy to achieve a shared public architecture. However it remains the following questions:

- What and how is the strategy towards existing systems?
- How to realize the need for a service oriented architecture to concrete instructions which can be used for system contractors?

3 Integration Reference model

3.1 Integration process based on SOA

How the integration process should take? The most natural approach is to independently analyse both systems, identify differences by for example understanding how they have been developed, what are the used technologies. Requirement specification and analysis of the "new" system should be determined. Then, integration requirements should be formulated. It is as well important to understand the implication for the users of the "new" system how they adapt to the changes.

One way to see integration of both systems Kostra and Idun, is to begin with aligning the business processes. As mentioned earlier, both systems have common business processes, examples include: "process for developing a new questionnaire", "process of publishing the statistics" or "data acquisition process". Therefore, the first phase doesn't represent a major challenge in this integration case.

The methodology adopted is as follow:

1. Identify business processes involved for each system
2. Identify requirements for each process and for each system
3. determine differences/similarities in requirements
4. align the requirements
5. implement the requirements to the business processes
6. implement the business processes

The used approach was based on several research methodologies. Qualitative data were collected through numerous interviews with various users and stakeholders. We have as well developed web surveys that were sent to users in order to get consequent quantitative. And finally in order to have a more comprehensive and complete understanding of the requirements, documentations, reports and notes have been used.

SOA should satisfy the requirements that have been specified while analysing both *Kostra* and *Idun* architecture and the related business processes. They are outlined as follow:

- *Leveraging existing assets*: Business service is build as an aggregation of existing components that are working quite well in both applications. The data flowing between the components constituting the service should be hidden to the outside world.

- *Reduced cost*: maintenance of both systems should be considerably reduced and furthermore addition of a new requirement will not generate a dramatically cost increase while implementing the related new service. A services library will allow certain flexibility to the overall IT architecture.

- *Infrastructure Commoditization*: infrastructure development and deployment are more consistent across *Kostra* and *Idun*. Existing components or newly developed are better consolidated within the well defined SOA framework.

- *Continuous business improvement*: SOA should provide a clear representation of the process flows with a good control for the users to monitor while the components composing a service can be reorganized.

- *Scalability*: represents an important requirement to satisfy, since *Kostra* and *Idun* are in the near future subject to provide different type of multimedia information such pictures, sounds and video via the same platform.

In summary the architecture model should provide support for interoperability, flexibility, scalability, security and openness.

The global solution is definitely heading towards portals with a great deal of standardisation concerning the following elements:

- Methods to describe services and data

- Models of data to be exchanged

- Business processes

- Standardized interfaces

- technical protocols for transmission

- principles for building systems

SOA constitutes a very good model for data processing distribution over the IT infrastructure. In our context, we describe services as being models, data and functions and as a group of standards or applications.

While defining services, we have faced some challenges that are described in the next part.

3.2 Keys Challenges to implementing SOA

The most common challenges involve build- deployment and run time issues. Most of the business services are

designed to perform a business level function that can be reused across intra /inter organisational level. Therefore it is vital to have a specific mechanism providing guideline on how and when services are build without pointless duplications of the services and to guarantee that services are meeting the interoperability requirement. Reuse and elimination of service duplications are being major advantages of SOA.

Once a service is published to the SOA, users of that service come to depend on it as a reliable IT asset. It is crucial to set up a specific process for "provisioning" services to SOA, encompassing checkpoints to make sure in one hand that services are conformed to the IT and the business policy and in other hand that the metadata about services are of high quality.

At SSB, Business services are constituted with several underlying business and IT services such as servers, legacy database. A service catalogue is containing the description of the interdependencies of those services with the higher level business services.

Once services will be build and deployed, the next challenges [3] are related to the services management:

- *Business service security*: It is expected that more web service will be published to a registry. Thus authentication and authorization of services not well—know within an environment can become quite critical to any enterprise-wide SOA

- *Service level compliance*: Business services are composed of different web services, which depend on other web services. Some inconsistencies can be a hindrance.

- *Business service lifecycle management*: a highly collaborative lifecycle is needed. Different stakeholders such business people, customers, clients, users, developers and operators need to have the same information available however it should be within their own context. This information is represented under a model that can be easily updated by any of these constituents as events occur (business, technical, etc.). Updates will spread actions taken by others within the service delivery chain to effectively support changes done to the business service.

The following presents the global integration architecture model encompassing applications, components and databases of both systems. There are three layers and most of the services are implemented at the component-tier level.

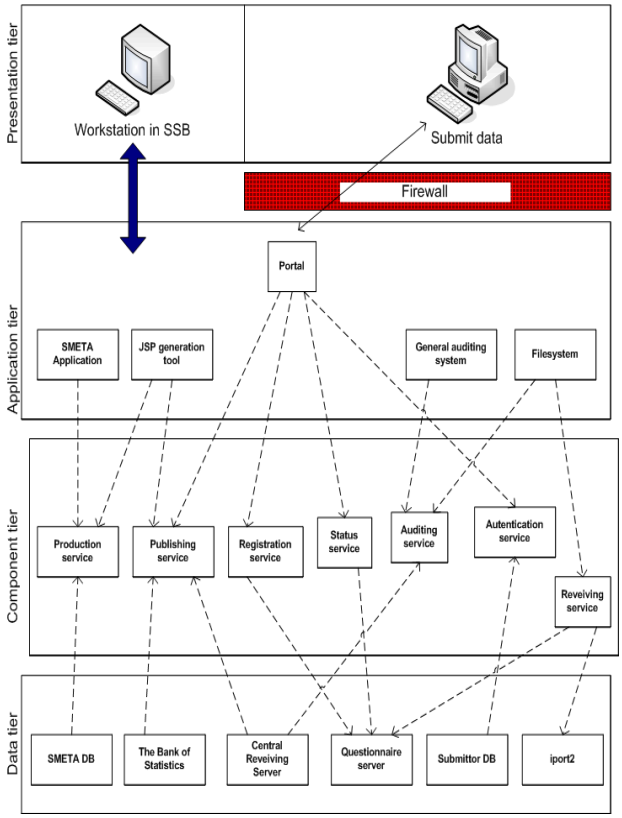

Figure 3: Global Integration model

While specifying the integration architecture model, we had to keep in mind critical success factors that could facilitate decisions to move toward SOA such for i.e.

- Choices about architecture have been based on management and business strategies and that finally the executive management had to approve it before starting any real implementation.

- The reference model should include the various perspectives of the users and the business processes and therefore has to be discussed across the SSB agency.

- Objectives and advantages by defining and complying the shared IT architecture has to be clearly documented and described.

- Clear description on the process on integrating new business requirements in term of new services

- Strategy elaboration for IT architecture maintenance and evolvement over time.

The model is tested currently against user requirements and is being in the process of validation.

4 Conclusion

The papers have outlined some requirements and some potential issues encountered while a public administration have decided to integrate several enterprise information systems. The need for such integration is driven by the concern of cut reduction while maintaining the IT infrastructure across the whole organisations. The model based on SOA technologies have been specified while keeping in mind that business processes integration should be as well taken in account.

Social and organisational aspects should be as well taken in account and will represent an amount of non neglected effort since the integration success will depend heavily on the acceptance of the global model.

The project is still ongoing, after the first phase of evaluating the overall model, and with a special focus on security issues, we intend to analyse further the impact of such model in term of cost reduction and to determine if it is really cost effective for SBB to move their whole IT infrastructure to SOA model.

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