From E-Processes to E-Networks: an E-Service-oriented approach

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Abstract

Looking at the recent history of information systems, two complementary trends seem to emerge. On the one side, systems become more modular. The shift is from tight integration to loosely coupled components. On the other side, the distance between business models and information technology (IT) is shortening. Aggressive business models impose new requirements on IT. At the same time, operational capabilities made available by IT drive the definition of new business models. Web services are the most noticeable outcome of the first trend. E-services play a similar role for the second trend. In this paper, we concentrate on e-services and their relationships with the type of business processes used by e-businesses. We refer to this type of processes as e-processes.

We first introduce e-services, and outline the interconnections with web services. Focusing on the composition aspects of e-processes and e-services, we then discuss potential and requirements of process-level cooperation for composite e-service solutions. We refer to these composite solutions as e-networks. The discussion is based on our work on the DySCo (Dynamic e-Service Composer) framework for e-network management. A brief description of the framework and the associated platform is included, together with an analysis of some of the issues related to service level agreements (SLAs) in e-networks.

1.The e-service vision

Until recently, the Internet was about the creation of e-commerce systems, and it was dominated by web sites and storefronts. We have now entered the next Internet evolution: the proliferation of e-services [13]. E-services are modular, nimble, units of service made available from a business to other businesses and to consumers. Almost any business asset can be turned into an e-service and offered efficiently via the Internet.

A definition: *an **e-service** is any asset that is made available via the Internet to drive new revenue streams or create new efficiencies.*

Chapter 1 of the Internet was about businesses being wired to their employees, customers and partners; key business processes being linked to the Internet, and a critical mass of consumers coming online. Businesses were learning how to turn a new technology into a new business resource. Now, the Internet is ready for its next evolution. It is no longer about businesses looking at the web as a technology. The Internet has been absorbed into the core business infrastructure, and businesses can capitalise on this new asset.

Chapter 2 of the Internet is about the mass proliferation of e-services. E-services come in the form of modular units, which can be combined and recombined to solve business problems and to help businesses to overcome the limitations of a static business infrastructure. Successful companies will be those capable of turning their business assets into services and deliver them via the Internet.

2.E-services and web services

Since the e-service vision was proposed by Hewlett-Packard two years ago, virtually all the major players in the IT industry have aligned behind it. A number of different initiatives have emerged, all paving the way towards the full realisation of the e-service world. First of all, e-services mean openness; and openness means common standards. XML is a clear example of the impact that standards can have on open systems. Layered on top of XML, a number of standardisation efforts are building the foundation for automated business interaction. Platform-level initiatives like SOAP [1], WSDL [3], and WSFL [6]

complement initiatives like BPMI [2], ebXML [4], and RosettaNet [10] at the level of business processes. UDDI is an example of the way the dynamic formation of business relationships advocated for e-services can be supported in practice.

The changes advocated by e-services go beyond technology into the very structure of businesses. In chapter one of the Internet companies had to reengineer their internal processes in order to sustain web-based channels to customers. Similar if not deeper changes are required to businesses in order to take advantage of the opportunities available in chapter two. Technology is mainly instrumental to most of these changes, but it certainly represents an important catalyst. In particular, flexible IT platforms enable flexible business solutions. Web services represent an important step in this direction.

Web services represent an IBM-led initiative aimed at standards for modular and open applications. The definition for web services given by the IBM web services architecture team is *"… self-contained, modular applications that can be described, published, located, and invoked over a network, generally, the Web"* [5]. WSDL and WSFL are among the outcomes of the web service initiative. The requirements described in the e-service model for business-level services find a clear mapping on the application-level model proposed for web services.

3.E-services and e-processes

In chapter one of the Internet, the characterisation of an e-business was given in terms of the capability of a company to interact electronically with its customers. Electronic interaction meant browser-based interaction. The Internet was used as an additional channel to customers. New front-end solutions were built for internal business processes, but the back-end infrastructure of the company was left substantially unchanged. Market forces have already decided the inappropriateness of this type of business model for a number of individual cases. Learning from the (very expensive) experiments made by a number of companies, we propose a model for e-businesses based on the separation between standard processes and e-processes [11, 14].

The successful operation of a business substantially derives from the synergy between all the processes in the company ecosystem. A distinction between internal and external processes could lead to a definition of e-processes as the external processes involving the Internet [12]. Wide enough to accommodate most of the business architectures emerged in the past, we believe that such a definition fails to recognise the internal impact of electronic interaction in general, and of the Internet in particular.

A definition: *an **e-process** is any business process sustaining the operational aspects of an Internet-centred business model.*

The blur in the distinction between e-processes and standard processes reflects the pervasiveness of Internet-centred business models into the structure of a company. The entire company has to align behind new e-business models, and this is the principle that we try to capture with the definition proposed for e-processes. Far from suggesting that every process in an e-business is an e-process, our aim is to stimulate a more careful analysis of business processes and their adequacy with respect to the needs and opportunities of the Internet. The focus is on the structure and content of processes rather that the type of technology involved.

E-services focus on the way in which the value generated by a company can be offered to other businesses and customers. On the supply side, e-services propose a common approach to aspects like description, discovery, and negotiation of the products generated by an e-business. The e-service offer of an e-business emerges from the customer interaction elements of the e-processes implemented by the company. On the demand side, e-services offer a new way of acquiring business resources and capabilities. E-processes can exploit the potential of a supply chain based on e-services.

4.E-networks

Fundamental value advocated for e-services is the capability for them to be composed, in order to create new e-services and solutions. In extreme scenarios, e-services could spontaneously aggregate in order to solve specific problems. A classic example is the autonomous organisation of a trip; involving flight bookings, hotel reservations, car rentals, and so on. More business-centric scenarios picture e-services

composing with e-processes to support the operations of a specific company. The example of the trip can be reused. In this case, a travel agency needs to connect with a number of other companies in order to organise the trip. The travel agency triggers the formation of an e-network.

A definition: *an **e-network** is any set of e-services cooperating in accordance with the specifications coming from a set of cooperation processes.*

The composition logic for the parties involved in the e-network derives from the e-processes of company(s) that define the e-network. In the example, the cooperation processes linking airlines, hotels, car rental companies, and the travel agency would emerge from the cooperation requirements of the e-processes of the travel agency. The precise definition of the cooperation processes also depends on a negotiation process between the parties [9]. In simple cases, the e-network is star shaped. One company acts as a hub. In more complex cases, the e-network is structured as a graph. All the companies involved in the e-network interact directly in order to achieve the business goal established by the creators of the e-network itself. Whichever shape cooperation processes give to the interaction structure of the e-network, delegation of roles does not automatically imply delegation of responsibilities [11].

We propose that the relationship between the cooperation processes and the e-processes of the companies (e-service providers) involved in an e-network is central to the e-service world. Cooperation processes reflect the requirements coming from e-processes, but there is a clear distinction between these two entities. From a technical perspective, cooperation processes have very different requirements with respect to e-processes. For example, cooperation processes focus on business-to-business coordination and interaction. E-processes focus more on execution and internal coordination. Most important, e-processes are likely to be entirely run and managed within one organisation. Standard process management technology can be used. We propose that a cooperation process emerges from the aggregation and reconciliation of the local views that the parties have on the process itself. We do not envision centralisation as feasible in terms of execution platforms to support e-networks.

5.The DySCo framework

The DySCo (Dynamic e-Service Composer) framework has been developed in order to explore concepts like business-to-business cooperation, e-service aggregation, and dynamic re-configuration of business roles [8]. In the remaining part of this section, we first give an overview of the e-business model supported by DySCo. We then present the cooperation model and the development platform currently part of the DySCo framework.

5.1.E-business model

The cooperation processes targeted by the DySCo framework derive from a business scenario based on the dynamic nature of e-marketplaces. In particular, DySCo addresses the problem of having different companies playing different sets of roles in different instances of the same cooperation process. The objective is to reconcile the need for flexibility in business relationships with the need for stability and reusability of business processes. Reflecting into the technology a clear business requirement, the idea is to make change a stable element of a solution.

5.2.Cooperation model

In order to understand the cooperation model used in DySCo, it is first necessary to understand the resource model used in the framework. In DySCo, the concept of *Role* is used to represent a unit of business capability (unit of service) that will be required at execution time. The role abstracts from the operational characteristics of the entity that will actually play the role itself. An organization usually plays more than one role. To link the abstract concept of role within a process description with the execution environment of a process instance, the concept of role group is used. A *Role Group* captures the set of all the roles played by the same organization. Examples of roles are transport provider, quality tester, packaging provider, and customer. An example of role group could be buyer. If the buyer company takes care of transporting and quality testing the goods, the three roles in the role group could be customer, quality tester, and transport provider.

The cooperation model used in DySCo is based on three levels of abstraction: cooperative framework, cooperative process, and cooperative step. A *Cooperative Step* is an atomic unit of activity inside a

cooperative process. It can involve a single role, or it can require the coordination of two or more of roles. The actions performed by the roles within the step involve data exchange between specific roles, data sharing using a logical storage space available to all the roles in the step, and specific service-oriented activities. An example of a cooperative step is the transfer of the goods from the transport provider to the customer. A *Cooperative Process* is a process meant to orchestrate the execution of a specific aspect of the cooperation between a number of business partners. The elements of a process are mainly represented by cooperative steps required to specific set of roles. An example of a cooperative process is the payment of an invoice, which could involve roles like customer, seller, bank, and archive provider. A *Cooperative Framework* represents a set of interrelated cooperative processes. Examples of cooperative frameworks are the customer interaction framework, the order management framework, and the production support framework. In terms of communication model, messages are used within cooperative processes and cooperative steps. Events are used for inter-process communication.

The last fundamental aspect of the cooperation model in DySCo that we discuss revolves around the concept of projections. The *Projection* of a cooperative framework onto a role group embodies a view on the framework limited to roles in the role group. A company should be concerned only about the part of a cooperative framework related to the role group it is contracted to fulfil. The content of a projection captures the activities related to a given role group, plus the coordination required with other role groups. Projections can be used during the negotiation phase [9] in order to express the level of commitment required to a company. Projections are also used for the execution of the business processes contained in the cooperative framework. Central to DySCo is the capability to automatically generate projections.

5.3.DySCo platform

The DySCo platform is composed by a number of modules supporting the main phases in the lifecycle of the cooperation processes in an e-network. The main functional areas are design, projection, and enactment. The design environment is based on a graphical interface, and on predefined libraries of cooperative steps. RosettaNet PIPs are an example of such libraries. The projection module allows automatic analysis and partition of the process specification. Processes and projections are encoded in an XML-based language for process specification called XpML. The core of the execution platform is based on a commercial process management system HPPM from Hewlett-Packard. The rationale for this choice was to investigate the impact of cooperative processes on standard process management platforms. Specific modules complement the activity of the HPPM process engine. An alternative approach is described in [7].

6.SLAs in e-networks

The concept of service is central to e-networks; hence service level agreements (SLAs). General solutions for the issue of SLAs in e-networks are made particularly difficult by the potential complexity of its structure. In particular, we discus the problems of the decupling between buyer and user of a service, and dependency networks.

Using the example of the travel agency presented earlier on, the problem of decoupling between buyer and user of an e-service emerges in the relationship among all the participants in the e-network. For example, the travel agency acts as a buyer with respect to the airline. Still, the actual user of the service is the traveller. If a plane is late, which agreement (if any) or agreements have been broken? The problem of dependency between SLAs emerges. In terms of monitoring, should the travel agency wait for the complaint from the traveller? Wouldn't it be useful for the agency to be notified directly from the airline, so that it could proactively act on the new requirements of the traveller? The airline could inform directly the hotel about the late arrival of the customer on behalf of the travel agency. Should the travel agency be notified anyway? The complexity increases further when we consider services involving continuative activities. For example, an automatic answering machine service could be offered for the duration of the trip. The problems mentioned are particularly common for e-networks modelling a supply chain.

Far from having a comprehensive answer to the problem of SLAs, we propose that the explicit modelling and enforcement of the cooperation processes in an e-network provides a conceptual and technological basis for managing SLAs. Assumptions on the level of service and the control mechanisms put in place impact the cooperation processes between the parties. Different business models require different solutions for SLA management.

7.Conclusions

One of the fundamental values of e-services is to enable flexible business cooperation in the form of e-networks. Customer interaction management was the focus for first-generation e-businesses. E-network management is the focus for second-generation e-businesses. A close alignment between service models and enactment platforms is crucial in order to achieve effective business solutions.

We propose the concept of e-networks both as an aggregation model for service providers and a composition model for e-services. The role of cooperation processes is central to e-networks. Cooperation processes reflect the operational requirements of the parties involved in an e-network. Among other uses, we propose that cooperation processes could provide the basis for the definition and enforcement of SLAs in the context of e-service delivery.

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