Network-based business process management: a discussion on embedding business logic in communications networks

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Abstract. Advanced Business Process Management (BPM) tools enable the decomposition of previously integrated and often ill-defined processes into re-usable process modules. These process modules can subsequently be distributed on the Internet over a variety of many different actors, each with their own specialization and economies-of-scale. The economic benefits of process specialization can be huge. However, how should such actors in a business network find, select, and control, the best partner for what part of the business process, in such a way that the best result is achieved? This particular management challenge requires more advanced techniques and tools in the enabling communications networks. An approach has been developed to embed business logic into the communications networks in order to optimize the allocation of business resources from a network point of view. Initial experimental results have been encouraging while at the same time demonstrating the need for more robust techniques in a future of massively distributed business processes.

1 Evolution of business process management (BPM) architectures

The new BPM systems make it possible to define process logic as an applications program and run this on different 'organisational environments' (that is, different computer systems and application programs, and different human interactions in the process flows). This approach has particular attractions to business and technologists.
Processes can be properly defined in a runtime environment. Previous process modelling languages and tools often resulted in prescriptive recipes, were difficult, time-consuming and costly to implement. Now we can define and build small process modules, which can be templates in an organisational library, can be integrated within a complete process, plug-and-play in different environments, can be re-used, easily changed, and continually improved. Processes can be improved gradually: existing processes are viewed as black-boxes, so the BPM logic defines a certain expected behavior, or norm, of present computer systems and human beings. Deviations from the expected norm are reported to the process management console while the BPM

kernel event manager keeps track of all process events and flows. The behavior of processes can be governed by rule-engines so that process results can be changed very quickly and in a controlled way. Outsourcing of elements of business processes is made easy and manage-able as well as insourcing or service provisioning to business partners and others.

In this paper we argue that changes in BPM's, but above all that a technical integration of the BPM execution networks and environments, enable to reduce duplication in modularized business processes and their support systems, and therefore to run business processes more efficiently and with more flexibility. For example, client authentication and credit checking do not need to be caried twice in the mobile networks and in the banking transactions processing systems, so they can be moved from financial institutions to communication operators or vice-versa. The paper suggests therefore to go with the technical current and to move major elements of business process logic (such as authentication and credit checking) into communication nodes for more flexible and efficient execution. Client behavior and regulatory rules as well as other changes are anticipated. This “embedding” has an explicit link to BPS; for example, the network of actors that collectively execute a business process can be seen as a BPS. The changes proposed to this BPS and the anticipated changes in the business environment are clearly associated with fit/alignment.

2 From business process to business network

Once process logic can be abstracted from its runtime environment it is possible to divide process modules over a number of different actors - defined as organizational entities - that are connected together via a communications infrastructure (see Figure 1).

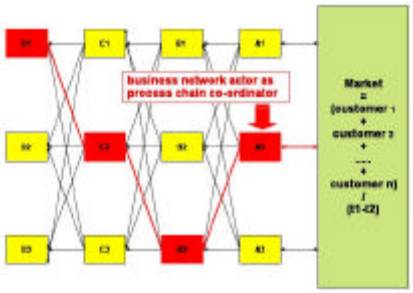

Fig. 1. According to the Modular Network Design of business interactions, each actor pledges process modules (defined as service elements and production elements) that can be linked together to satisfy a defined customer order [1].

Generally, one of the major stumbling blocks to swift process co-ordination is the distribution of business and process logic over actors at the outside of the network. The business problem of path finding and resource allocation is also very similar to

the issues surrounding naming/ addressing/ routing and capacity utilization in traditional communications network design and management. This paper endeavours a novel approach to embedding business logic into the control layers of communications networks.

3 The business Process impact of on-the-fly user-driven management of communication architectures

3.1. Transport and signalling networks

What has been little realized outside technical circles within communications equipment suppliers or communication service suppliers, is that historically voice and data flows have obeyed two underlying design principles:

a) the separation of transport and content (voice, data), although specific protocols and quality of service can regulate properties of the flows based on the application requirements;today this extends to the regulatory definition of backbone network operators and access network operators on one hand, and content providers on the other hand;

b) the separation of the transport networks from the control networks, which allow to set-up, manage, close and record the characteristics of connections or communication sessions; such control networks are often, for availability and security reasons physically separate from the transport networks, and execute control functions in a connection based or connection less way (SS7 and its equivalent for ATM networks in the first case, TCP in the second case, and SCTP as an intermediate solution) [1].

However, because obviously a control network is required to run and get revenue from a transport network, the ownership of the two was traditionally the same, and thus the suppliers were traditionally supplying integrated transport and control networks with management thereof.Operators could embed via application-specific programming of the upper SS7 stack layers (MTP-3), so called “intelligent network” or “computational intelligence “ functionality, such as call admission control, mobile agents, etc...(see e.g. [2]).

From the business process management point of view, the interest is not on the transport networks, but on the capabilities offered by the signalling/control networks. Admittedly, SS7, SCTP management exclusively by the operators gave them too much power in process management.

[1] The Stream Control Transmission protocol SCTP allows companies to exchange signalling information between switching systems using IP

3.2. Open signalling and adaptive networks

From a technical and research perspective, things have changed with standards such as the IEEE P1520 standards [3] for interfaces to communication networks, as well as so called adaptive networks. Both define interfaces such that a user, e.g. the economic agent initiating a transaction, can determine the controls applicable to his own communication needs (connection, session, flow), and choose between transport networks or their dynamic configurations

From the business process management point of view, it should be possible to extend the IEEE P1520 programmable interfaces to networks, with corresponding programming model and binding mechanisms, to business logics and not just tariffs or quality of service.

3.3. Other technical capabilities

1)Active networks: The approach described above is especially appropriate for services implemented statically, usually of transactional nature, based on servers. Active networks cater to cases when the packet processing is distributed and performed by the routers along the path (or tree) to a destination..

From the point of view of business process management, active networks enable the capability to identify, select and manage a set of economic agents involved in some of these processes, and to manage their links.

2)Hot billing and pre-paid services: Whereas traditionally subscription based fixed or mobile voice and data services rely on the delayed payment to the operator, via payment intermediaries, of the subscription, plus traffic (or bundles thereof), the need to check the outstanding balance prior and during a call against the credit balance of a pre-paid non-subscription customer, have shifted the ultimate solvency testing of the end user away from the payment intermediary over to the mobile operator and it's associated rating systems. Communications equipment providers have thus engineered interface and control systems which link directly the control network (which establishes the connection or session) with the customer care system (which checks on prepaid balances), all this in real time. What this means, is that from being traditionally trusted with the collection, aggregation, and solvency checks of the end user, the payment intermediary has only the collection task left. This turns the mobile operators into de facto deposit banks. As to the end user authentification, it is still split and essentially done twice in different ways, because of different processes for authentification on the communications service provisioning side of the operator (typically AAA servers), and for the payee authentification of the payment intermediary (typically a financial collection system with account identification and authentification).

From the point of view of business process management, hot billing illustrates alltogether the ability of non-payment agents to take on financial deposits

management, and even to extend this to other services, while managing the communication networks at the same time. Pre-paid services also illustrate the ability in mobile networks to activate and monitor service level agreements between parties in real time.

4 Embedding the business logics into the communication networks

4.1. A communications-enabled business architecture

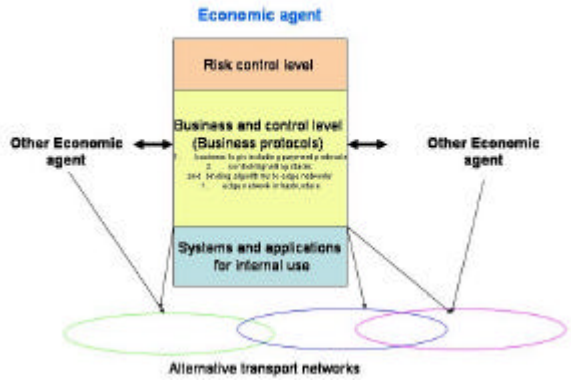

Fig. 2. Economic agent which interacts with other economic agents without general trade and payment intermediaries; this agent has imported into its communications and computer systems the network control functions, and merged these with his own business logic and processes (trade, payment, ERP, etc...)

Figure 2 shows how communication networks can provide a basic business architecture, with:

-a transport and capacity level, which is a technical agent chosen by the next level up;

-a business and control level at which an economic agent determines his business logic around the information, transport and services he needs, to select and control the transport level; this level interfaces with enterprise internal systems and information;

-a verification and risk control level, where business logic vets and activates the control level.

The technical nodes and business logics or protocols, as well as the interfaces supporting this are defined and discussed below.

4.2. Combination of network control logic with business logics/processes: the proposition

Based on the above, we propose here, and formulated here first in business terms, to embed the business logics and processes of each economic agent into the Business and control level of that Economic agent's control Node in the communications networks at the edges (see Figure 2). Said in other words, but now formulated from a communications point of view, each economic agent would install the interfaces and control software of communication networks, and combine these with his own business logics and processes on both the trade and payment sides.

This is of course only possible, in terms of genericity and availability of the corresponding software, for those elements of the network control, trade processes and payment processes, which are best practices in each case – This implies of course that only specialized trade or payment intermediaries which have proprietary interfaces and processes, will co-exist with the economic agents initiating transactions, as the bulk of standardized processes will bypass them.

Figure 2 also highlights that, whereas all economic agents have engineered a possible choice of transports to support their needs at transport level, some of these may be shared between economic agents who interact. This is obviously the case both for communication carriers, ISP's as well as transport/logistics networks. However, the economic agent who initiates the transaction or business may, from his own business and control level, retain some control over such transport level resources.

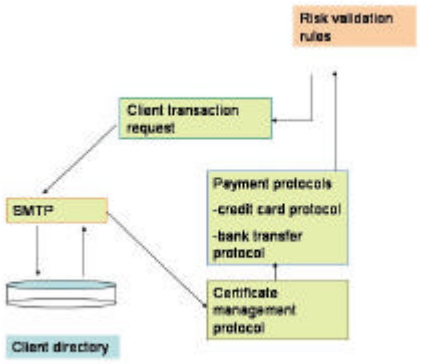

Fig. 3. Example of a business control protocol (parts in green, interacting with internal system in grey and risk control level in brown) enabling a payment process in combination with the SMTP network control. This Figure does not give the detailed flow of interactions between parties, but only aggregates thereof

Transport networks and the network controls for these are unaffected, except that binding interfaces or active network features resident at the economic agent's premises would interface with them. However, it is also possible, at the lower protocol level, to embed as well detailed transaction rules inside or alongside transport, network or application protocols; this is explained in detail in [9] and illustrated here in Figure 3.

5 BPM Management implications of embedding business logic inside the networks (propositions for discussion)

Embedding the business logic inside the networks, with on-the-fly identification, selection, and management imply several consequences:

Proposition 1: End users can manage some processes to their liking and for competitiveness, wheras in the past they had to use at best commodity service specifications.

Proposition 2: Potentially a major competition will take place between those operators/network owners offering end users business logic embedding mechanisms, and those who want to set and manage their deployment and operations.

Proposition 3: New type of real-time business processes and services will become possible (e.g. document and order process synchronization and linking with company archives), paving the way to real-time service level agreements and order fulfillment across several partners ([6]).

Proposition 4: Relying on Proposition 3, new type of on-the-fly reverse auctions will become possible (with multivariate attributes and constraints) (see [9]) and will be executed inside the network without relying on a third party.

Proposition 5: Whereas now the execution of a busines process across several parties is done relying on a neutral set of actors (network providers, data storage providers, ASP's, authentification centers, etc), the neutrality of which can sometimes been put in doubt, the proposed architecture would imply that groups of parties take control of their support nodes;this of course assumes changes to regulatory frameworks in some cases (e.g. granting communication licences to logistics or payment agents).

Proposition 6: New insurance, risk management and legal frameworks are needed to support embedding business logics inside the networks.

6 Future developments of integrated business and communications control logic

This paper investigates a novel way to embed business logic into the control layers of communications networks at the edges of the backbones. This is motivated e.g. by initial encouraging work at the Rotterdam School of Management in the field of logistics [9], which shows that process modularization requires formalized languages as well as much faster exchange of process messages in order to result in improved logistical flows. This necessitates more business logic driven directly from the communications networks.

Also, as process events can be linked very quickly, and economic agents may recompose themselves and/or their functions, the dynamic resource optimization across many economic agents will be increasingly complicated. We suggest that some genetic and bio-informatics algorithms are useful to realize the corresponding adaptation selection and recalculations of the business logic embedded at the communications level [11]. Finally, such an approach opens the way technically to

individualized communications tariffs and process costs or each agent, with settlement not only by operators or financial institutions [13].

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