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Service business processes for the next generation of services: a required step to achieve service convergence

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Abstract Users' needs are the driver of the next generation of telecom services. Founding the services on users' needs requires that various services cooperate together to meet specific needs. As a consequence, services should no more be developed as "silo" but with composable service enablers. This enabler paradigm raises the issues of the identification of the enablers and of the consistency of a service composed from various enablers. These issues must be addressed by considering the service from the user point of view: what is the added value for the user and through which perceived steps is this added value provided? Such service business processes are then a key tool to identify enablers and to ensure the coherence of composed service.

Keywords NGS · Service enabler · Business process · Service modeling

1 Introduction

The term Next Generation Networks (NGN) is well known. It designates a network architecture pattern where transport functions, control functions, and applications are separated into three independent layers with well-defined interfaces between them [10]. A great standardization work has been achieved since the end of the 1990s to specify the architecture of these layers, their functional entities, and interfaces [16]. Telecom manufacturers and operators have deeply invested in this standardization effort, particularly with the IP Multimedia Subsystem (IMS) that is an operational instance of the NGN control layer. This effort has led to the development of IMS products that are now ready to be deployed by operators [35].

Before investing in IMS, operators have to build a business plan and to calculate the return on investment. And what can be sold to clients is not technology but services. Because of the independence between the control layer and the application layer, the IMS does not bring intrinsically new services. But it might bring an environment that enables many new services, as explained for instance in [6, 11, 28] or [4]. [12] argues even that this IMS service environment would constitute a "killer environment", a "converged unified architecture that can seamlessly deliver a plethora of services to its end users using horizontal approaches to service delivery". But it describes neither what these potential services are nor how to ensure that they would answer to users' needs. The Next Generation Networks should offer a next generation of services. But what is this Next Generation of Services (NGS)? How can we define it and model it?

In this article, we will first investigate the service studies done in the telecom community to conclude that NGS should rely on a set of shared functions. Next, we will learn from the enterprise IT community that the identification of such shared functions cannot be done at the applicative level but through business processes. We will then survey the existing telecom business processes and propose new processes to cover the use of the services. Finally, we will conclude by showing how to build on NGS with these processes.

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2 The next generation of telecom services

2.1 NGN architecture

The promise of the NGN, as defined in the late 1990s, was to move from a vertical approach (where access, control, and services are closely tied) to a horizontal approach (where each layer provides re-usable elements to other layers). Specification work has been achieved at ITU-T (as described in [16]) to formalize the separation (e.g., through standard protocols or APIs) between a transport stratum and a service stratum. The IP Multimedia Subsystem (IMS) architecture is a realization of the NGN principles, relying on the SIP protocol for the session control.

This NGN technical architecture with two strata is defined at the ITU-T (Fig. 1). The NGN architecture may also be represented with three layers instead of two strata (this is, for instance, the case for the IMS). In this case, service control functions and transport control functions are grouped into a control layer. The separation is then between a transfer layer (with transfer functions), a control layer (with transport control functions and service control functions), and an application layer (with application functions).

The NGN community has mainly considered that specifying innovative services is not under its responsibility but under the responsibility of service providers that will use the NGN. [10] states for instance that "to face the explosion of user demand for new services, NGN should support the provision of all kinds of services". In other words, the requirement was not to support well-defined services but to be able to support undefined services. The NGN community has rather focused on how services could be enabled over the NGN (and in particular on the interface between the control layer and the application layer) than on defining a next generation of services and studying how services could meet users' needs. [6] illustrates this approach by specifying capabilities that the NGN provides to services and so by not starting from a requirement analysis of future services. The shortcoming of this approach is that the NGN community has implicitly reused the need analysis of the services they knew. The NGN is thus very well designed for the services from the 1990s, i.e., telephony services that mainly consist in modifying the basic call process.

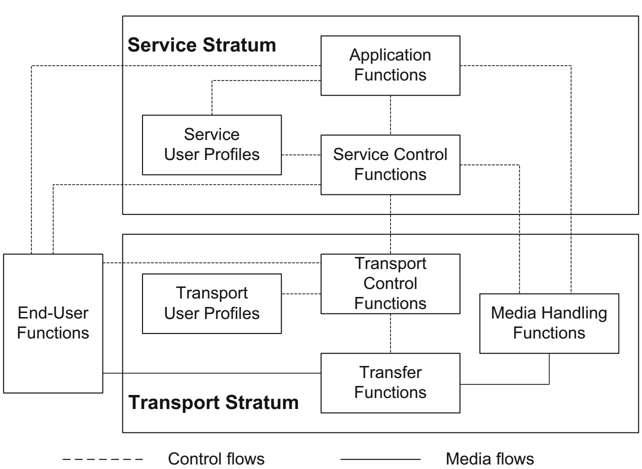

Fig. 1 NGN technical architecture as defined by the ITU-T

2.2 NGN and user-centric services

In the telecom community, some actors have developed a more prospective vision of a next generation of services, often designated with the term "convergence", as for instance in [1, 11, 28] or [17]. This vision unifies actually two kinds of convergence that should be distinguished: network convergence and service convergence.

Network convergence is the essence of the NGN architecture pattern; it aims to provide the same services through different access networks (Fig. 2). For example, the same telephony service could be used either through an ADSL wireline access network or through a 3G mobile access network. This network convergence has been metaphorically described as moving from a vertical architecture (where access network, network control, and service control are tightly coupled) to a layered architecture (where access network, network control, and service control lie on independent layers). The unified service control provides an interface to applications. This interface might be either a protocol (typically SIP) or an applicative interface (API), like OSA (Open Service Architecture)/Parlay.

Service convergence aims to provide a coherent service environment to the end-user, an environment where his different services are cooperating and where he is recognized as the same user across his various services (Fig. 3). For example, the same address book could be shared between a telephony service and an email service. Or the presence of an end-user on his desktop PC could be criteria for a call forwarding service. This service environment would evolve according to the service subscriptions. For

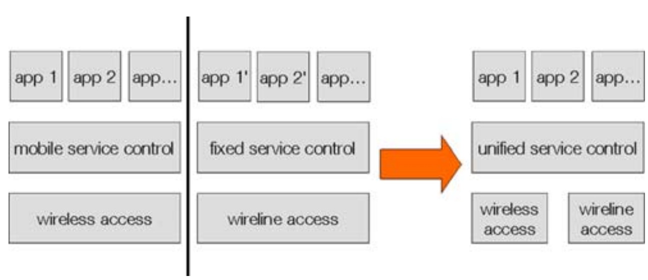

Fig. 2 The network convergence vision

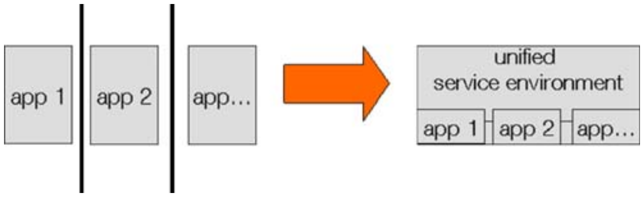

Fig. 3 The service convergence vision

example, if a new instant messaging service (IM) is provisioned, it would automatically cooperate with the address book to retrieve the IM buddy list. The end-user is here metaphorically at the center of a comprehensive environment of services. That is why this kind of services is also called user-centric services. This evolution toward user centricity is not specific to the telecom world but is part of the societal transformation from an industry society (driven by the mass market production) into a service society (driven by individual and specific needs) [9]. The same evolution is ongoing in various social fields like healthcare services, education services, or employment services; the trend everywhere is to enhance the "user experience" by making cooperating different entities to meet a unique user need as shown in [36]. [27] underlines even that "we witness the rise of "mass service," driven by improved coordination and a greater availability of information. Whereas mass production focused on the product, the new philosophy is customer-centric." In this Next Generation of Services, usage is indeed based on user needs, as stated for instance in [29].

This service convergence vision is technically conveyed by the term SDP (Service Delivery Platform). An SDP, as surveyed for instance in [20], is a horizontal platform for the service layer that especially aims to avoid service silos and to enable an attractive end-user experience for new services. In other words, an SDP should provide the unified service environment where various services enablers may cooperate to deliver services. The concept of SDP is not fully defined today and many forums (e.g., the TeleManagement Forum or TMF) are working to reach an agreement. SDP should rely on an Identity Management system, as introduced in [21], and on service building blocks.

When this service convergence vision is combined with the network convergence, we obtain a comprehensive service environment (service convergence) that can be accessed through various access networks (network convergence). But the service convergence may also be implemented without network convergence. That is the case with many Internet services. Service providers like Google or Yahoo do effectively offer a comprehensive service environment where services cooperate. For example, Google mail, Google agenda, and Google talk cooperate to form an environment of communication services. These innovative services have been achieved outside the NGN, on the Internet, and with web technologies and IT methods. Unlike the NGN community who has focused on the architectural concepts, the web community has mainly focused during the first decade of this century on the user experience and on meeting user's needs (building on the web technical innovations developed in the 1990s). Nevertheless, these Internet services were built "from scratch" and with a limited set of functionalities. Moreover, they do not rely on service control functions. The context is thus different for the services over the NGN. However, the need of cooperating services remains the same.

We can deduce from the previous considerations that the primary characteristic of NGS is to be able to cooperate with other services within a comprehensive service environment. In the telecom world, the implementation of this service convergence vision has been first driven by the Open Mobile Alliance (OMA). Mobile operators are concerned with the service convergence, because their business strategy is to offer services and not only connection. The OMA has achieved a first conceptual breakthrough by defining the enabler paradigm.

2.3 OMA enabler paradigm

The OMA groups Telecom and IT companies in order to standardize functional service building blocks, which are reusable at runtime by various services. This approach enables to build innovative and evolving services mostly independently of network considerations, as introduced in [6], and to ensure a better interoperability between devices, operators, and service providers. This approach enhances the ability of service providers to offer a consistent user experience (e.g., reuse of user information, service continuity…), by defining exactly the responsibility of each service building block and by providing a communication framework between these building blocks (this communication framework is one aspect of SPDs). Of course, this may also lead to cost savings, but this aspect is outside the scope of this paper. These service building blocks are called "Service Capabilities" by the 3GPP, "Service Support Capabilities" by the ITU-T, and "Service Enablers" by the OMA as surveyed in [5]. Service Enablers at the OMA [25] include for example data synchronization, device management, digital rights management, downloading, email notification, instant messaging, presence and mobile location, or multimedia messaging. According to the OMA, an enabler is defined as

- "A technology intended for use in the development, deployment or operation of a Service; defined in a specification, or group of specifications, published as a package by OMA." [24]
- "An enabler should specify one or more public interfaces. Examples of OMA enablers include Location or Device Management." [25]

These definitions highlight the *normative character* of an enabler. Ultimately, a component or a technology is an enabler because it has been *standardized* as an enabler. However, when enablers are defined separately without coordination, they may overlap together, i.e., similar functions may be present in different enablers. As a consequence, Service Provider may face difficulties for providing user-centric services: "integration and deployment of services is complicated and expensive; high implementation efforts for applications wanting to use several capabilities; there is no common integration of the different services from the point of view of the end-user (e.g., no common group management or user profile across multiple services)." [25]. An OMA enabler should thus contain only *intrinsic functions*. Intrinsic functions are defined as "those functions that are essential in fulfilling the intended task of the specified enabler. For example, the Position Calculation function is Intrinsic to Secure User Plane Location; Authentication is intrinsic to Single Sign On; Encryption is an intrinsic function of Digital Rights Management." [25]. This separation into intrinsic and non-intrinsic functions is a way of ensuring that different enablers will not offer the same function (e.g., an authentication function in each enabler). As specified in [25], "any requirements or features that are not intrinsic to an enabler should not be specified within the enabler's specification." However, the separation into intrinsic and non-intrinsic functions is not obvious but remains subjective, as admitted in [25]: "The classification of intrinsic and non-intrinsic is *subjective* and needs to be done on a per enabler basis".

The OMA has also specified principles of the SDPs with the OSE (OMA Service Environment), as detailed in [21] or [4]. The OSE provides a common architecture for the integration of enablers and service creation. It consists of enablers that run on an execution environment, and which are accessible to applications and other enablers through a policy enforcer.

This enabler paradigm is necessary for service convergence because it allows different services to share and reuse common data and functions. But it is not sufficient. Two questions remain unanswered:

- How can enablers be identified, which functions should form an enabler?
- How can services ensure the consistency of the user experience? In other words, how to ensure that a service composed with independent building blocks will be consistent for the user?[1]

[1] Significantly, after having defined many enablers, the OMA is now working in assembling several enablers in a converged service named CPM (Converged IP Messaging), focusing explicitly on the user experience.

Similar questions were raised in the field of enterprise information systems.

3 The enterprise IT lessons: a need of business processes

The evolution from standalone services to services that interact to fulfill a specific user need is also occurring within enterprises [26]. In order to adapt their information system (IS) to this service era, companies have to break the boundaries between their various applications and make them cooperate, as illustrated for instance in the e-commerce area in [22]. This evolution is enabled by the service-oriented architecture (SOA) paradigm: applications should no more be considered as standalone entities, but divided into services, i.e., discrete and independent units of business that perform a specific task and that are only accessible through an open and well-defined service interface. Service-oriented architecture is usually defined as "an application architecture within which all functions are defined as independent services with well defined invokable interfaces which can be called in defined sequences to form business processes" [7].

Companies have discovered that the main challenge to apply this SOA paradigm was not a technical challenge. Technically, products and technologies (SOAP, UDDI, ESB…) are available. Their deployment is not obvious, but can be technically mastered. The main issue is indeed to identify and define the services, these discrete and independent units of business. Which part of the business should be considered as services? Should the services be fine grained (one function per service) or coarse grained (many functions per service)? How to ensure independence between services? How to ensure that the service suit to the enterprise business and strategy? How to identify the services that are necessary to meet a specific need?

These questions highlight the necessity of a service architecture work for the functional definition of the services and the functional links between them. Within the IS field, the best practices for the design of such a service architecture are named urbanization or Enterprise Architecture (nuances between urbanization and Enterprise Architecture are out of the scope of this paper). These best practices define commonly four viewpoints to describe an IS architecture: a business view, a functional view, an applicative view, and a technical view, as explained for instance in [18] or [30] (see Fig. 4).

This notion of viewpoint is a typical notion of enterprise architecture, introduced for example in the IEEE standard 1471 [13], following OMG studies. According to IEEE 1471, a view is a representation of a whole system from the perspective of a related set of concerns from stakeholders of this system. Viewpoints are useful to separate different

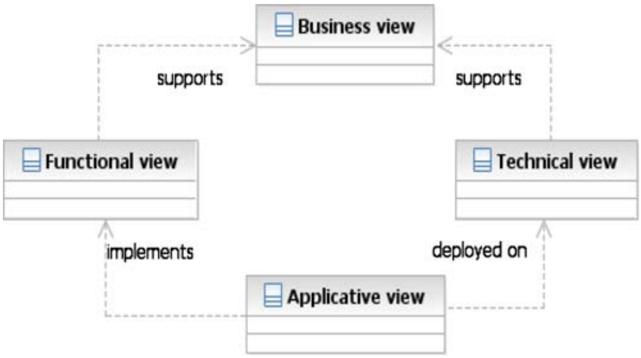

Fig. 4 Architecture views and their relationships

concerns into different views. With various viewpoints, we can avoid to treat a functional question (e.g., should email addresses and phone numbers be linked in our system?) from an applicative point of view (e.g., should we connect our LDAP phone directory to our Outlook email platform?). In the enterprise IT field, the business viewpoint shall contain the business process model of an enterprise, i.e., a model of all the activities realized by an enterprise. A business process is for instance defined in [23] as "A structured set of activities designed to accomplish a specific objective. A process takes one or more defined inputs and turns them into defined outputs."

We propose to apply these Enterprise Architecture best practices to telecom services and to conceive services following a top-down approach, from the business view to the applicative view. The business view represents indeed the needs of the users, without applicative constraints. This proposal completes the existing work on enablers and SDP. The questions we left unanswered in the previous section (on the identification of enablers and on the consistence of the user experience) can indeed not be answered at the applicative viewpoint (which is the viewpoint mainly considered at the OMA). The business viewpoint is crucial to enlighten these issues.

4 Service business processes for telecom services

4.1 From operation processes to service processes

In the telecom field, the TeleManagement Forum (TMF) has specified a whole framework of processes for fulfillment, assurance, and billing of services [15, 33, 34]. However, these standards focus on the *internal* activities of an enterprise for providing services, e.g., service design, service delivery, and service support [8, 14]. They do not enter in the core value of a service as seen by its user; the TMF does not specify how a service is used and what it is used for.

This question is yet crucial for designing Next Generation Services that answer to users' needs. As far as the usefulness of services is concerned, we shall not take into account the customer but only the user. The customer is defined in [33] as a person that buys products and services from the enterprise or receives free offers or services. The user or end-user is introduced in [34] concerning e-business: "a Subscriber role is responsible for concluding contracts for the service products subscribed to and for paying for these products; the End User role makes use of the products". The same person may be of course both subscriber and end-user, but the roles are still different.

We have thus to investigate the services as used by the end-user, and not only as designed or operated by the provider.

4.2 A business view for service usage

At telecom service providers and operators, the business view of services is under the responsibility of the marketing department. Marketers usually do not really formalize their business view, but make it unstructured (e.g., with slide-ware). But if each marketer conceives independent and incompatible business views, then the consistence between various services inside a coherent service environment will never be achieved at the applicative level. Consequently, a well-structured business view of the services is a required step to achieve service convergence.

In the broadest sense of the word, the term "service" has received several definitions in the literature, as surveyed in [2]. Academic studies on services have emphasized recently that:

- A service includes an exchange between two or more parties [19]
- "This exchange is co-generated by both parties" [9]
- Service systems comprise service providers and service clients *working together* [32]
- The actors of a service system (client, provider) "are connected by value propositions, and shared information" [31]

What are these value propositions and this shared information involved in service exchanges? [9] explains that it mainly consists in *tacit* knowledge, and not in codified knowledge. For example, people have in mind what they can expect of a service, i.e., the course of a service, its usefulness. When a service is standard and widely known, this tacit knowledge is widely shared and become a kind of social knowledge. Let us take the example of a hairdressing service, which is a relatively standardized service. When Alice goes to the hairdresser's, the hairdresser and Alice first share a common comprehension of the steps of the service: hair washing before haircutting (logical sequence); and Alice must have chosen which cut she wants before the haircut (precondition). Moreover, Alice and the hairdresser share a common comprehension of the main concepts of haircutting: she can ask a crew cut or a perm only because they both agree on what is a crew cut or a perm. This knowledge does not cover the sales of the service (each hairdresser packages and prices freely his service) but the definition of a hairdressing service, as seen from a user. We propose here to formalize a part of this common tacit knowledge as a service process. We do not formalize *how* a service is achieved by the provider, i.e., the set of activities from the provider to achieve the service result (by using deftly scissors, comb, hairbrush, and hair clippers). But we formalize *what is expected* from a service by its user.

In the previous example, we see the key elements to formalize. There is a logical sequence of the activities constituting the service, i.e., the set of exchanges between the user and the provider. In our hairdressing case, these activities would be choosing a haircut, hair washing, haircutting… These activities are accomplished by a role (the user or the hairdresser) that has the ability to do this task. These activities describe *which* action is accomplished by the roles involved in the service, but do not describe *how* it is accomplished. For example, choosing a haircut could be done either with the help of a computer program or with the help of a hairstylist.

These three elements can be typically represented like a business process, e.g., with UML: an activity diagram describing the task sequencing, the added value of each task and the link between these tasks, and the key concepts of the service (shown as objects). Figure 5 below represents such an activity diagram. Roles (shown as UML swim-lanes) are responsible for each activity. The key concepts produced, and used by each activity, are shown as UML objects. The "choosing a haircut" activity produces a description of the wished haircut (e.g., a crew cut) with the state "chosen" that indicates that the description has been chosen. This chosen haircut description is then used by the "haircutting" activity to produce the haircut. This represents that a chosen haircut description is a precondition for the "haircutting" process.

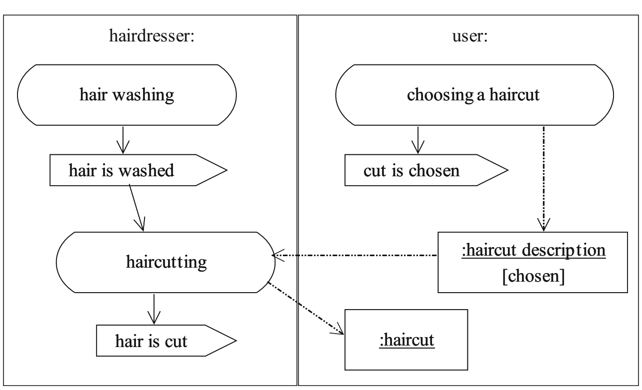

Fig. 5 Key concepts of a hairdressing service

4.3 Services business processes for telecom services

A telecom service is also a mass market product that is relatively standardized. It is not designed for a single user, but to meet the needs of millions of users. Everybody knows what sending an email or making a phone call means. This shared comprehension is sufficiently stable to be formalized with business processes. As introduced in the previous section, this formalization can be achieved with enterprise IT modeling concepts like activities, events, and information. A given sequence of events and activities executed by a caller and a callee through a phone constitutes what is named "phone call", i.e., the telephony service as seen by the user.

Moreover, a telecom service is often not the final goal of its user. When Alice goes to the hairdresser's, her final goal is to get her hair cut. When Alice calls Bob on the phone, her final goal is to talk with Bob, and not to make a phone call just for the fun of it. Telecom services are often a mean and not an end. In other words, they are often mediation services. In addition, many types of actors might be involved in a service: end-user, administrator, supervisor… Consequently, a telecom service business process cannot consider only as actors the user and the provider but should consider more precisely the actors between whom the service is rendered.

Many of these processes are linked together in the sense that the result of a given process is a precondition for another process, as a chosen haircut description is a precondition for the "haircutting process" in our previous example. Let us detail some of these processes and the links between them.

4.3.1 Phoning

The phoning service business process involves three actors: the caller, the telephony service provider, and the callee (Fig. 6).

- The caller first selects the phone number of the callee he wishes to call. This activity produces the number of the callee, which is a reachable address, i.e., an address that can be used to reach a callee. This information is produced with the state "selected", as the phone number has been selected by the caller.
- Then the caller requests a call with the callee. This activity requires that the callee has been chosen and that the terminal of the caller is registered by the telephony provider, i.e., that the caller has a way to access to the telephony service that is recognized by the service provider.
- The telephony provider delivers next the call and alerts the callee (for instance through a ringtone). This activity requires that the callee phone number is correct (i.e., correspond to a phone number that was effectively provided to a user) and that the terminal of the callee has been registered.

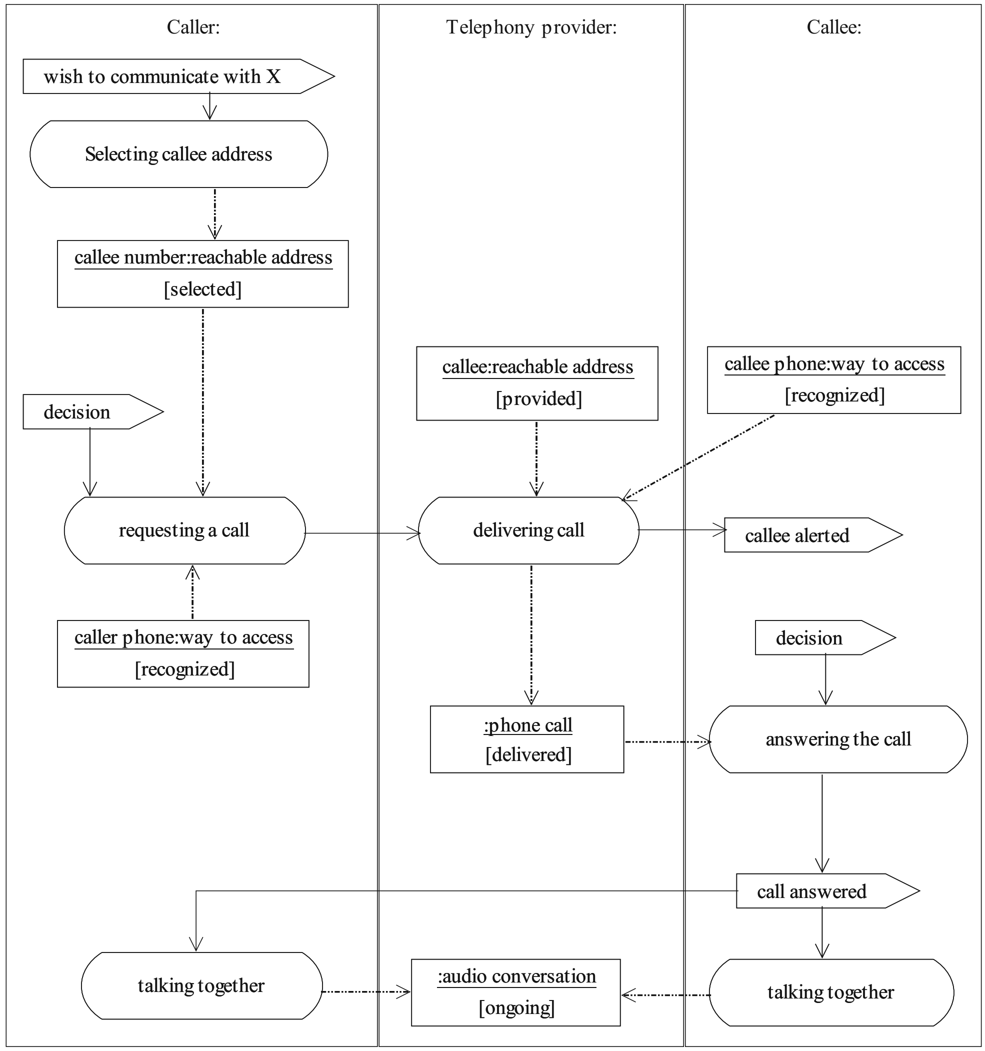

Fig. 6 "Phoning" service business process

- The callee answers the phone call (the other case—no answer—is not shown here).
- Finally, the caller and the callee talk together. It results in an audio conversation.

Some states required by the service process are not generated by activities from this process. For instance, the "recognized" state of the caller phone is not generated by any activity of the phoning service business process. This state is indeed generated by another process: the "signing in" process.

4.3.2 Signing in

Concerning the signing in, the identity of the user may be linked to an account (e.g., in a webmail service) or to the possession of a device (e.g., in a telephony service) (Fig. 7). In the first case, the user signs in by entering credentials; in the second case, he signs in just by starting his device. The service provider then assesses the identity of the user (through credentials or used device) and checks the rights granted to determine if the user may access to the service. This requires a network connection between the device and the service provider. A way to access to the service (e.g., the registration of the terminal) is then provided. Again, this process requires states that are generated outside: "device connected" and "access rights granted".

4.3.3 Signing up (subscribing to a service)

The TMF has extensively described these activities from a provider perspective in the telecom operation map eTOM [34]. The key activities concerning this process are briefly summarized in Fig. 8 below from a user perspective.

At the end of the process, the user receives a way to access to the subscribed service (either a physical way, like a device, or a logical way, like credentials). The provider provides access rights for this user and, as far as for communication services are concerned, provides a reachable address (e.g., a phone number).

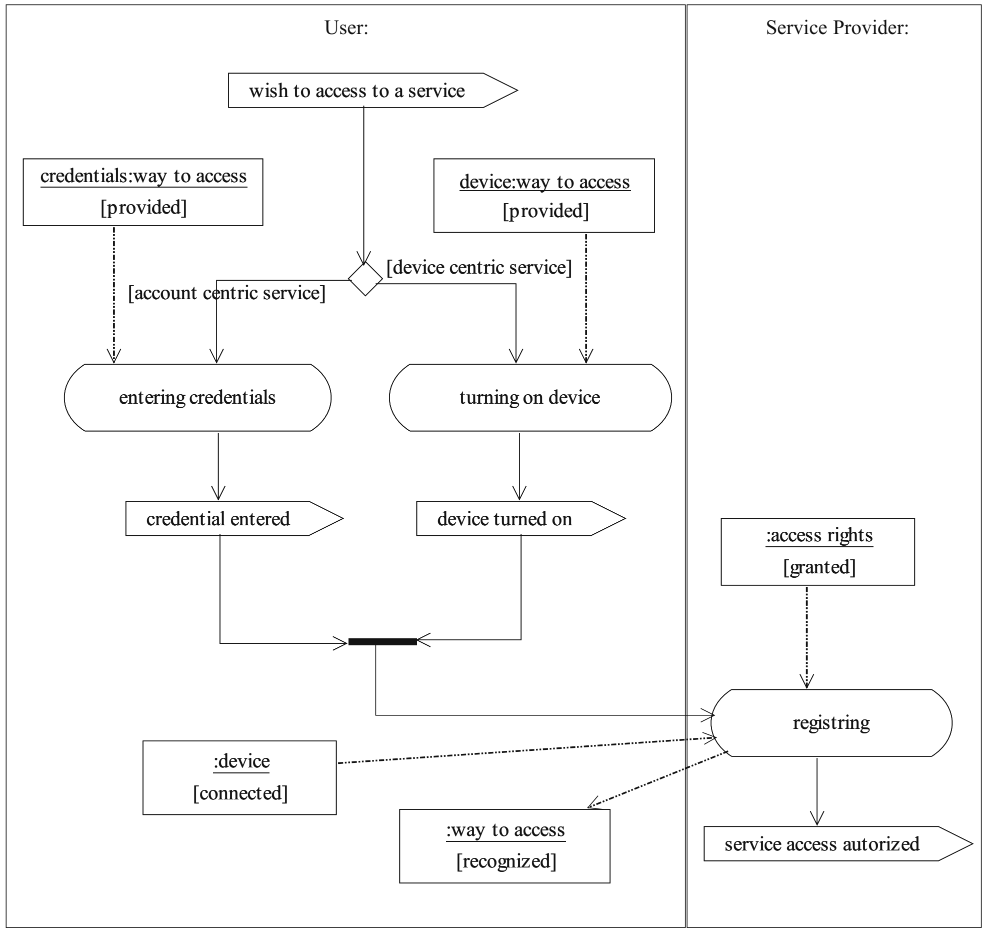

Fig. 7 “Signing in” service business process

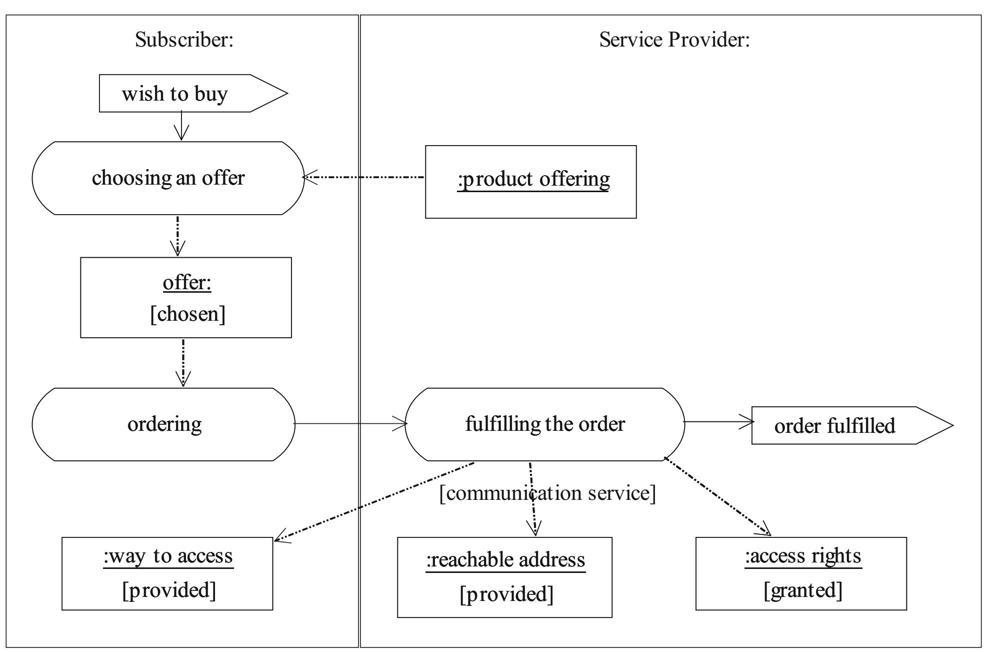

Fig. 8 “Buying a product” service business process

An advantage of this service business process modeling approach is that activities or processes may be simultaneously accomplished in some cases. For example, when a user plugs a PSTN phone, he is both connecting a device to a network and signing in by starting up a communication terminal. But with a soft-phone running on a desktop PC, the two processes are explicitly distinct. Another advantage is that the same process may apply to various situations, as long as these situations are seen similar by the end-user. For instance, the subscribing to a service process is the same whatever the service.

5 Perspectives

As explained in Section 2, the Next Generation of Services is primary characterized by the service convergence, i.e., the cooperation of various services (within a comprehensive service environment) to meet a specific user need. This implies to conceive service platforms no more as standalone “silo” but as a service environment (often named SDP for Service Delivery Platform) that aggregates service enablers. This paradigm raises issues that are summarized in the questions left unanswered at the end of Section 2:

- How to identify an enabler and to set its functional perimeter?
- How composed services can ensure a consistent user experience?

To answer them, we propose to use the best practices of the IT Enterprise Architecture where the design of a service starts with the business view. The first step is then to define business processes for telecom services. We introduce in this paper service process modeling as a way to formalize the services, as seen by their users, by specifying the tacit knowledge on the activities that are constitutive of these services. These processes are then a tool to identify the enablers and to check the consistence of the user experience.

Concerning the identification of enablers, we saw that enablers should contain only intrinsic functions. We pointed out the lack of objective criteria to determine which function is intrinsic or not. At a coarse grain level, we can now identify various domains to classify the enablers—and this point is very important in the definition of an enabler. An enabler domain can be derived from each provider role we saw at the business level. For example, a telephony domain is derived from the telephony provider role; a connectivity domain is derived from the connectivity provider role. A comprehensive business view induces thus a comprehensive list of domains. At a fine grain level, an enabler should implement the functions of one business process. In addition, key data identified in the service processes (e.g., device, audio conversation, terminal) enable to measure the coherence between the functions of enablers and this data model, as shown in [30].

Concerning the consistency of user experience, we saw that a service composed of independent enablers should be semantically consistent. A criterion to check this consistence is the alignment of the dynamical chaining of enablers with the chaining of service business processes. Business processes introduce indeed functional structural dependencies between enablers. For example, an enabler implementing the call delivery would depend from an enabler implanting the signing in, as the “phoning” process requires the result of the “signing in” process.

Our perspective is to specify in a comprehensive way the service business processes. This task is not endless because the key services offered by a telecom service provider are limited when considered from a user point of view (the added value for the user) and not from a commercial point of view (the product catalog). As far as the most common telecom services are concerned, the service business processes identified are the following:

- Connecting a device to a network
- Signing in
- Phoning
- Sending email and reading email
- Sharing personal context (presence, location) and accessing to this context
- Playing multimedia content (streaming and TV broadcasting)
- Sharing personal data (e.g., photo)
- Exchanging formal information with business partners (B2B)
- Signing up (subscribing to a service)

Most of the innovative services may be described as a new chaining of the basic functions involved in these service processes. For instance, the color ring back tone (CRBT) service (where the caller hears as ring back tone an audio selection that has been previously determined by the callee) is a chaining of functions supporting the “phoning” process and the “playing multimedia content” process. In this perspective, disruptive services are services that create a new service business process.

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