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E2E Service Delivery through User Mobile Session Management

Noëmie Simoni, Chunyang Yin, and Ken Chen

A revolution in network connectivity is leading us towards the Next Generation Network (NGN) era with novel types of services which are driven by two trends: user-centric, End-to-End (E2E) service delivery respecting Service Level Agreement (SLA) and mobility. The user-centric requirements need a new session management paradigm for providing ubiquitous services. This paradigm should take into account the changing environment (user, terminal, network and service mobility), that we consider as various types of mobility, in order to ensure continuous service delivery conforming to E2E and SLA specifications. This paper provides a solution to the above requirements. We first propose a horizontal service overlay architecture for the composition of ubiquitous services. A mobile service session management paradigm based on virtual communities is then proposed to resolve Quality of Service (QoS) dysfunction due to various types of mobility. Using a dynamic cross-layer binding of the managed mobility, the proposed user mobile session enables E2E service delivery in a continuous and automatic way. A realistic application scenario is provided.

Keywords: E2E Service Delivery, Mobile Session Management, Service Composition.

1 Introduction

Telecommunication providers are facing increasing difficulties in providing appropriate services to a specific user with his growing use of mobile devices (laptops, smartphones, etc.). Indeed, new mobility-friendly services are flourishing and people are getting more and more mobile in heterogeneous network environments.

This proliferation is expected by users as a logic consequence of the convergence of Internet (Web-based services) and Telecommunications (Telecom services). What's more, the emerging services on telecommunication networks should be more varied and richer in features. They should be offered competitively by third-part service operators, independently from the network operators.

Major existing "Telecom services" are based on E2E mode and require persistent resources. These services are supported by complex and monolithic functions with very little evolution possible. Therefore, profiling and customization of existing Telecom services are extremely difficult. Meanwhile, today's Telecom users expect more services, such as surfing the Internet, live TV and other multimedia services, on various devices (including mobiles), through various connection and providers, at all times and in all places, in a user-transparent manner. Various heterogeneities (contents, services, devices, network, etc.) make the realization of such services extremely difficult.

In NGN [1] context, heterogeneities occur not only on terminals, but also under other forms (user, network, service). In this paper, we refer them by unified vocabulary "mobility". We distinguish *spatial mobility* which includes user, terminal, network and service mobility from *temporal mobility* which is caused by drift of the E2E session due to spatial mobility.

We emphasize service mobility from the viewpoint of the NGS requirements, for which services are responsive to the SLA and the user's context. The ubiquitous service

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landscape is enriched by embedded systems and software, real-time interaction and omnipresent networking. The service mobility is then necessary to enable the replacement of a service from another service platform.

The challenge introduced by spatial mobility is to keep providing, in a continuous manner and with regard to user's QoS requirement, the desired service for mobile users, despite the heterogeneity of the device, access, networks and service platforms. The temporal mobility provides a vision of the drift of an E2E session (most often composed by several services) and the real-time coordination of all the spatial mobility.

Service Delivery Platform (SDP) [2], which addresses the service delivery issue, is within the scope of this paper. It aims to enable rapid development and deployment of the wanted converged services. It refers to a recently embraced architectural style applied to telecommunication infrastructures. SDPs typically provide a service control environment, a service creation environment, a service orchestration and execution environment, and abstractions for media control, presence/location, integration, and other low-level communication capabilities.

But is this kind of platform sufficient to response all the NGS requirements? Especially, can the existing system-centric solution provide solutions for various emerging ubiquitous services with user preferences? Can this kind of solution respond to the challenge of ensuring the E2E service delivery issue, with respect to user's preference and QoS requirements?

A new service management paradigm is needed to configure and maintain a growing network of revenue-generating services for a new generation of customers.

- First of all, this paradigm has to provide better support of pervasive converged NGN services.
- Second, the QoS requirement should be taken into account throughout the life cycle of user applications. Facing the changing environment, the service management should handle all the QoS mismatching due to mobility.
- Third, the user application delivery should be handled in an automatic and dynamic way, so that E2E service delivery can be supported and maintained in real-time.

This paper addresses these three issues. In Section 2 we present related works mainly on the service composition architecture and the notion of session which is the main conceptual concern of our propositions. In Section 3 we present our proposition which declines into horizontal service composition management, mobile service session management based on virtual communities to response different mobility, E2E continuous service delivery through mobile session binding and finally a functional map to present an overall vision of all our proposals. A complete scenario is then described to show the feasibility of our approach in Section 4. The conclusion and perspective are given in Section 5.

2 Related Works

2.1 The State of the Art

2.1.1 Service Architecture

Various motivations (complexity hiding, reuse, etc.) have inspired several trends in the service architectures: Web Services, Web 2.0/3.0, Service Oriented Architecture (SOA), Software as a Service (SaaS).

A Web Service is defined by the W3C [4] as *"a software system designed to support interoperable Machine to Machine interaction over a network"*. Web Services are usually provided just with Web APIs, interface between the service requester and service providers are provided by service brokers. Web Services are very important as they provide a lowest common denominator. The current success of Web Services leads to a popular idea that the Web Services paradigm can be adapted to the telecommunication networks for new services.

It is true that Web Services approach allows the creation of a user demanded service by sharing service components through the Web. This paradigm also has its limits: it is difficult to add or modify, dynamically, a service component. It follows basically the "Client-Server" paradigm, which is notsufficiently flexible.

Web 2.0 [5] is defined as *"the philosophy of mutually maximizing collective intelligence and added value for each participant by formalized and dynamic information sharing and creation"*. The Web-based applications such as many-to-many publishing (blogs, wikis, etc.) or social software provide service enhancement possibilities in a user-friendly manner. Communities of Interests (CoI) are grouped for knowledge sharing (e.g., Swicki), common topic discussion (e.g., Facebook for photographs) and social networking (e.g., Expedia for business travels). The sharing and the creation are actually limited to the content. Web 3.0 *"emphasizes on machine-facilitated understanding of information in order to provide a more productive and intuitive user experience"* [6]. Related to Web2.0, Web 3.0 [7] is expected to perform more personalization and vertical search facing the Data Web. Although both Web 2.0 and Web 3.0 support the sharing of User Generated Content (UGC) and User Generated Application (UGA), they cannot provide fully sharable services.

The widely accepted OASIS Reference Model for SOA [8] defines SOA as *"a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations"*. It supports the development of distributed software systems in terms of loosely coupled networked services. In SOA, networked resources are autonomous and accessible without knowing their underlying technologies. A key feature of SOA is that services are independent entities which can be invoked in a standard way. SOA reduces Total Cost of Ownership (TCO). However, though SOA offers a loose coupling, the composed service doesn't afford the access from different actors (user, controller or management) since it cannot be mutually used.

Web Service Ecosystem [9] is a proposition concerning the Service Delivery applying the SOA. It is a hosted environment in which participants expose their services using common Web technology such as Hypertext Transfer Protocol (HTTP), Extensible Markup Language (XML), Simple Object Access Protocol (SOAP) or Asynchronous JavaScript and XML (AJAX). It provides a number of service delivery components. This enables service providers to focus on their core functionality by outsourcing the service delivery to third parties. All the services are in the same form of component, which enables the Service Mediator to select the appropriate service components for meeting the requirement of the service broker. Services can thus be sharable although they always adopt the Client Server mode when deploying the user-demanded service.

Architecturally, SaaS [10] [11] is similar to other applications that follow the "service-oriented" concept. Like the Application Service Provider (ASP) or other on-demand applications, SaaS applications are in the group of managed or hosted software. In contrast to the ASP, applications based on the SaaS model are built from the outset in Web and optimized by the Internet. The SaaS model allows offloading the maintenance, operation and application hosting. Payment for consumption is a means to optimise cost.

In a few words, Web Services contribute to the simplification and reuse of service, but their architecture follows client-server model. Web 2.0 and Web 3.0 are aimed at sharing the content and applications in the form of service option. Finally, SaaS manages the components of ubiquitous service but its vertical architecture provides strong coupling. New service composition paradigms are needed to meet the requirements of the NGS.

The "user-centric" vision provides a way to do more in the organizational plan, i.e. to have an efficient deployment of the service components to obtain a user-friendly ambient network. The virtualization and ubiquity of the service are then necessary, together with the service components which are not only reusable, but, more importantly, sharable, in order to achieve dynamic provisioning.

2.1.2 Session

There are several types of session:

- *Open Systems Interconnection (OSI) session*, defines a set of point to point exchanges between interlocutors.
- *Web session*, designs an application level's connection.
- *Telecommunications Information Networking Architecture (TINA) session*, induces three types of session: access session, communication session and service session. The vision of the service session is interesting; what's more, TINA has a vertical vision of session and identifies the different intervening actors in the user-demanded service.
- *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN) session*, defines a multimedia multicast carrying data flow between senders and receivers.
- *Session Initiation Protocol (SIP) session*, provides a transparency of service redirection to another terminal by "SIP register" and the "Location Services Server". These components maintain all the possible terminals associated with a user and the permanent and provisional addresses of each terminal. The mobile access is better considered, but it follows a Client-Server mode.

In the above definitions, a session represents always the temporal connection concerning a service between a user and the related service provider. But, with NGS requirements and the effects of the different types of mobility, especially the service mobility and session mobility, we should have a mobile cross layer session.

2.2 Background of our Work

Our proposition (Section 3) is based on a common framework that we set by using some earlier works [12] [18]. We briefly introduce this framework here in order to provide a common semantic.

First, following the Meta model [12] of <Node, Link, Network> and the P2P (Peer to Peer) architecture, we adopt a reference model [18] (Figure 1) which is an abstract framework for presenting significant relationships among the existing network architectures and service level. The service level is reorganized as a service overlay network [21] and the service composition helps to identify the service components (nodes).

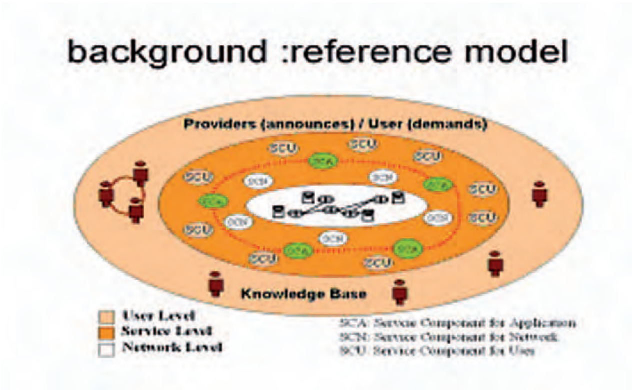

Figure 1: Reference Model.

Service composition design is most often considered at the technical level as the identification of mainly low-level services. In our study, inspired by SaaS, we spread the SOA concept throughout the three levels of our reference model. All the elements on the service level are regarded as reusable and sharable atomic components. Therefore, service components are represented as three independent types: Service Component for Application (SCA) at the service level, Service Component for Network (SCN), and Service Component for User (SCU) adaptation/personalization.

The user level is actually a virtual network of the Knowledge Base, which offers user-centric resource information associated with different types of mobility thanks to the User Community [22].

The expected global architecture should be open and interoperable. The trend of NGN enlarges network access possibilities and creates an interoperable context for heterogeneous systems. The different access possibilities are represented by all type of access networks that a user may face. Through a unified core network, the user can access the service overlay network which is composed of services components. Following this layered architecture (Figure 2), we have proposed three types of middleware to handle the demands:

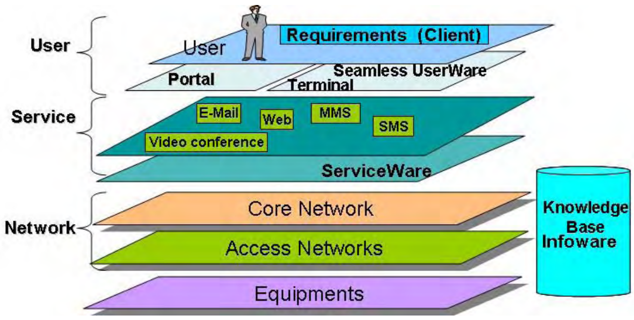

Figure 2: Global Architecture.

- **Serviceware** is in the service overlay layer to obtain an overlay service network including specific functionalities (services) and logical link between them. Serviceware is in charge of organizing service components in service networks. These service components are applicative resources of services (email service, Video Conference service, etc). In this way, providing and (re)routing, which are "networking techniques", become possible.
- In the *informational* dimension, **Infoware** is proposed as a knowledge base to cover all the necessary information in each level of visibility (user, terminal, Access Network, Core Network and Service). This infoware is designed to handle particularly user-related information ("user-centric") and QoS-related management information (QoS-aware) in order to achieve appropriate information inference for decision making. The core part of Infoware consists of a structured knowledge base for informational inference. It is responsible of gathering, organizing and managing information in a reactive and efficient way, following our layered architecture, together with QoS-related information, in order to have a dynamic service adaptation everywhere.
- The third part of this framework is a user-centric middleware section named "**Seamless Userware**" [13] for achieving personalization and transparency. This Seamless Userware is situated on the user's side. It keeps up-to-date the personalization and ambient resources information and uses them to interact with the network in order to maintain the continuity of the on-going service in a transparent and seamless way.

Our approach is based on this service delivery which in turn is based on the architecture in order to give a trans-layer E2E continuous service under heterogeneous and mobile contexts. This framework with its three middleware sections handles various networks and distributed service platforms and it solves interoperability problems seamlessly by exchanging personalization data, making service and context adaptation, and insuring the management of the overall service platform.

3 Propositions

Under NGN with its differing mobility and heterogeneity, users are primarily nomadic. Thus, there is a need to change from a "system-centric" paradigm to a "user-centric" paradigm. The latter is better suited to capture the users' need to be connected from any terminal easily at any time during its travel, to any network that he prefers and has access right. Our proposition aims to achieve personalized and QoS-aware E2E service delivery in this NGN context.

3.1 Service Management

Our proposition of service management is actually a horizontal service composition management (Section 3.1.1) supported by the overlay serviceware (Section 3.1.2).

3.1.1 Horizontal Service Composition Management

We previously (Section 2.2) analyzed different conceptions of service within the NGN context with the conclusion that the existing service composition techniques are not appropriate for the NGS.

We argue that, in the NGN context, a service should be defined as a generic Service Element (SE) with the following four important characteristics: virtualization, mutualization, interoperability and autonomic computing (self management).

Virtualization means that services should be offered transparently to end users, i.e. users can get access to a desired service in a continuous manner, even in the case of location change without worrying about which mechanism to choose for maintaining service continuity and the corresponding QoS. Virtualisation allows resource utilization optimisation by means of dynamic resource allocation according to the applications' context and its need which are captured and updated in real-time. Virtualisation also achieves resource protection by isolating simultaneous users of the same service from each another.

The service *mutualisation* provides not only the reusability and robust of a service, but also its shareability as a resource on a network and by the interaction among the resources (which are managed as a network for deployment and provisioning). This leads to a service composition done with small size interactive service elements (SE). This simplicity and independence between SEs provides viability and robustness of the system. The mutualisation of service is managed through a dynamic provisioning of service platform. The scalability will be ensured by the ubiquitous context.

The *interoperability* is defined as follows according to ISO/IEC 2382-01: *"The capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units"*. In our context of service composition, interoperability focuses on the cooperation possibility for service components with each other on the basis of functional structure schemes. Each component should work seamlessly with other components and should handle any real time demand. This means that the functional scheme of each service component should not be based on “client-server” type brokers. Instead, it should behave as a “Peer” with standardized interfaces.

Each service component should thus insure *autonomic computing* in order to make context adaptation and perform self-management of QoS.

A Service Component should also be commercially exploitable, i.e. it should have a commercial value for the providers (Service Component sellers) and the consumers (Service Component buyers).

In order to provide access to the service from anywhere, a dynamic service composition and adequate service deployment and architecture is desired. This service architecture should be horizontal in order to have loose coupling, distributed, multi-Service Providers and a single service logic for a user application. The interactions between service components should be loose, in order to allow service composition under business process constraints (ROI: Return of Investment; TTM: Time To Market).

In our system, (cf. model and architecture in Section 2.2), applications are supported by overlay network of service components (nodes) which are associated by logic links, translating the service logic (Figure 3).

Service components in the service overlay layer are managed (Figure 3, frame 1) according to their types (SCU, SCA, SCN) together with the virtual links, which forms the service logic between these service components. Since we adopted the approach of user-centricity, each user’s service demand is considered as a virtually single service (Figure 3, frame 2). In addition, as service components are “mutually reusable”, they can be instantiated in different global services/sessions. According to the chosen context (ambient and/or P2P network) and to our service composition reference model (Figure 1), the provider of a service component can exist at any level of visibility. Therefore, a global service session can be provided jointly by different service providers, possibly located in different levels.

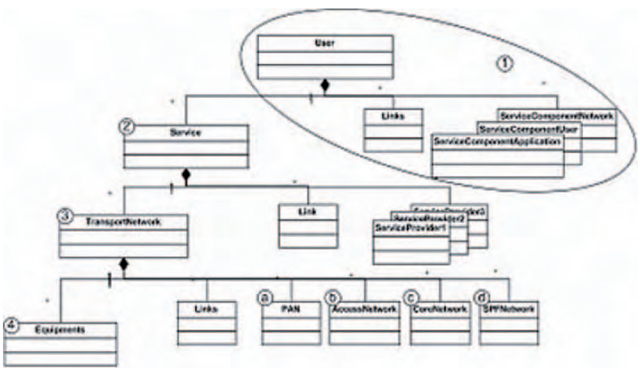

Figure 3: Architecture Model.

Service providers are linked together to form a Virtual Private Service Network (VPSN) [14], which is what we need for handling the overall service session which always resides on a transport network (Figure 3, frame 3) according to the user’s geographical location. This VPSN support the four types of mobility in the NGN (which we previously mentioned) within a single service session:

- User mobility, i.e. the capacity of a target user to move from one terminal to another, is supported by the Personal Access Network (PAN) node (Figure 3, frame a).
- Terminal mobility, i.e. the capacity of a given terminal to move from one access network to another, is supported by the AccessNetwork node (Figure 3-b).
- Network mobility, i.e. the fact that the access network itself is moving, can be supported jointly by AccessNetwork node (Figure 3-b) and CoreNetwork node (Figure 3-c) , and finally,
- Service mobility, i.e. the possibility to replace a service component by another (for example, a nearby service component which is more suitable than the current remote one). This type of mobility is supported by the mode of Service Provider Network (SPNetwork) (Figure 3-d).

Note that these four nodes (Figure 3-a to d) have self management capabilities which are supported by its own community. This point will be detailed in Section 3.2. The links between these nodes ensure that interactions between them cause the service delivery to be continuous all over the mobile session. The E2E service delivery can thus be realized by linking specific equipment (Figure 3-4) which will be illustrated by an example in Section 4.

3.1.2 Overlay Serviceware

Services are delivered through VPSN. We detail the “Overlay Serviceware” as follows (Figure 4).

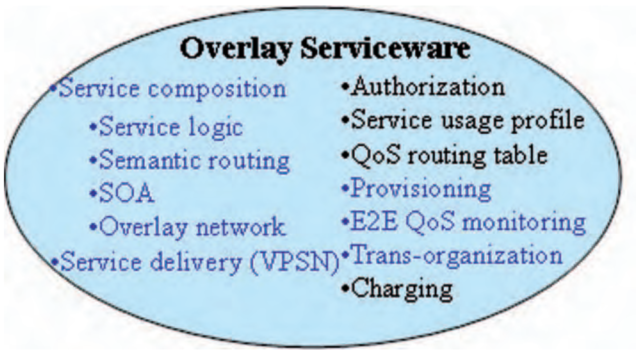

Figure 4: Overlay Serviceware.

- Service Composition.

This function realizes all the specifications previous mentioned. We integrate the SOA into the Service Composition in order to have generic, atomic and automatic service components. The service management autonomy is handled in two steps: 1) reacting to events in an automatic way (Service Composition), 2) chaining the designed components to a dynamic service management module (Semantic Routing).

■ E2E QoS management.

The QoS must be considered in all parts of the service composition and their maintenance. An E2E QoS requires consideration of not only the QoS aspects of a single component, but also the chaining of these components in order to construct a "network" to offer a global service. Therefore, the analogy of a network routing table is introduced and named "QoS routing table".

■ Service delivery (VPSN).

The service delivery concerns the management of service aggregation and is based on the QoS routing table. This table is maintained by the continuity function supported by community self-management in order to take into account differing mobilities. The dynamic construction of VPSN insures the continuity of a service session.

■ Charging.

This function permit us to chain up all the service components of different Service Providers (SPs) and offer the user global charging on the functionalities and a comprehensive consolidated bill.

3.2 Mobility Management Based on Service Session

For an end-user, a session always represents a point-to-point connection. In NGN, there is a need for an automatic, QoS-aware, transparent and dynamic handling of different types of mobility. Here we analyze this issue (Section 3.2.1) and provide a solution which is based on community self-management (Section 3.2.2).

3.2.1 QoS Dysfunctions

We choose to use the following four distinct QoS criteria, availability, reliability, capacity and delay, to express the characteristics of a service. We analyze the causes of the QoS dysfunction within the mobility context according to these four criteria:

■ Availability.

Besides the componential break down, the main causes we identified are as follows:

- *Timeout*: We take example of a service level component. For this component, a timeout can occur if the credit to use this service vanishes or if the authorization is no longer valid. Other causes of timeout include i) the need for an updated version, ii) a change of existing parameters.

- *Connectivity interrupt*: They are due to hardware or software failure. A hard failure indicates a fault in equipment such as servers, cables, terminals, handover failure, etc. A soft failure may be network congestion or fault/timeout in the protocols of communication.

Moreover, if we consider a transorganisational context, we probably have interruptions when the SP changes or after an update of the configuration due to location change.

■ Delay.

This is also due to terminal mobility or other mobility, which makes the response time longer than what is originally requested by the user in the SLA. Note that in the ubiquitous context, there are options to preserve the response time.

■ Capacity.

This is a lack of resources for treatment, it may occur at the terminal, the network component or at service component level. Resources provisioning (terminal, network service component) may be under the required level when the mobility occurs: user mobility (change of terminal), terminal mobility (change of network access) or service mobility (change of service component).

■ Reliability.

This kind of dysfunction is mainly due to the loss of data at different handovers which occur when moving.

Considering that all the dysfunctions are the trigger events for the mobility management of the components, we thus propose an organization in the forms of community for the mitigation of these inconveniences.

3.2.2 Community Self Management

Considering different types of mobility in the NGN context, reaction can be efficiently provided by QoS and functional equivalent components organized into community. Every SE is autonomic, it controls and provide its QoS information in real-time. This facilitates the *interoperability* among community.

The notion of "community" refers not only to the term of "Community of Interest" already existing in Web 2.0 and Web 3.0, but also to the fact of having all the functional and QoS equivalent service components organized into communities. Based upon the middleware and the NGN Sessionware described earlier (Section 3.3.2), we propose community management on each level of visibility (Figure 4) in order to offer the requested QoS for a specific functional service component.

The role of community management is keeping the community membership (maintain, arrival, departure) based on functional behaviors and QoS characteristics.

Due to the existence of a resource element since our service components are mutually reusable, thanks to semantic routing and the self-managed communities, we can find the equivalent component (ubiquitous) to maintain the E2E QoS.

The creation and the maintenance of the community should also be supported in a self-managed way in order to construct these virtual communities in a ubiquitous manner, therefore we propose four basic services in each community: Location-Based Service (LBS), Presence-Based Service (PBS), Discovery-Based Service (DBS) and Activity-Based Service (ABS).

For example, a device community is concerned by the support of the PAN (Figure 3-a) in the architecture model. The members of the device community are ready to replace another member which is no longer functionally or QoS suitable to serve in a given mobile service session.

Terminal mobility, network mobility and service mobility supported respectively by their specific communities formed by nodes of the same type (Figure 3-c to d) in the architecture model.

We focus on the service layer to examine how to assure QoS continuity when the terminal moves. The objective is to maintain the continuity of service session and ensure the transparency of the management.

In our approach, the service components are organized into the service community function and the QoS equivalent. The self management of service community will resolve the service mobility.

Alice moves (Figure 5) with her PDA while watching a movie provided by SE_{22} and synchronized by SE_{11}. After she reaches $AN_{1'}$, the QoS of service offered by SE_{22} is deteriorating, thanks to the self-service community SE_{2x} (SLBS, SPBS, SDBS), SE_{21} is automatically selected for a session without a break.

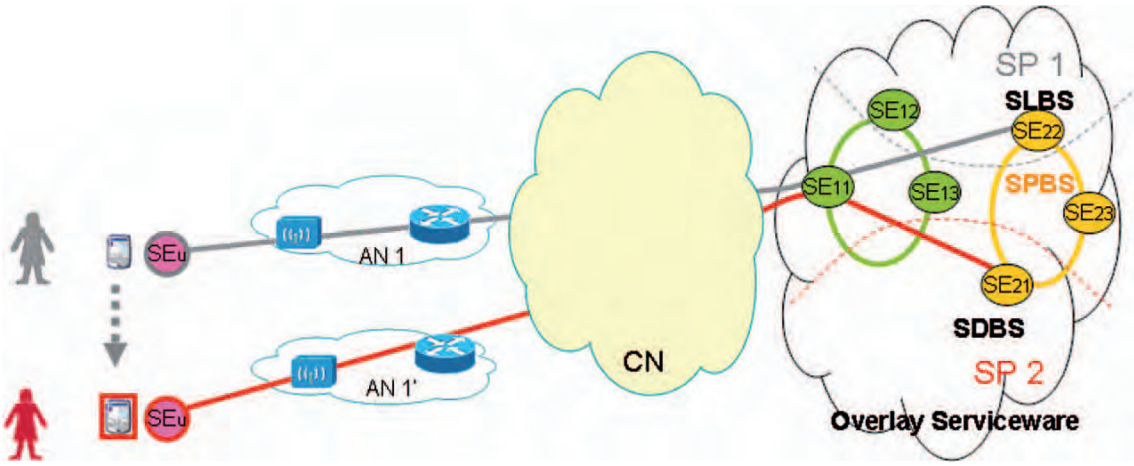

Figure 5: Services Community Self Management Example.

With generic services proposed before, we have the management of community services as follows (Figure 6):

Figure 6: Service Community Management.

3.3 E2E Service Delivery

With the help of these supports, we integrate the impact of the service session mobility management into the dynamic E2E service delivery through a session automate (Section 3.3.1), and detail the "NGN sessionware" (Section 3.3.2) which performs the E2E session management.

3.3.1 Automate of Service Delivery

Based on the horizontal service session and its support for the mobility, we integrate the service session into an E2E cross layer dynamic session. This session has a temporal vision and continuously delivers the E2E services to the user. Meanwhile, each level can have their own mobility, i.e. the user; the service and the network connection (especially the access network) can be mobile. We propose to manage each level's mobility by a Virtual Private Network in order to maintain the corresponding sub-session. For example, the sub-session in the user level is maintained by the VPUN. Therefore, this E2E temporal session is actually composed of three sub-sessions. A session-automate diagram is shown (Figure 7) in order to give a clearer vision of the continuous service delivery.

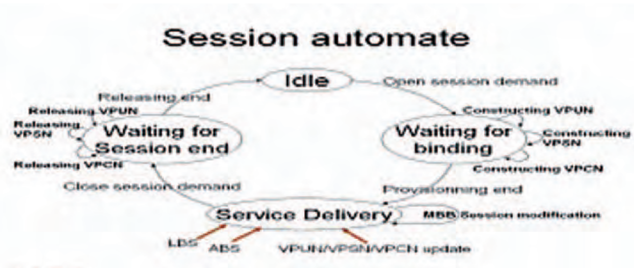

Figure 7: Automat of the Service Delivery.

The three proposed sub-sessions are constructed simultaneously, the members selected in the VPXN (X=U, S or C) are the communities' members at the corresponding level. When the provisioning of the sub-sessions ends, by binding all of them, an E2E session for global service is obtained which assures continuous service delivery. The continuity is assured in a MBB (Make Before Break) manner: if any component in the session is experiencing QoS degradation or no longer usable, another component which has the same functionality and the same QoS will take the place before the deletion of the degraded component. The MBB Session modification is also event driven. The events can be one of the two kinds: external events as Location and activity changes, and internal events as the update of the VPUN/VPSN/VPCN.

The construction of Virtual Private Networks is outside the scope of this paper.

3.3.2 NGN Sessionware

We propose to manage the E2E service delivery (maintained E2E cross-layer session) by NGN sessionware. The latter is the core middleware which supports the continuous E2E QoS-aware global service session. Following a request, research is carried out in order to discover and choose the components best adapted to the user's needs and required QoS (Figure 8).

Figure 8: NGN Sessionware.

The Continuous Service Delivery function consists in maintaining the E2E service by using the continuity function in every community.

The Service aggregation function is in charge of the vertical integration of each horizontal layer's service management. All the real time information about this cross layer session is kept in the session profile.

4 Experimentation/Scenario

Our proposition is focused on service composition. This overlay architecture enables the service mutualization by organizing service components into overlay networks. The following scenario (Figure 9) illustrates how a service can be delivered according to our proposition.

It is 18:00, our target user (Alice) leaves her office. Following her agenda, she is still awaiting an e-mail confirmation from a client (UABS). A SL_1 (Figure 9-1) shows the current application (1):

$$SL_1 = SE_1 + SE_2 + SE_{2bis1} + SE_4 \quad (1)$$

Thanks to Alice's agenda, we can predict her path during 18:10-19:30 with her car (UABS), she cannot read her email during her journey by car, a modification on the logic of service (SL_2) (Figure 9-2) is notified by Alice's preferences: she wishes to receive her SMS in voice mode. The actual session automatically includes SE_3 which converts SMS to vocal. Due to Alice's movement, the mobile network provider offers email service through its 3G (AN_2) coverage which is wider than WiFi, the self-management of service community (2) enables the replacement automatically with SE_{2bis1} SE_{2bis2}.

Service Community (email)= $\{SE_{2bis1}, SE_{2bis2}\}$ (2)

The change in the composition of service dynamically notifies the VPSN. The network support (VPCN) self-

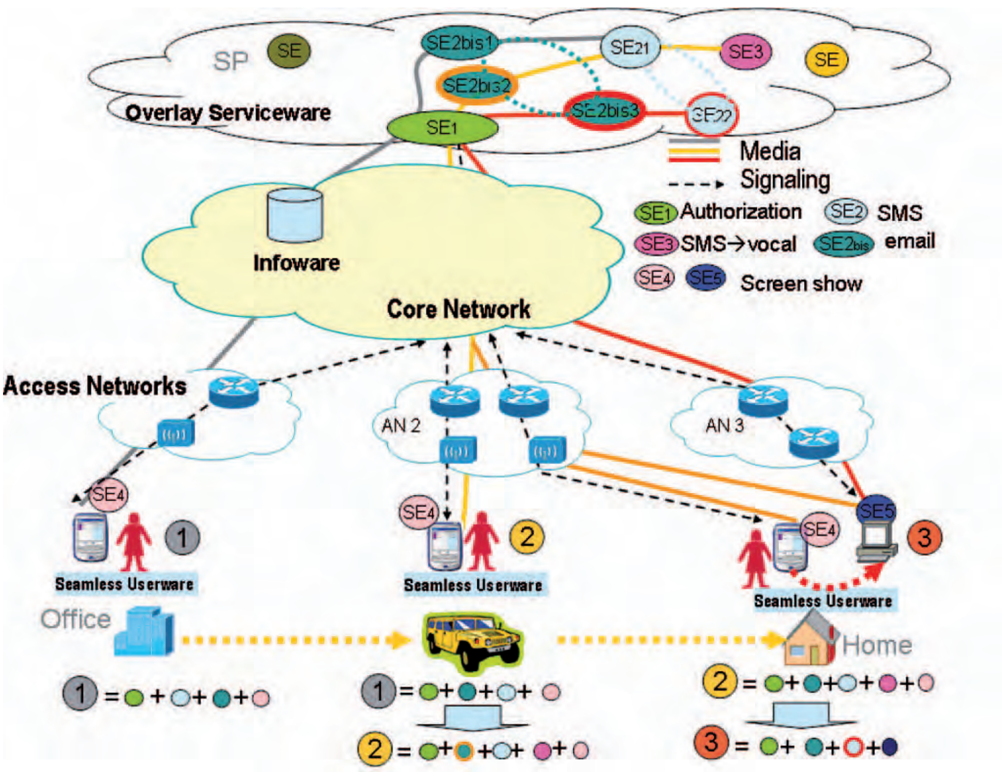

Figure 9: General Scenario.

manages the supplier of mobile networks to offer better connectivity. The "NGN Sessionware" maintains during the session a seamless service logic (3):

$SL_2 = SE_1 + SE_2 + SE_{2bis2} + SE_3 + SE_4$.	(3)

When Alice arrives at home, PAN the availability of a desktop computer. We observe that the new network provider allows users to have more opportunities to use a dedicated service on different platforms from different service providers. The communities of service are automatically and dynamically built:

Service Community (email)= $\{SE_{2bis1}, SE_{2bis2}, SE_{2bis3}\}$ Service Community (SMS)= $\{SE_{21}, SE_{22},\}$	(4)

The event "Alice arrived at home" generates a change in the service logic; Alice no longer needs the "SMS Vocal" service component because she can read the text messages now. The desktop computer is chosen for its better display quality (SE_5), discovered by the community management. The change is not only in the terminal but also in transport and service due to new E2E QoS requested by Alice (user-centric session). The Binding is done by the NGN Sessionware and we thus get the current session (Figure 9-3):

$SL_3 = SE_1 + SE_{22} + SE_{2bis3} + SE_5$.	(5)

In this scenario, we find that the service logic is updated depending on the location and activity (1) (3) (5). Service Community (2) (4) also self-manages to support their own VPSN. The provisioning of service is always guaranteed to be delivered continuously through the cross-layer Binding.

5 Conclusion and Future Works

This article aims at providing a framework for maintaining service continuity for E2E sessions while users may move from one network to another with terminal changes. Our proposition is based on a four-layered, SOA-based architecture.

Firstly, we achieve mutual reusability and dynamic service provisioning. Therefore, the designed service components are accessible by several actors (User, controller, and the management). Secondly, we propose to use basic service components organized into communities to react to the QoS dysfunction (which is mainly caused by mobility), we realize in this way the QoS-based Mobility Management. Third, the E2E global mobile session is maintained in continuous way in order to keep the service continuously delivered despite the different types of mobility. The session modification is performed by sessionware which binds the VPXN dynamically. The E2E service delivery is then also feasible.

The work on the VPXN construction needs further research and a more complete platform is expected in the near future of the project "Seamless Userware".

The deployment and the ontology of the service components with all the constraints remain to be effectuated in order to suit the exploitation which we have described and to which we have contributed.

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