Model-Driven Dynamic Service Delivery in Mobility and Ambient Environment

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Abstract— **The rapid evolution of the new generation networks and services (NGN/NGS), particularly the converged infrastructures, raises the challenge of ensuring not only the Media Delivery but also the Service Delivery towards the user, regardless of his terminal, his access network, his preferences and his Quality of Service. The existing approaches for Media Delivery enable the improvement of the network in order to share and allocate the resources in the most optimal way. But the mobility and the heterogeneity of the user's ambient environment invoke more and more the complexity of the Service Delivery. In this paper, we propose a Dynamic Service Delivery process over Media Delivery in order to ensure the service continuity during the mobility or during all the other changes in the user's ambient environment. This Delivery process is driven by a model which represents the real world and differentiates the Service Delivery treated by the service platform from the Media Delivery treated by the network. The advantage of the proposed model is that it ensures the consistency within the deployment of user session and takes into account the End to End Quality of Service in the NGN/NGS context.**

Keywords-NGN/NGS; Service Delivery; Model Driven; Dynamic Management; Mobility.

I. INTRODUCTION

With the new generation network (NGN), the user is facing a new environment composed by multiple access networks, core networks, service platforms, access terminals and even different operators. In such a varied environment, user hopes to change the terminal everywhere while maintaining the service continuity according to his preferences. A first response to this increasingly complex environment was the network convergence, which enables to provide the same services to the user through different networks. This convergence has thus allowed the passage from a vertical architecture (where the access network, the core network and the service platform are tightly coupled) to a horizontal architecture [1] [2] [3] (where the network and the service platform are on independent layers). If this architectural transformation succeeds, the objective of the trans-organization, the mobility and the personalization requirements, is fulfilled. However, in this service separated architecture, how to address the service management and keep the consistence with the delivery of the network transport service (media delivery)?

Service Overlay Network (SON) allows the access to the same types of services (Service Overlay) through different but provisioned networks (Network Convergence). Unfortunately, these architectures are still vertical from the point of view of resources reservation when providing the solutions for the improvement of the Media Delivery. Indeed, the infrastructures remain specific to certain types of services. As a result, there rests the passage from one type of service to another (for example, from a Telco service to a Web service), or the service composition will necessitate a change in the whole transport infrastructure.

Additionally, in this type of architecture, the maintenance of the service continuity during the mobility is only treated via the network (Media Delivery). But the End to End (E2E) Quality of Service (QoS) depends also on the QoS of Service Layer to achieve the demanded Service Delivery; moreover, the service layer can also provide complementary solutions. Indeed, depending on the current ambient network in which the user stays, we use an ubiquitous component of this area in order to have another network path and thus to meet the E2E QoS. Our main proposition called "Service Delivery" is based on this observation and takes account of mobility.

From this point of view, we replace the Service Overlay by a Service Network which enables service convergence and global dynamicity in the network layer and in the service layer as well. Architecturally, this service network is driven by a model and the Service Delivery enables this service network to facilely provide user personalized services. This service network auto-manages itself independently of the transport infrastructures, and changes dynamically due to the mobility and the changes of environment in order to manage the real time service continuity during the delivery of the service.

The rest of the paper is organized as follows:

In Section 2, the related work shows the lacks of Media Delivery for the E2E service. After we introduce the models which are the base of our proposal (Section 3), we present in Section 4 our proposition in details. In the first place, we present as an example the Internet Protocol Television (IPTV) architecture to show the importance of the service level contribution. Afterwards, we present the important part of our contribution which allows the dynamic management to treat mobility. Then, in Section 5, we show how our proposal goes from the theory to the practice by two parts: for the Model-Driven of our delivery process we present how to anticipate

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the degradations in order to maintain E2E QoS. On the other hand, we show how our model can help in the standardization; we propose the integration of our Service Delivery Process in the Tele Management Business Framework Process. Finally, we conclude the paper in Section 6.

II. Related Work

To deliver the services to today's large numbers of mobile users although a user's ambient environment, the management of multiple composed services, the flexible provisioning of resources, and the guarantees of QoS remain as challenges. However, current solutions are not dynamic and are of the type Overlay as the following in SON [4]. The Service Overlay Network (SON) is proposed as an intermediate layer, which enables the access to the same services by converging the different networks. SON attempts to increase application adaptation and service reliabilities. In this section we analyze the existing optimization solution for SON in order to show the lacks.

A. Topology Re-configuration Policies in SON

As the reconfigurability is one of the most appealing features of SON, J. Fan et al. proposed optimal reconfiguration policies for the topology design of SON in order to improve the performance and to minimize the operation cost of dynamic routing [5].

As the communication requirement changes, the topology may need to be reconfigured with a lower-cost path. Comparing with other work, it is considered in a general case that the topology is not assumed as fully-meshed but as degree-bounded: the number of the neighbors of a node is limited. They analyzed and identified all types of cost during the phase of reconfiguration, observed the optimal reconfiguration of small systems, and then gave out the reconfiguration policies for large systems where the communication pattern is dynamic.

The policies are verified to have low cost when facing changes of communication requirements. As the nodes in the topology graph are assumed to be fixed and the numbers are limited, it is difficult to discover other service nodes in an unknown domain out of the existing SON.

The policies can resolve some mobility but in a limited range. It is not a trans-organizational solution.

B. An optimal routing based on service federation

M. Wang et al. proposed a distributed algorithm [6] of the service flow graph based on the service federation in order to optimize routing in SON. The service federation enables independent services to perform the tasks in either a sequential, parallel, or interleaved fashion by allowing parallel paths for a complex service.

To connect the service requirement and the overlay graph, they defined a service abstract graph, within which, a service abstract node is populated with the instances of the corresponding service. After applying the algorithm proposed by Z. Wang et al. [7] in the overlay graph, a service abstract graph is constructed respecting to proposed strategies, and the same algorithm is applied again in the abstract graph, so that some links of the previous path maybe replaced by optimal ones. This service federation algorithm is proved to be able to construct service flow graphs with high-quality.

Although it can response dynamically in the service layer, but the algorithm is not flexible enough facing the ambient environment and service continuity during the process of the dynamic routing.

C. QoS-Assured Service Composition

X. Gu et al. presented an infrastructure for the efficient service composition, focusing on the assurance of QoS [8], which is in favor of the reliability within a SON. They propose a QoS-assured algorithm for the mapping from service template, which is mapped from service requirement, to an instantiated service path.

For the initiation of service composition, the basic algorithm generates the weighted candidate graph instead of searching the path in the first step, and then runs the Dijkstra algorithm to find the shortest path considering various QoS constraints. In order to consider each individual QoS constraint, an enhanced algorithm is proposed in additional, which can change dynamically the weight of different factors. At last, the dynamic service composition algorithms are proposed to deal with the recomposing of service path in a complete way or in a partial way, in the run time when outage or significant quality degradations occur.

The proposition is proved to be dynamic and to be able to provide both QoS assurances and load balancing for composed services in SON. As the algorithm considers the nodes and the links in the whole overlay topology, we still need to improve the flexibility and efficacy without increasing the complexity.

D. Auto-configuration in SON

R. Braynard et al. presents Opus, an overlay peer utility service which can automatically configure server network overlays by running instances of global resources and tracking their status, in order to improve the performance via the avoidance of unnecessary re-implementation [9].

A service overlay works as a “backbone”, through which Opus can track and disseminate the information. For each individual application, Opus creates an overlay, and dynamically adapts the overlay topology according to the system load and network conditions. Opus determines the allocation of resources for competing applications, by maintaining a cellular structure, within which, a cell can be an entire Opus presence or a portion of it. To track the system characteristics, they applied to a generic communication library within Opus, some existing routing protocols which have the properties of aggregation, hierarchy and approximation. At last, to ensure reliability and availability, several approaches are pursued, such as restricted flooding and construction of disjoint paths.

It is a good idea to appoint a special management unit to implement the auto-configuration. However, it is too centralized. Can the management mechanism to be more distributed which is self-manageable for each unit? And be more independent as possible to the infrastructures?

In conclusion, the Overlay Network does not have enough flexibility to meet the new NGN/NGS challenges.

III. BACKGROUND

In this part, we present the models on which our proposition is built and which gathers: the NLN (Node-Link-Network) meta-model [10] which represents all kind of component (§A), the QoS model to manage the behavior of the components (§B) and the Information Model which represent our knowledge base (§C).

A. NLN Meta-Model

In the delivery process, we must ask ourselves: what do we manage? Which type of resources do we want to provision? In order to be as generic as possible and to take into account all kinds of resources, we follow the NLN meta-model describing three types of objects: the Node which represents the component in each visibility level (Service, Network or Equipment) and which is responsible for specific treatment; the Link which represents the interaction between two Nodes, according to the service logic and the Network which represents all the Nodes and the Links offering a global service to each visibility level. This model enables the decomposition of the whole system in several abstractions' levels according to the service provided by each component, which allows a complete management of the system.

B. QoS model

In order to maintain the user Service Level Agreement (SLA), we must have an E2E QoS control during all the service provisioning and delivery processes. We propose a QoS agent in every component and the behavior of each component will be translated by QoS measurable parameters. QoS can be categorized according to four criteria [11]: Availability, Reliability, Delay, and Capacity.

These criteria are necessary and sufficient for self-control (IN/OUT Contract) because they are able to cover Fault, Configuration, Accounting, Performance, Security (FCAPS) framework proposed by the Telecommunications Management Network (TMN). Availability indicates the relation states for the configuration; Reliability depends on Fault; Delay and Capacity concern Performance and Accounting, and Security is considered as a service where we apply the QoS agent. This QoS model is instantiated on each visibility level and the aggregation of these parameters on all of the visibility levels ensures an E2E QoS. This QoS model allows managing the resources in use and their possible degradations.

C. Informational Model (IM)

The IM we propose is generic and abstract to describe any resource. This IM, as our knowledge base, is independent from application. It is directly related to the events that occur in the real network. The inference rules (implications of each event) have been defined in [12] [13].

In the next section, we present our proposal based on the model which allows the same architecture for the Service Delivery and Media Delivery.

IV. PROPOSITION

Our proposal takes into account the usage in the NGN/NGS context, essentially in a mobile and user-centric oriented context. Indeed, between the user's demanded service and its dynamic utilization in this context, it is necessary not only to provision the service at the moment of its activation, but to re-provision continuously and dynamically according to the user's location and the terminal in use. In additional, the service presented on a catalogue (for example, the Triple Play) incites, in terms of resources, several service elements (Voice, Data, TV), which need to be integrated in our dynamic management (Provisioning, Re-provisioning and Assurance). In this section, we firstly show the necessity of Service Delivery complementary to Media Delivery, by presenting in the IPTV architecture the application services and the network services, then explain the importance of Service Delivery in the service layer (§A). In (§B), we analyze the needs impacted by all types of mobility (User, Terminal, Network and Service), and the ambient networks offering ubiquitous services in order to meet the NGN/NGS context. Then, in order to manage the dynamicity during the usage of service (during the movement), we propose to follow the traceability of the dynamic session basing on the NLN model through the different layers (Service, Network and Equipment) (§C). In (§D), we present the process of E2E Service Delivery, which takes charge in the usage and complements the Media Delivery. At last, we detail the models (Virtual Service Community and Ubiquitous Service Element) which manage the mobility in the delivery process (§E).

A. What is the Service Delivery

In this section, we explain the Service Delivery and its contribution relative to the Media Delivery.

During the phase of provisioning, we need two to provide a service requested by a user. The first is the selection of the requested service according to the user's preferences, his location and his terminal. The second is the selection of the network that can satisfy the requested QoS. Within the ambient context, the user moves while having the continuity of service. Current Media Delivery solutions treat these requirements by shifting the access point and the corresponding supporting services in the network layer. The QoS is obliged to be recalculated and sometimes the delivery is interrupted, although we are now facing an ubiquitous context, i.e. we are already able to predict towards which pervasive service the user can be served while maintaining the desired QoS. That's why we believe that a higher level concept of Service Delivery is needed to address the dynamicity during service usage. We benefit from the ubiquitous context in the level of the service platforms. The service continuity can be obtained by dynamically managing the Service Delivery. During this dynamic management, we can adapt to the change of the user's location and to the QoS degradation, and can always conform user's preferences. Once the Service Delivery is in place, the network layer follows the solution and provisions the resources to provide QoS continuity.

In the following, we present the IPTV architecture and show the need of the Service Delivery, which complements the Media Delivery.

The IPTV service [14] is becoming more and more popular among telecommunications companies because it promises to deliver TV programs at anytime and anywhere. Based on IP protocol, IPTV features advantages like bandwidth efficiency and ease of management.

We can identify three main parts of the overall architecture (Figure 1):

Transport Functions: RACS, NASS and Transport Processing.

IPTV service control and applications functions: Service Selection Function (SSF), Service Delivery Function (SDF) and Service Control Function (SCF).

Media Delivery, Distribution and Storage functions: Media Delivery Function (MDF) and Media Control Function (MCF). The MCF has three interfaces: one with application service (SCF), one with network service (MDF) and another with the User Equipment (UE) to control the remote.

In this architecture, there are application services (offered by SSF, SDF, SCF or MCF) and network services (offered by MCF or MDF). The application services identify the flow-generator services which must be transmitted through the network. Such services might change during the transmission.

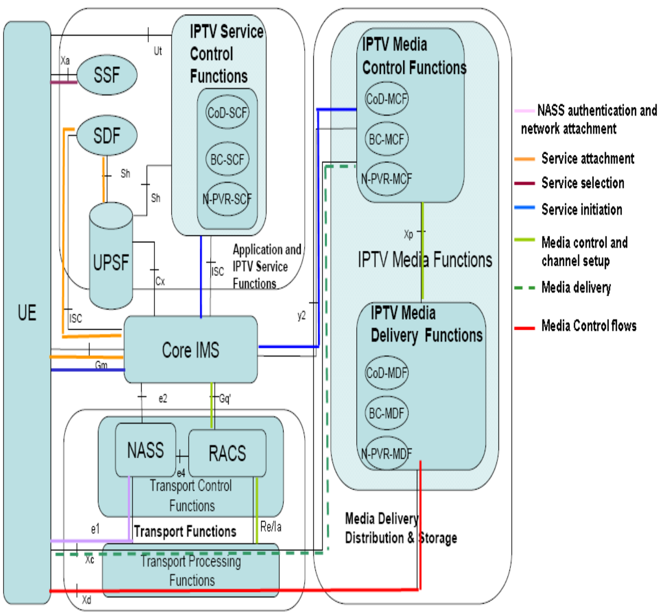

Figure 1 Applicative Services and Network Services in the IPTV Architecture

The MCF and MDF are concerned with the media transport via all the network components with the help of NASS and RACS, which manage the Policy Enforcement Point (PEP) as policy control to ensure the QoS.

These two types of services work in an independent way, which separate the service from the network. However, the actual solution for the terminal mobility is oriented to the access network, i.e., the access part detects the new location and the Media Delivery part will not rearrange another delivery flow until the transport deviation is finished. As a result, the user service is not continuous due to the non seamless of the service handover. If we can realize the Service Delivery which aims at delivering complexes services (as IPTV) to today's large numbers of nomadic users through out a user's ambient environment, we can thus achieve the service continuity with the user desired QoS.

B. Requirements analysis of Service Delivery

In order to realize the Service Delivery concept, we need to focus on the mobility management, the flexible provisioning of resources and the guarantees of service continuity and dynamic E2E QoS during the mobility.

First of all, the ambient environment is actually a very heterogeneous environment due to different access technologies, services and networks environments. The competition and the cooperation of various market players are facilitated by defining interfaces, which allow the instant negotiation of agreements. This new environment enables services to be pervasive, i.e. the same type of services from different suppliers are all visible to a user.

As a result, this new context challenges us:

- To offer the ubiquitous services. This aims to provide the same services in the user's ambient environment during the movement.
- To take into account the user's preferences. This might influences the choice of service, of operator, of access network, of equipment or of price rate against another.
- To provide personalization by composing heterogeneous services during a session. This requires horizontal management to be independent to the different architectural layers (Service, Network and Equipment).

Secondly, another major challenge rose is the mobility management during the user mobile session. We summarize four types of mobility that might occur during the session facing the ambient environment.

The terminal mobility refers to a terminal which moves through different access points while maintaining its connectivity.

The network mobility concerns the movement of the infrastructure of the transport support.

The service mobility refers to the ability of service to be transferred from one machine to another so that the user can use the service independently to the terminal or network in use.

The user mobility concerns that the terminals are switched by a user, which requires the adaptation of service on the new terminal.

This mobile context imposes us:

- To guarantee the continuity of service all through these types of mobility. This results in the session mobility. The session mobility concerns the dynamic management of the user session due to its E2E uniqueness in the real time. In fact, each type of mobility belongs to an architectural layer (Equipment, Network or Service), and is not able to ensure the E2E QoS by itself. It is the session management in the real time that maintains this E2E QoS.
- To ensure the Re-Provisioning of resources during the movements. The new usage induces the consideration of the preferences and the mobility of the user.

Our goal is to meet these needs by proposing a process of E2E Service Delivery driven by mentioned NLN and QoS models, which we detail in the next section. The Service Delivery takes in charge of the changes impacted by all types of mobility on the service platform in the ambient environment.

C. Model-driven Service Delivery

Our model thus consists of several concepts to response the requirements identified in §B:

- The service element (SE): we model it ubiquitous and mutualisable. Its ubiquity answers especially to the ambient environment. The service elements are equivalent in function and in QoS and installed on the same platform or on different platforms. The characteristic of mutualisation enables the sharability between multiple users, which allows, as consequence, different users' preferences and a more dynamic and efficient participation of the service composition.
- The model NLN presents in the background: it allows us to model the heterogeneous real world via the nodes and the links. The network of nodes and links of the same nature constitutes a virtual network. Taking advantage of these virtual networks, the required horizontal management obtains its architectural base.
- The concept VPxN: allows the provisioning of resources in each layer of visibility. We propose to model each architectural layer by a Virtual Private x Network: VPxN (x=Equipment, Network or Service), which auto-manages itself dynamically during the movements. The VPxN allows re-provisioning the resources to the user according to the changes (mobility, preferences, degradation) for the purpose of the E2E QoS continuity. Thanks to the VPxN, during the mobility we can offer the user an ambient environment (all the resources of equipments, networks and services which enable the session continuity in the new location).
- The concept Virtual x Community (VxC): allows creating communities of equivalent resources in function and in QoS at each visibility layer. Thanks to VxC, during mobility we can anticipate the degradations by replacing the degraded resource by another equivalent one.

As a result of the application of these models, we have our global architecture as the following:

The VPEN, which regroups all the ambient equipments of the user: terminals, networks equipment and servers.

The VPCN, which consists of access and core networks. It regroups all the ambient connectivity of the user: Wifi access, BTS access, ADSL access, IMS core, etc.

The VPSN, which makes up a logic network of all the accessible services to the user. These services are managed in a horizontal way (independent from any particular network infrastructure).

Each visibility layer (VPEN, VPCN, and VPSN) is dynamic and self-manages in a horizontal way. Thus it is the session management which takes into account the different layers of visibility for the calculation of the E2E QoS. For example, given the user's preference of terminal, it is decided which ubiquitous service element to use, through which network, in order to guarantee the QoS continuity. Finally, to meet the needs of the dynamic management of the service elements during the mobility, the VxC monitors the comportment of each resource and proceeds to its replacement in each VPxN. The replacement is effected following any types of changes in order to maintain the continuity of the QoS.

Therefore, we have three layers of visibility in the global architecture: equipment, network (access and core) and service platform (Figure 2).

In the equipment layer, we have represented all the equipments in the PAN of the user, the equipments of his access network and of his core network, and the servers on which all the service elements accessible to the user are installed.

In the network layer we have represented the access network and the core network chosen for his session.

In the service layer we have represented the logic network (VPSN) of all the services to which the user has the right to access.

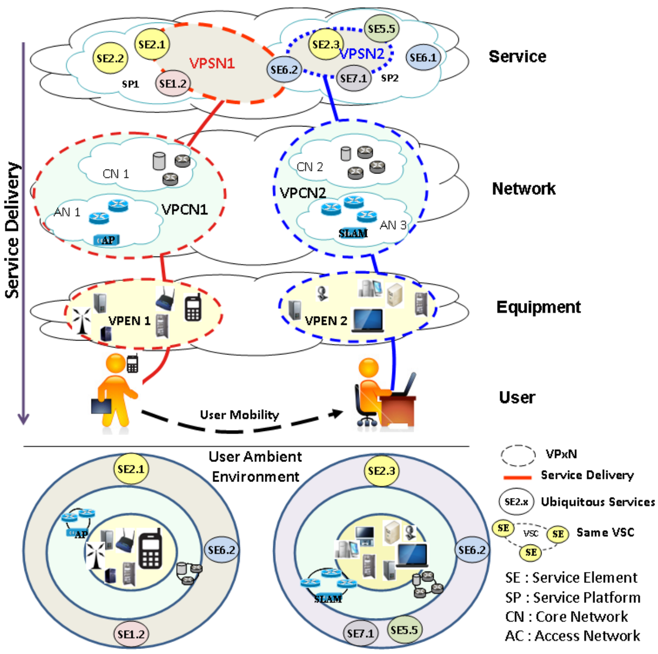

Figure 2 Service Delivery with QoS Continuity according to Mobility, User's preferences and Ambient Environment

From the VPxNs, in a given location, we can thus give the whole ambient environment of the user. For example, the user in his first location has chosen his cell phone as terminal during his session, he passes through the selected access network and the core network (VPCN1), and he may use the service elements (SE2.1, SE1.2 and SE6.2) during his session. All the service elements are ubiquitous (of the same color in the Figure 2) and distributed on two different platforms (SP1 and SP2).

During this session, user mobility occurs, i.e., he changes the terminal from a cell phone to a computer, which will cause a change in the access and core networks (VPCN2 in the Figure 2). This may require a change of a service element to adapted to the new terminal, or maintaining the same service element on another platform while changing the network or the terminal. In the example, an ubiquitous service (SE2.3) on another platform (SP2) replaces SE2.1. This change may be treated with during the transaction of the calculation of the E2E QoS, which selects this ubiquitous component in order to guarantee the demanded QoS. After the mobility, the user has still two new elements (SE7.1 and SE5.5) adapted to his terminal, which replace the previous element (SE1.2). The VSC management takes in charge of the efficient replacement of the service elements by anticipation.

We present the E2E Service Delivery Process in the following part.

D. *Service Delivery Process*

When the user orders the services, the service provider firstly provisions the resources to meet his demand. In our proposed process, this step is the creation of a “Pre-VPSN”. The Pre-VPSN will contain all the services subscribed by the user. The service provider will add the necessary services for this user. At the session initiation, following his service logic, the user constitutes the services that might be used all through the session which will be the “VPSN”. Each service element in the VPSN belongs to a VSC which manages it dynamically during the mobility. During usage, the service elements requested will be reserved and constitute a Transaction “Active VPSN”. We have illustrated the different steps (Pre-VPSN, VPSN and Transaction) in the Figure 3.

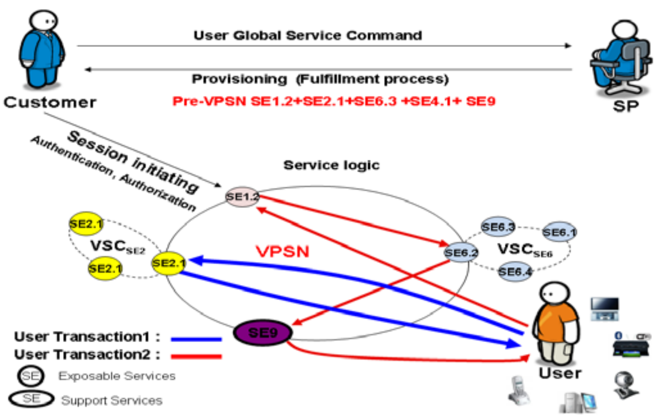

Figure 3 Pre-VPSN, VPSN and Transaction processes

In the following, we detail the processes which manage the different steps.

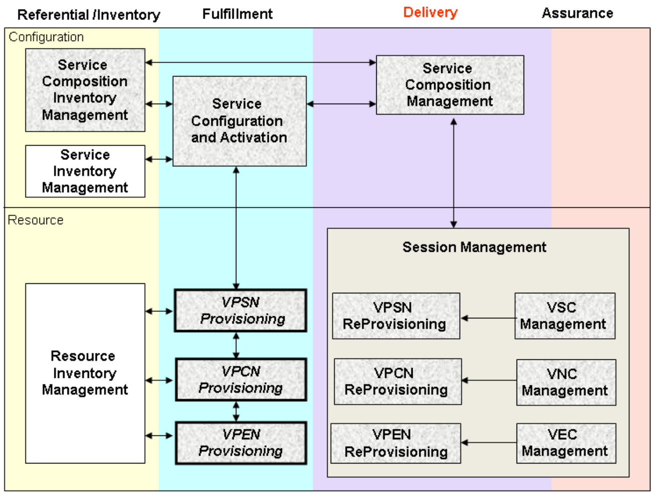

Figure 4 Service Delivery Process and his interaction with Fulfillment and Assurance

For the Order phase, we have the Fulfillment process (Figure 4). We have two parts: Configuration and Resource.

- The Configuration part takes in charge of service elements configuration and activation according to client order (Service Configuration and Activation process). This process communicates with the process (Service Inventory Management) in order to have the available services and their configurations. The Configuration part sends a request to the Resource part (OSS) to provision the demand.
- In the Resource part, we have the provisioning of three visibility layers [15], thus the process (VPSN Provisioning) provision the service resource. This process sends a request to the process (VPCN Provisioning) in order to reserve the network resources selected for the required services. Then the request is sent to the process (VPEN Provisioning) to reserve the user equipments, network equipments and service equipments selected for the demand. These three processes communicate with the data base “Resource Inventory Management” to find the available resources, their QoS, their addresses, and etc.

For the Usage phase, we have the Service Delivery process (Figure 4). This process manages mobility and changes in the user ambient environment. There are two parts in the process:

- In the Configuration part, we have “Service Composition Management” which takes in charge of the management of the services subscribed by the user. These services represent a user's VPSN at his session initiation. The VPSN contains all the service elements that the user has chosen during his session. The information of these elements is stored in the proposed data base: Service Composition Inventory (Figure 5).

User	Pre-VPSN at order	VPSN at the session opening		Active VPSN at usage (transaction)
User 1	SE1	Exposable Services	SE1	SE1
	SE4		SE4	SE4
	SE2			
	SE8	non Exposable Services	SE8	SE8
User2	SE1	Exposable Services		
	SE3		SE3	SE3
	SE5	non Exposable Services	SE5	SE5
User3	SE5	Exposable Service	SE5	SE5
	SE7	non Exposable Services	SE7	SE7
	SE8'		SE8'	SE8'

Figure 5 Pre-VPSN and VPSN example in Inventory

- In the Resource part, we have the processes of Re-provisioning of VPSN, VPCN and VPEN. Each VPxN auto-manages itself in a dynamic way and re-provisions the resources during mobility, preference changes or resource degradation. It is the session which deals with the aggregation of the three layers in order to handle the demanded service with QoS continuity. The "Session Management" thus regroups the three layers of re-provisioning and community management which auto-manage themselves ensuring session and QoS continuity.

For the Assurance phase, we have the Assurance process (Figure 4), where we have the management of VEC, VNC and VSC. These components monitor the behavior of the resources (the behavior results in QoS). Each resource announces its conformity or its non conformity to the contract with the members of its community. In the case of a non conformity thus of a QoS degradation, the resource is replaced in each VPSN, VPCN or VPEN associated by a resource functionally and QoS equivalent of the appropriate community.

In the next section, we detail the mobility management treated by VSC and ubiquitous service elements.

E. Taken into account mobility (VSC and Ubiquious SE)

The VSC we proposed are built at the deployment phase. When a service is deployed in a location it will search the ubiquitous service elements that are identical to him in terms of QoS and functionality, to represent the service community. This community aim to self-manage faults or QoS degradation. The goal to have these communities is that, when a service element is degraded and filled not its contract it will find in its location the nearest and similar service element which can replace it in the VPSN. Thus with this concept we can anticipate degradations in order to allow service continuity.

During mobility, let us suppose that we have degradation in a service element (e.g., SE1.2); degradation is alerted by SE1.2 community. This community will carry out the replacement of this service element by another equivalent in the VPSN and will thus allow service continuity. But before replacing this element, we first calculate the QoS of the link (transport layer) between this new service element to replace (e.g. SE1.3) and the next and previous service element in the VPSN (e.g. SE6.5 and SE7.3).

From the service element QoS table (TABLE I) on Server1, Server2 and Server3, we have the QoS of SE1.2, SE1.3, SE6.5 and SE7.3.

TABLE I. QOS TABLE OF SERVICE LAYER: SERVER1, SERVER2 AND SERVER3

SE	Server 1	SE	Server 2	SE	Server 3
SE1.2	QoS $_{SE1.2}$	SE1.3	QoS $_{SE1.3}$	SE1.5	QoS $_{SE1.5}$
SE2.3	QoS $_{SE2.3}$	SE6.3	QoS $_{SE6.2}$	SE7.3	QoS $_{SE7.3}$
SE7.5	QoS $_{SE7.5}$	SE6.5	QoS $_{SE6.9}$	SE6.5	QoS $_{SE6.5}$

From the Transport Layer QoS table (TABLE II), we have the QoS of all the links (networks) possible between Server1 and Server2, and between Server3 and Server2. Thus to replace SE1.2 installed on Server1 by SE1.3 installed on Server2, we have {$QoS_{SE1.2}$, QoS $_{(1\text{-}3)''}$, QoS $_{(1\text{-}3)'}$} and after replacement we have {$QoS_{SE1..3}$, QoS $_{(2\text{-}3)}$, QoS $_{(2\text{-}3)'}$}, which allows maintaining the E2E QoS during the current transaction.

TABLE II. QOS TABLE OF TRANSPORT LAYER: SERVER1 AND SERVER2

	Server 2	Server 3	Server 4
Link	QoS $_{(1\text{-}2)}$	QoS $_{(1\text{-}3)}$	QoS $_{(1\text{-}4)}$
Link'	QoS $_{(1\text{-}2)'}$	QoS $_{(1\text{-}3)'}$	QoS $_{(1\text{-}4)'}$
Link"	QoS $_{(1\text{-}2)''}$	QoS $_{(1\text{-}3)''}$	QoS $_{(1\text{-}4)''}$
Link"'	QoS $_{(1\text{-}2)'''}$	QoS $_{(1\text{-}3)'''}$	QoS $_{(1\text{-}4)'''}$

	Server 1	Server 3	Server 4
Link	QoS $_{(2\text{-}1)}$	QoS $_{(2\text{-}3)}$	QoS $_{(2\text{-}4)}$
Link'	QoS $_{(2\text{-}1)'}$	QoS $_{(2\text{-}3)'}$	QoS $_{(2\text{-}4)'}$
Link"	QoS $_{(2\text{-}1)''}$	QoS $_{(2\text{-}3)''}$	QoS $_{(2\text{-}4)''}$
Link"'	QoS $_{(2\text{-}1)'''}$	QoS $_{(2\text{-}3)'''}$	QoS $_{(2\text{-}4)'''}$

V. FROM THEORY TO PRACTICE

In this section, we show the feasibility of our proposal through two parts: For the Model-Driven of our delivery process we will present in (§A) the implementation of the VSC by JXTA [16] which allows us to anticipate and deal with the changes of user's ambient environment in order to maintain E2E QoS. To verify the consequence of considering the mobility during usage via the service management processes, we show in (§B) how our model supports the standards of Tele Management Forum.

A. VSC Implementation in JXTA

As we have explained, the VxC takes in charge of the maintenance of the resources (Equipment Element, Network Element, Service Element) in each layer, for example, a VSC in the service layer contains all Service Elements equivalent both in function and in QoS in the service network. In the first place, each SE needs to publish its function and QoS values to the others and receive the information from the others, so that VSCs can be constructed. Secondly, a VSC should have the ability to be aware of the change of its SE and to discover the unknown SE which can be added into the current VSC.

In our feasibility, we use the JXTA platform, which includes a set of open, generalized peer-to-peer (P2P) protocols. With the JXTA technology, all the elements can be regarded as peers, and can communicate and collaborate with each other in a P2P manner by publishing an advertisement with the form of language-neutral meta-data structures represented as XML documents. Within a sub network, the peers can communicate directly with each other by Peer Advertisement. In JXTA, a Rendezvous peer can maintain global advertisement indexes of the peers that register to it in a sub network, and exchange information with other Rendezvous peers of the other sub networks. Therefore the peers can get the information of the peers in another sub network by communicating with its Rendezvous peer via Pipe Advertisement.

In our case, each SE publishes an advertisement including its characteristics, such as supported function, designed QoS, current location and etc. At the same time, each SE listens the advertisements from other peers in its neighborhood, and keep in a local table those whose function is the same with itself, basing on which a VSC is constructed.


```xml
<?xml version="1.0"?>
<!DOCTYPE jxta:PeerAdvertisement>
<jxta:PeerAdvertisement xmlns:jxta="http://jxta.org">
<PeerId>urn:jxta:uuid-280984B767FF4B80980DE4586287229305</PeerId>
<Name>SE1<Name>
<Layer>Service</Layer>
<Function>IPTVMediaControlFunction</Function>
<QoSCapabilities>
        <Delay>15ms</Delay>
        <Reliability>98%</Reliability>
        <Availability>99%</Availability>
        <Capacity>2.5Mbps</Capacity>
</QoSCapabilities>
<Location>PointA</Location>
</jxta:PeerAdvertisement>
```


Figure 6 Peer Advertisement published by a SE

In Figure 7, before the VSC is constructed, the two elements with the same shape and the same color are two elements of the function MCF with the same designed QoS. They need to find each other and add each other to its own VSC. Each publishes a peer advertisement within the sub network shown in Figure 6, and a pipe advertisement (same contents as in the peer advertisement) to its Rendezvous so that the peers in another sub network can also receive its information. When the convergence of this phase is finished, the SE of IPTV MCF in platform 1 will know that in platform 2 there is another SE of MCF which has the same QoS, and adds it to its table. Therefore, these two SEs make up a VSC of MCF (Figure 7). After being successfully created, the VSC will maintain its SEs by the current QoS values in the real time in order to help VpxN to adapt to the mobility and the changes of the user's ambient environment

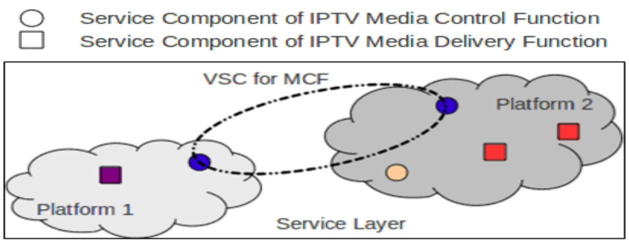

Figure 7 Creation of VSC for MCF

B. *Valorisation on Standards*

In this section, we show how our model helps in the standards. The Tele Management Forum (TMF), one of the most general forums in the domain of telecommunication management, has proposed a framework to define a complete management environment. The TMF includes the Business Process Framework (eTOM) [17] which can help service providers to define and describe the business and functional processes they use, to understand the links between these processes, and to identify the working interfaces and external entities, in order to structure the basic management Processes.

This management processes today are disjoined: the service is first provisioned following the customer's order, then used and assured, then billed [18]. However the NGS requires interactions between service logic during the usage. This interaction must be dynamic and takes into account the NGN/NGS challenges (e.g., User preferences, mobility and ubiquity). To meet these new paradigms we proposed to incorporate a usage process (Service Delivery) in the eTOM cartography. This process responds to NGN/NGS and interacts dynamically with the eTOM operations processes. In order to have coherence in this interaction we are based on an abstraction model of the real world for these processes (Fulfillment, Assurance, Billing and Delivery). In this model we have models each resource visibility level as a virtual private network (VPSN, VPCN and VPEN). We have also the VxC model that monitors the behavior of each resource and replace it by another ubiquitous resource in the VPxN in the case of QoS degradation. This can have a generic reference model for the NGN/NGS service management.

But before the operations processes, we have the Strategy, Development and Deployment processes. In order to have business continuity from strategy to operations, we have proposed the same model that allows consistency between the different processes. Thus these processes exchanges information dynamically. In order to be trans-organizational and to have the possibility to deploy services that are not developed by the provider himself but bought from other suppliers, we proposed a separation between the deployment and the development processes in the eTOM cartography. We also proposed new processes to take into account when dealing with the NGN/NGS context. An example of these processes is the “Community Creation” (see Figure 8, Deployment Process) who creates and manages communities in the different visibility level (VSC, VNC and VEC). These communities are created at the Deployment phase and managed in the operation phase. Thus, our model facilitates the relationship between the SIP processes and Operation processes.

VI. Conclusion and Future Work

In this paper, we proposed a dynamic Model-driven Service Delivery in an NGN/NGS context with mobility and ambient environment. The proposed Service Delivery focuses on the service layer, where we use the solutions provided by the network (Media Delivery) to guarantee the service continuity.

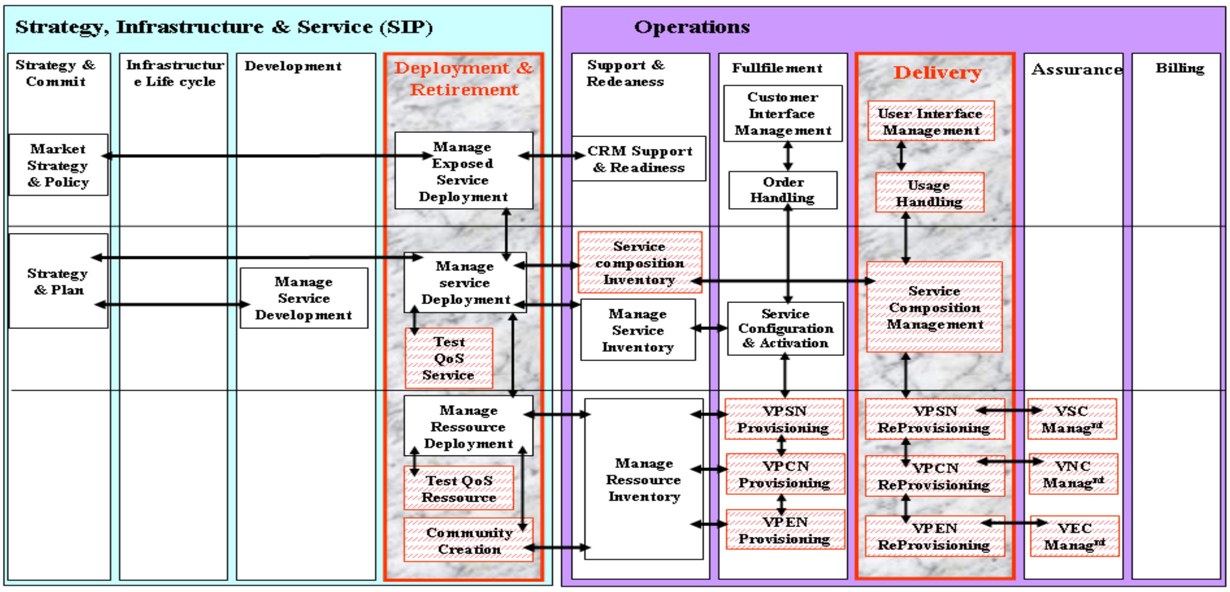

Figure 8 ‘Service Delivery’ process integrated in the eTOM cartography.

And also the solutions provided by the service platform (ubiquity, mutuality, composition and independence of services in the transport layer) to ensure QoS and service continuity during the session. The proposed model (SE, NLN, VPxN and VxC) enables the coherence among the different layers. The VSC enables the anticipation of degradation in order to ensure the QoS continuity. The implementation of VSCs in JXTA, allows us to verify the feasibility of our QoS Management by VSCs in P2P. The VSC and Ambient Environment concept that we have defined to resolve management problems allows taking account into the mobility between different ambient areas. It allows us to make a “Semantic Handover” on other triggers criteria that the QoS management. Thus as a future work, we will finalize the Semantic Handover automate according to different criteria.

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