# A FLEXIBLE MANAGEMENT ARCHITECTURE FOR THE SUPPORT OF ADVANCED BUSINESS MODELS IN 3G MOBILE SERVICE PROVISION


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***Abstract:*** *3rd generation mobile communication networks (3G) have been heralded as a paradigm shift that will irreversibly change the structure of the telecommunications industry. In an ideal "3G world", users will be offered ubiquitous access to an abundance of value-added services[1] (VASs), which will be typically the result of co-operation between many contributing market players in the frame of innovative business paradigms. The path to the realization of this vision, though, will not be easy, as also indicated by the mediocre success of current pre-3G data services based on technologies like WAP and GPRS. It is commonly recognized that the creation of a dynamic marketplace in the emerging 3G era, where complex inter-domain interactions will be commonplace, will substantially raise the bar on the respective management frameworks. The present contribution deals with service provision aspects in 3G network environments and particularly focuses on advanced business models involving multiple entities and their support by mediating service management platforms. We identify the potential of service management frameworks in the context of 3G mobile services and provide a high-level presentation of such a distributed framework that we have designed and developed[2]. Furthermore, we demonstrate that the latter is able to be a catalyst for flexible, adaptable service provision over 3G networks and beyond, while supporting sophisticated business paradigms.*


## 1. INTRODUCTION

Future mobile telecommunication systems, commonly referred to as 3rd generation (3G) [1] are expected to trigger significant changes in the telecommunication services sector, by facilitating the participation of various market players in the overall service provision process. 3G networks are expected to enable the enrichment of services with additional value, which will be contributed by market players other than the mobile network operator. These players will typically come in the form of value added service providers (VASPs), content providers and content aggregators. However, business partnerships and multi-party co-operation are nowadays still hampered by the lack of efficient, largely automated mechanisms for inter-domain interactions (e.g., service deployment across administrative boundaries). Indeed, the fact that applications are developed and delivered by many co-operating entities and need to be deployed on multiple types of networks significantly complicates service deployment and provisioning. Therefore, a need is emerging for intelligent and flexible service provision platforms that will mediate between service developers, network operators and end-users for facilitating and optimizing service delivery [7]. In this contribution, we present the architecture and high-level functionality of such a platform that we have

[1] In the present paper the terms service and application are used interchangeably to refer to an information technology product which is directly accessible and perceptible to the end user and whose value resides mostly in functionality and content, rather than transport or connectivity.


[2] This work was partially performed within the frame of project MOBIVAS (IST-1999-10206, http://mobivas.cnl.di.uoa.gr.) The content of this paper expresses solely the opinion of the authors.

designed and implemented. Furthermore, we identify certain business models for mobile service provision, with a particular emphasis on a new role that we introduce, the *service platform operator (provider)* and show with an example how these models are supported by the proposed platform.

The rest of the present paper is structured as follows: First we discuss certain issues regarding value added service provision in 3G and beyond and in particular describe the envisioned mobile services environment, refer to issues critical to its realization and present the potential of mediating service management platforms in this context. Subsequently, we elaborate on certain business models of mobile service provision, including identification of business actors and revenue flows. We then present the functionality of a service provision platform that supports the application of such business models and act as a catalyst in the delivery of services, by intelligently mediating between involved parties. Next, a scenario demonstrating mobile service delivery through the platform is presented. The last section of this document is dedicated to summary and conclusions.

## 2. MOBILE VALUE-ADDED SERVICE PROVISION IN 3G AND BEYOND

### 2.1 3G mobiles services – The vision

In mobile telecommunication environments until 2$^{nd}$ generation (2G), network access and service/application provision has been typically bundled together in various subscription-based offerings by network operators. Services were typically developed by operators and equipment vendors, possibly in co-operation with a small number of external entities, like content providers. This paradigm led to important restrictions:

The number and functionality of available 2G value-added services is very limited; a typical GSM operator nowadays offers typically no more than a few dozens of content-oriented applications. Consequently, the corresponding revenues are negligible compared with the income from basic and supplementary services.

Service time-to-market is in the order of months or even years, since the coupling of services with the underlying network makes service development, testing and deployment a tedious and time-consuming task.

Most services are accessible exclusively to the subscribers of a single operator.

The introduction of 3G systems aims is to substantially enhance the mobile user experience by providing ubiquitous access to a large variety of functionality-rich applications at high bit rates and reasonable cost, thus leading to a massive increase of revenue from mobile service provision [14] [15] [16] [17].

The range of available services is expected to be enormous and the task of providing taxonomy of the applications that will emerge is very challenging. Relevant efforts have been performed worldwide, including a relevant study of the UMTS Forum [15] that, based on a clearly defined methodology and framework, have identified six service categories that represent the majority of demand for third generation services in the period 2001 – 2005. This classification is depicted Figure 1 and is elaborated below.

In contrary to their 2G predecessors, 3G systems will realize an always-on environment primarily for data communications – rather than voice. Enhancing the user's Internet experience with mobility features will lead to the formation of two similar – yet distinct – market segments: *Mobile Internet Access* for the residential market segment and *Mobile Intranet/Extranet Access* for the business segment. But mobility-enriched transport services are perhaps the least of what 3G has to offer. The fact that the mobile terminal is unambiguously associated with a specific individual allows the provision of customized and personalized service offerings that are tailored to the needs of the particular user; also known as *Customized Infotainment* services. Combined with the always-on nature and the higher bandwidth of 3G networks, the aforementioned association enables the provision of instant – or near-instant – *Multimedia* (e.g., video, audio, text annotations, etc) *Messaging Services (MMS)* to closed user groups. Exploiting knowledge of the mobile terminal's – and consequently a particular person's – current location will generate a rich portfolio of *Location-Based Services* (LBS) that can be effectively combined with other applications to form unique enriched services, targeted to consumer and/or business market segments. Alongside this emerging universe of feature-rich data-centric services and their combinations, voice telephony will maintain its presence, although in the significantly upgraded form of *Rich Voice*, such as Voice-over-IP (VoIP), voice-activated network access, web-initiated voice calls and other yet-to-be-conceived hybrids of voice and data communication technologies.

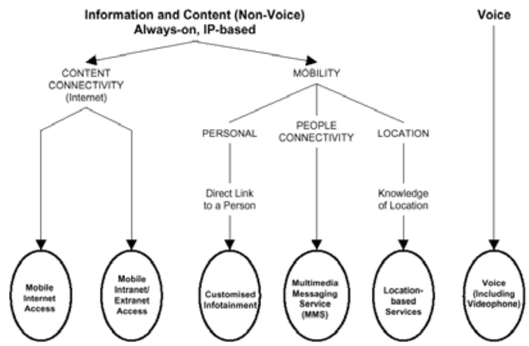


**Figure 1. 3G mobile service categories.**

### 2.2 3G mobiles services – Towards realization

The aforementioned expectations have brought about extensive investments from various market players in activities like technology development, standardization as well as spectrum license acquisition.
The ambitious objectives of the new era are to a large extent reflected in the design principles of 3G networks:

- Packet switching and in particular IP-based networks have been adopted for the transport of data (and in the future also voice) traffic. Besides the advantages in potential capacity gains and ease of deployment, this choice leads also to greater flexibility in network and service design and deployment, as well as the introduction of sophisticated billing schemes that can be tailored to specific applications and thus be more attractive to the user.
- There is a clear distinction between the network and the service/application domain. End-user services in themselves are no more subject to standardization (very few exceptions to this rule have survived the 3G specifications); merely service capabilities are being standardized [2]. Moreover, open APIs, like OSA/Parlay [13] [4], have been specified, enabling third parties to create advanced applications by making use of selected network functionality.
- The access and core network are to a significant extent decoupled, so that service provision over diverse access technologies is possible [1].

Despite the intensive efforts of market players (in particular equipment vendors and mobile operators), however, significant delays are experienced in the development and commercial deployment of 3G systems. Furthermore, pre-3G mobile data services based on technologies like WAP and GPRS have gained only modest popularity and have mostly failed to overcome the limitations of 2G models.
The above facts have created uncertainty regarding the realization of the 3G vision and the return of investment for the involved parties and have a considerably negative impact in the telecommunications industry worldwide. Many reasons could be identified for these unpleasant developments: Regarding the holdup of 3G introduction to market, possibly the two main hindering factors are the complexity of 3G systems as specified by standardization bodies, which makes their development an extraordinarily

challenging and time-consuming task even for the major equipment vendors, as well as the failure of academia and industry until now to provide complete answers to crucial technical issues (e.g., end-to-end quality of service in IP networks, inter-domain network and service management, adaptability and context-awareness of systems and applications, development of semantically-rich applications that exploit the abundance of information available in enterprise storage and the World-Wide Web, effective human interaction with small devices). On the other hand, the moderate success of pre-3G mobile data services is commonly attributed to the immaturity of the technological infrastructure (networks, devices). While this is to a large extent correct, another important factor is sometimes not attracting the appropriate attention by the involved parties: The lack of advanced, functionality-rich services that would provide real added value to the end-user and will make him/her pay for them. This unavailability is mainly caused by the inability of business players (network operators, service developers, content providers) to efficiently and seamlessly co-operate in a dynamic marketplace in order to reduce service time-to-market and offer the end-user a diversity of applications, rich in functionality and content. Instead of that, mostly "walled garden" partnerships have prevailed until nowadays, which have mostly failed to provide perceptible added value for consumers and generate the corresponding revenues. For example, the dominant feeling between users is that the range of content offered via WAP is very limited. Besides that the available WAP sites are indeed not great in number, this impression has been created also due to the fact that the range of WAP sites that an end-user is allowed to access depends on (and mostly is restricted by) the mobile operator he/she maintains a subscription with [15].

### 2.3 The potential of service management platforms

3G service provision has to overcome the problems described in the previous paragraph before it becomes a commercial success story. This can be accomplished, only if the service provision value chain is contributed by a large variety of non-telecomm market players, including software vendors and content providers, since a single organization, cannot have the expertise required. In this context, the mobile operator is identified as an entity that can play an important part in the overall service provision value chain, undertaking various roles other that a plain bit pipe provider [18]. For example, in [15], based on the previously defined service classification framework and taking into consideration market trends and industry dynamics, the UMTS Forum identified three probable business roles (depicted in Figure 2) for 3G mobile network operators:

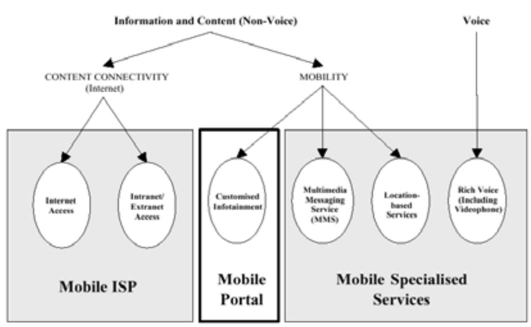


**Figure 2. Example business roles for 3G mobile network operators.**

- **Mobile ISP** providing typical ISP services with revenue streams from ISP subscription and airtime.
- **Mobile Portal** providing a mobile portal for access to selected – typically partner – content as well as access with revenue streams from subscription, airtime, advertising and transactions.
- **Mobile Specialized Services**, providing a specialized service capability (e.g., online retrieval of positioning information) for a service set (e.g., location-based service) targeted to a particular market segment (e.g., tourists) with revenue streams from subscription, airtime and messaging.

These business models, while identifying several roles for the next-generation mobile operator, do not (and maybe in any case could not) address certain major aspects of service provision. For example, besides content, 3G mobile subscribers will demand advanced applications, that should also be subject to personalization and context-awareness. Moreover, for Mobile Specialized Services, there is no recommendation as to how they are offered (and actually, there shouldn't be any). One could possibly think of an example of a location-based service, which could retrieve location information from the operator infrastructure (e.g., via the Mobility SCF of the OSA /Parlay interface). In this case, the operator undertakes the Mobile Specialized Services role. However, a location-based service could also retrieve user location data from non-cellular network dependent ways (e.g., plain GPS) and thus is such a case the operator will have the role of just a Mobile ISP. Furthermore, issues like service discovery by the end user and how the latter is billed for its usage, are of primary importance.

It seems that the forthcoming mobile systems from 3G and beyond introduce significant complexity into various aspects of mobile service provision: The range of combinations of business partnerships and relationships that can be formed for offering mobile services can not be predicted; users should expect highly personalized service discovery and access in an exceptionally large variety of environments, while billing for application usage should be performed in new, flexible ways.

In this context, the potential of intelligent service management platforms that act as mediators between VASPs, end-users and mobile network operators can be clearly identified [7] [6]. Certain functionality, which is crucial for mobile service provision in 3G and beyond can be more efficiently handled in a unified way by a mediating platform residing between the network operator and the VASPs than by entities like individual applications and mobile networks. This approach has the important benefit of simplifying and lowering the overhead of certain important tasks, by assigning them to a specialized entity (service provision platform) instead of distributing the corresponding responsibility to a multitude of actors. Ultimately this could lead to drastically decreasing the overall cost of mobile service provision for the involved market players and lowering entry barriers for new third-party service and content providers.

The tasks that should be undertaken by a service management platform would include:

- Rapid, automated service deployment. The deployment process normally comprises business-level agreements between the various parties involved in service provision, installation of service components to appropriate physical locations and appropriate configuration of network equipment (e.g., routers, transport bearers). All these operations should be automated to the highest degree possible. Moreover, a single application might need to be deployed over different technologies (types of radio access network), a fact that should be opaque to the service developer. The services that can be deployed should not be constrained by requirements regarding implementation technology, VASP identity, etc.
- Adaptability and context awareness. In mobile systems from 3G and beyond, which are designed to support connectivity over heterogeneous access networks and through a large diversity of devices [8], services should be accessible in an unprecedented variety of contexts, which could not be predicted or catered for during service design and development. These extensively demanding requirements clearly indicate the need for adaptability of applications as well as service provision and delivery procedures to highly diverse environments [9]. Adaptability to unpredictable environments and situations is a very challenging task, and the corresponding burden of developing adaptation logic should be ideally off-loaded from each service developer to a platform offering generic adaptation to a multitude of VASPs.
- Creation of a service one-stop-shop (e.g., mobile portal-like) for end-users, where the discovery and optimal provision of a plethora services is performed from a single user interface, and is customized to the service provision context (e.g., terminal capabilities, user preferences, location, network characteristics). This, to a large extent, should save users the time and effort of locating and getting familiar with what they need in an abundance of available applications. The described functionality should be accomplished through the maintenance of appropriate user profile information that would

exceed the subscriber data typically kept by mobile operators in network nodes (e.g., HLR).

- Flexible and reconfigurable billing. Rigid connection time-based schemes are no longer sufficient for handling charging and billing for the advanced multimedia services that are expected to emerge in the 3G era. The application of a variety of arbitrarily sophisticated pricing schemes should be commonplace. Moreover, a single bill should be generated per user for all basic and value-added services. Resolving these issues requires the development of billing systems that collect and process data from various network infrastructures (3G access networks, wireline IP networks) and enable the on-the-fly reconfiguration of pricing schemes as well as the dynamic modification of tariffs [10] [11] [5]. Thus, traditional telecommunication billing systems in use by mobile operators do not provide an adequate solution.

## 3. ADVANCED BUSINESS MODELS FOR MOBILE SERVICE PROVISION

The introduction of 3G systems is expected to be a major step towards a new era in telecommunication service provision. The transition from the rigid, strictly operator-centric, pre-3G past to a dynamic, open market should be evolutionary and lead to models that preserve the positive features of existing paradigms, while removing their limitations [5]. In this context, we propose the introduction of a new business actor, called the *service platform operator/provider* who owns and administers a mediating mobile service management platform, with the functionality described in the previous paragraph.
The business actors that we identify in the mobile service provision value chain are depicted in the UML class diagram of Figure 3 and elaborated in the following.

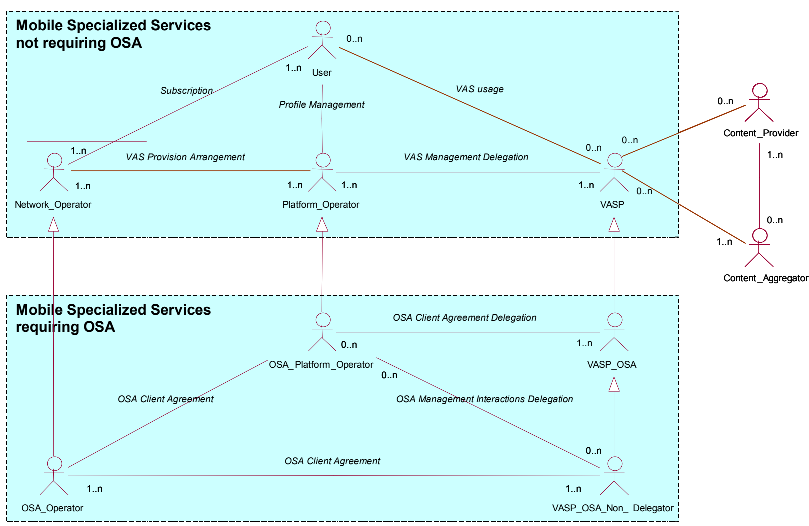


**Figure 3. Business actors in mobile service provision.**

In the proposed paradigm the following roles are defined:
*(Mobile) User*: An entity that is the actual consumer of the available services. The user requests the provision of value added services and applications from a service platform operator entity. To formulate and manifest these requests, the user employs a communication and computing infrastructure contributed by another entity in the business model, the network operator, with whom the user maintains a business relationship in the form of a subscription.
*Mobile network operator*: The mobile network operator is an entity that provides the network infrastructure and transport medium for authenticated and authorized mobile subscriber access to standardized circuit- and packet-switched services (e.g., voice telephony, Internet connectivity), as well as value-added services developed by third parties. It maintains the customer relationship with the user via a

subscription arrangement. The network operator would also typically provide independent software vendors with access to network functionality, through open, standardized APIs (e.g., OSA/Parlay), thus, undertaking the role of the *OSA/Parlay operator*. In our model, we assume that the OSA/Parlay operator is a specialization of the network operator (in other words, the OSA/Parlay operator is itself a network operator). Although this is not strictly imposed by the 3GPP and OSA/Parlay specifications, we believe that it is going to be the massively prevailing paradigm in 3G networks. In Figure 3 there is a clear grouping of the actors that are introduced for the deployment and provision of services (of the Mobile Specialized Services category, as described in section 2.3) that make use of the OSA/Parlay interface.

*Service platform operator/provider*: A business entity that mediates between service developers, network providers and end-users by operating a software platform for service management and provision. The platform operator comes into business level agreements with network operators and VASPs. These agreements concern the provision of services and applications owned by the latter to subscribers of the network operator. A specialization of the Platform Operator is an entity (*Platform_OSA_Operator*) that is able to undertake the deployment and provision of services that make use of the OSA/Parlay APIs. This is considered as a situation that deserves to be modeled by a separate role, since the management of OSA/Parlay applications introduces significant additional administrative effort as well as new business relationships compared with the case of plain (non-OSA/Parlay) services.

*Value-Added Service Provider (VASP)*: A business entity that controls the computational infrastructure directly employed in the process of developing and realizing applications and services. Such services can range from VoIP and teleconferencing to mobile banking and electronic commerce. Service providers establish business level agreements with platform operators, outsourcing to them the deployment and provisioning of their services to various 3G networks. Business-level agreements between VASPs and users are not required; however, they are not precluded. A specialized class of VASPs encompasses the providers of services that make use of the OSA/Parlay API (*OSA_VASP*). These providers may choose to undertake themselves the required business interactions with the OSA/Parlay operator (this corresponds to the OSA_VASP_Non_Delegator role) or delegate them to the Platform_OSA_Operator. The latter possibility enables small software vendors in the OSA_VASP role to avoid the management overhead and cost of having a contract directly with the OSA/Parlay operator. Thus, it is a step towards making the entry to the telecommunication services market easier for independent software enterprises.

*Content Provider:* An entity that is able to provide some form of content that can be of value to mobile users (e.g., stock prices, music, news). The content provider may establish business relationships with content aggregators or directly with VASPs, so that the content can be exploited in the context of mobile services.

*Content Aggregator:* An entity that collects content from various sources (content providers) and aggregates/packages it in a meaningful way so that it is more conveniently discoverable/accessible or more usable for interested parties (e.g., VASPs) than the data retrieved directly from content providers.

In the proposed paradigm, there is not necessarily a one-to-one relationship between actors and real-life entities. For example, a 3G-network operator could undertake the roles of OSA and Platform_OSA operator. Moreover, a platform operator or content provider could also itself be a VASP.

Figure 4 and Figure 5 depict revenue flows for two cases of mobile service provision involving the business actors defined in this section. It is worth noting that revenue flows ("who gets money from whom") ultimately depends on the relative strengths of the involved entities in a particular context and cannot be accurately determined or predicted. Thus, revenue generation patterns other than those illustrated in the figures below could occur between the same business actors in a given real-world situation, although we believe that the given examples represent realistic and feasible paradigms.

In the model shown in Figure 4, the mobile operator undertakes the role of the service platform provider and is directly engaged in business agreements with the VASPs for both VAS deployment and the management of VAS access to network functionality via the OSA/Parlay interface. The user receives a single bill for basic and value added services. Part of the revenue from the latter goes to the VASP. This arrangement could be a natural evolution of the pre-3G paradigms. The typical mobile network operator possesses significant strategic advantages, like an existing large subscriber base, direct customer relationship as well as easier access to information provided by the network, like user location. The trust relationship with its subscribers, possibly combined with a strong brand can be an important factor for attracting end users to 3G services that could benefit the overall development of the 3G market in the short to medium term. However, it is doubtful whether operators are able or willing to significantly extend their expertise in the IT domain so that they can cope with such a role. Moreover, a network operator running a service provision platform would probably offer deployment of services solely on its own network.

In Figure 5, a different setting is illustrated, where the service management platform is administered by an entity other than the mobile operator. Revenue sharing should then be applied also between network and platform operator. This paradigm enables third parties to become specialized in the service platform operator role, partner will various network operators and thus offer VASPs fast service deployment over multiple networks through only a single business-level agreement. Nevertheless, this would require significant effort, for gaining customer recognition (from both end-users and VASPs) as well as establishing non-exclusive business relationships with many operators.

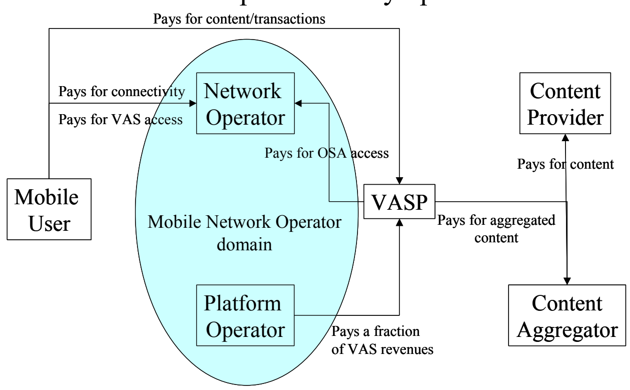


**Figure 4. Revenue flows in the case that the service management platform is administered by the mobile network operator.**

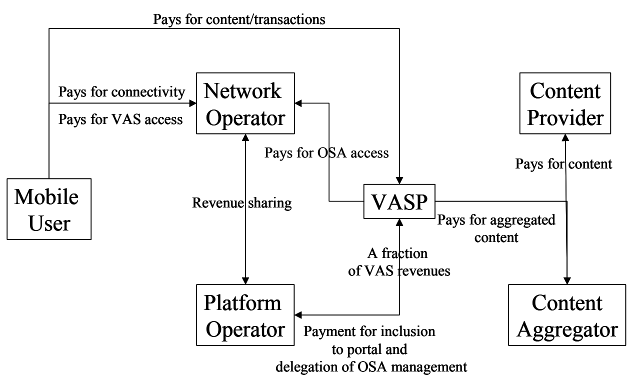


**Figure 5. Revenue flows in the case that the service management platform is administered by an entity other than the mobile network operator.**

## 4. AN ADVANCED SERVICE MANAGEMENT PLATFORM

In this section we introduce the architecture of a distributed middleware platform, aiming to provide the functionality described in paragraph 2.3. The proposed software framework should be administered by an entity undertaking the service platform operator/provider role, as elaborated in the preceding section and is

designed to support the advanced business models previously presented in this paper. The entire framework comprises several distributed software components.
The functionality of each of the architecture components is briefly described in the following:

- The VASM [7] is the central component of the platform, catering for the automatic service registration and deployment by 3rd party VASPs including the necessary reconfiguration actions on the underlying network for optimal service provision and the management interactions between mobile network/OSA operators and VASPs. Moreover, it handles service adaptability to highly variable environments by providing to the end user a mobile portal for personalized and context-aware service discovery and access.
- The L4+ Systems [12] are able to perform filtering of IP traffic, monitoring of specific flows and QoS provisioning, by examining transport layer information in addition to the network layer data used by conventional IP routers. In the proposed architecture the L4+ systems are located at the edge of the connectivity network of the mobile network operator so that they process all traffic between VASPs and users. They are configured by the VASM to provide QoS to specific IP traffic flows that correspond to service access and produce VAS usage records that are necessary for billing.
- The CAB system, using the information provided by the L4+ systems and the UMTS network for the usage of its resources, calculates the overall charges induced by service consumption and apportions the aggregate revenue among VASPs, the MOBIVAS platform operator – as well as the 3G network operator, if different from the latter. The system produces a single, itemized user bill. It has been designed to allow the application of arbitrarily complex billing models and tariffing schemes and to be dynamically reconfigurable by the VASM. A more detailed description of the overall approach for charging and billing is beyond the scope of the present paper. A thorough treatment of relevant issues can be found in [10] [11] [5].

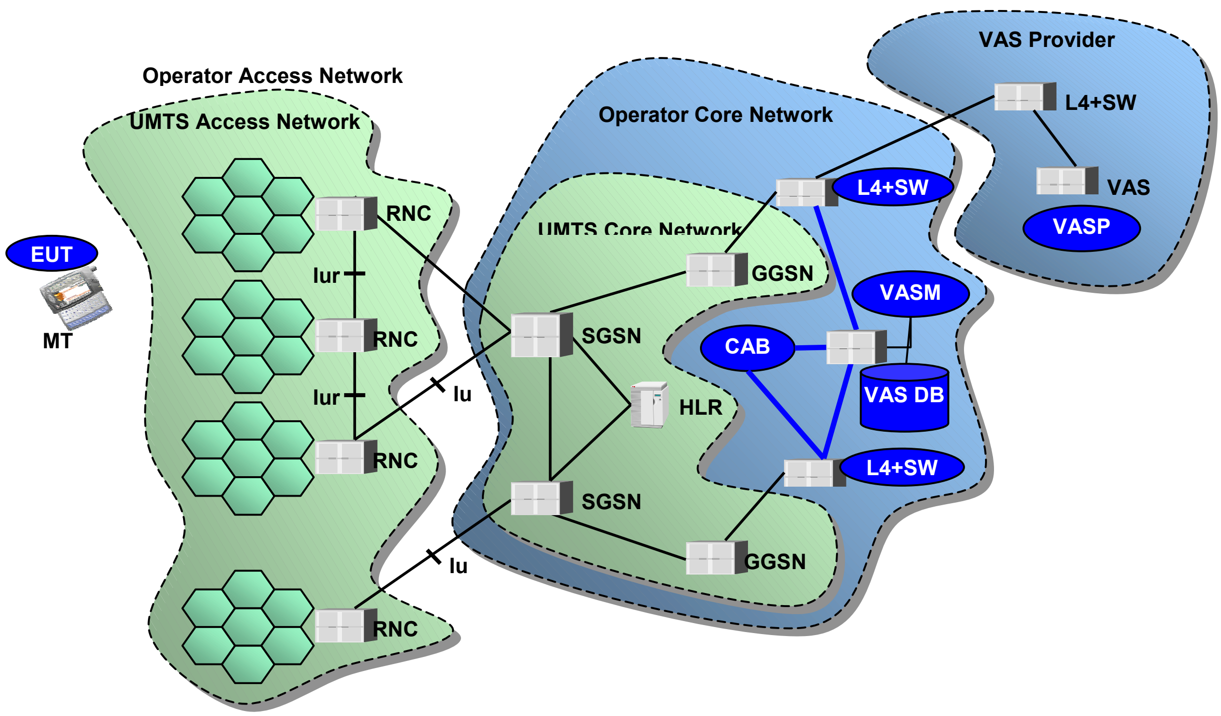


**Figure 6. The proposed architecture.**

- The VASP component of the platform handles secure terminal access to a repository of VAS clients and also contains web interfaces to VASM functionality, through which VASPs can carry out sophisticated service management operations (e.g., VAS deployment).

- The EUT comprises modules that provide a variety of functionality, like a graphical user interface for VAS discovery, secure downloading and lifecycle management (e.g., start/stop/abort/resume) of VAS clients, as well as initial user registration with the platform and subsequent user login/authentication.

The platform architecture as well as an example physical placement of the above-mentioned components is depicted in Figure 6. Note that while integration of certain framework parts (e.g., VASM and CAB) to a single physical location is possible, platform components can be physically distributed, since only IP connectivity is assumed to be available between them.

The introduction of the proposed framework results to the burden of service deployment and management being to a large extent moved from the VASP to the service platform operator. The platform is adaptive, so that it can manage a wide range of disparate services over a variety of underlying radio access and core transport networks. Moreover, the intelligence required to implement the service provision adaptation functionality is placed in the service platform, thus lowering requirements on mobile terminals and application logic and extending the applicable service provision domain. This way, the mobile terminal or network infrastructure need not adapt to the service requirements; rather the service delivered via the download mechanisms is dynamically adapted by the platform to the current context.

## 5. EXAMPLE SCENARIO OF 3G MOBILE SERVICE PROVISION

In this section we present an example of service provision over a 3G network, where the previously mentioned business models can be applied with the support of the proposed platform. The case presented also illustrates the disparity in possible context-dependent situations in 3G service provision and the potential of service management platforms for addressing such environment unpredictability.

Before elaborating on our scenario, we should briefly refer to our perception of the “value added service” concept in 3G, which was taken into consideration in designing and implementing the platform. A service will typically consist of code that runs in the end-user terminal (service client) and optionally a server part. The former includes, besides other functionality, the service user interface. It can be pre-installed in the terminal, or downloaded and executed on demand. The latter case is aligned with the dynamic nature of service provision desired for 3G systems. Service execution normally, but not necessarily, includes interaction with the server part. If available, the application server part is located in the premises of the service provider (e.g., web server). Multi-tier architectures will be also commonplace, where the server part comprises many interacting components. These components may be located in the administrative domains of entities other than the service provider, like content providers marketing access to their databases, or network operators providing interfaces to network functionality (e.g., OSA, Parlay, JAIN). A service in general comes in many versions (editions), targeted to different contexts.

Coming back to our example, we consider a hypothetical multimedia application for viewing exclusive video clip content. The content is available through content providers/aggregators that maintain video clip repositories. A VASP has developed an advanced application, which enables viewing as well as processing video clips and has come into agreement with the content providers for repository access. Moreover, the VASP has established a business-level relationship with a service platform provider, which concerned the deployment of the service over various mobile networks (the latter included arrangements for providing the required QoS to the application, as well as charging service access according to the appropriate billing policies). The service complies with the aforementioned application model that prescribes one or more downloadable clients (also termed client proxies) for each application. Furthermore, the VASP promotes the profiling of the users of his/her applications by providing an optional “temporary storage” service for the requested video clip free of charge. For each mobile user that requests a particular video clip, several context-dependent factors determine the optimal service provision configuration. Let us consider the following hypothetical scenarios (Figure 7):

1. The mobile terminal that the user is currently employing does not have sufficient persistent storage

(e.g., disk space) to store the particular video clip, thus leaving streaming mode as the only feasible option of immediate content delivery. Since persistent storage of the video clip at the user's mobile terminal is not possible, the charging model applicable should reflect the cost of one-time-delivery only, i.e., the use of wireless and wireline network resources and possibly a minor charge due to the content's exclusiveness.

2. The mobile terminal that the user is currently employing has sufficient persistent storage for the particular video clip, thus implying the application of a different charging model, i.e., once the user has successfully downloaded the video clip at his/her mobile terminal, he/she has acquired copyrighted content and thus must pay the premium attributed to the copyright.
3. The mobile terminal that the user is currently employing has sufficient persistent storage for the particular video clip, however, the user's account balance is insufficient for either streaming or download-and-store delivery mode, leaving the "temporary storage" service offered by the value-added service provider as the only possible option. In this case, the applicable charges will include the copyright premium but not the use of wireless network resources for the particular video clip.

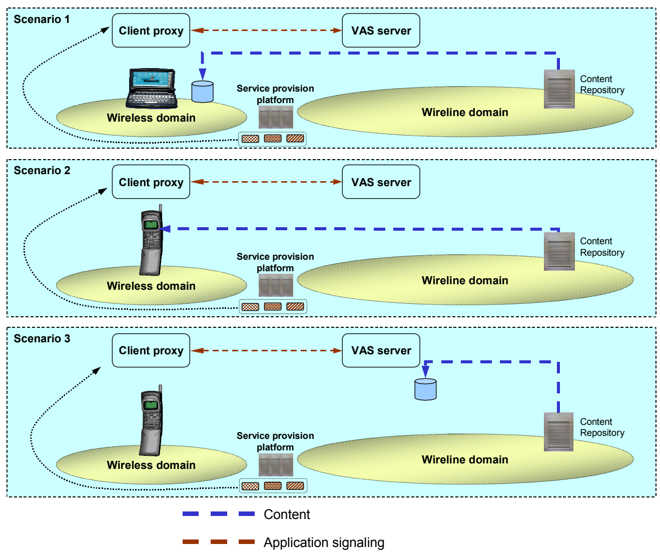


**Figure 7. Illustrative scenarios for service provision platform's potential to an adaptable service provision process.**

Evidently, delegating the complexity of coping with such multi-faceted alternatives in an efficient manner to the application developer introduces unnecessary complexity in his/her application development process and bloats up the application code. We should note that it is not as much the functionality required by each aforementioned scenario (i.e., streaming functionality, download functionality, etc) as the accommodation of the decision logic that introduces the major complexity. For instance, retrieving context information from various sources (e.g., OSA/Parlay network interfaces) and selecting the most appropriate alternative leads to significant overhead for the service developer. The proposed service provision platforms address such multifaceted situations by providing functionality that can efficiently support context-dependent decision-making processes on behalf of both mobile users and value-added service providers.

## 6. SUMMARY - CONCLUSIONS

Third generation systems mark a paradigm shift in mobile communication technologies. Their market opportunities are tremendous, but so are the technical and business challenges that must be confronted. To a great extent, success of third generation systems will depend on whether a sufficiently large mass of independent application developers will be engaged and committed to the production of innovative value-added services and feature-rich applications for the 3G environments. With that in mind, technical solutions and business arrangements that lower the technical complexities imposed on them and allow them to focus on the conception, specification and development of innovative service products should be given absolute priority.

Service provision platform approaches present an attractive solution that can contribute to the efficient resolution of technical issues (e.g., inter-domain network and service management) whilst supporting the advanced and more complex business arrangements that can reap market success in the forthcoming 3G era and beyond. Particularly in combination with OSA-enabled network environments, service provision platforms can help realize important benefits for all players, users, mobile network operators and value-added service providers alike.

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