An application platform for downloadable VASs provision to mobile users

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Abstract: *For the provision of downloadable Value Added Services (VASs) to mobile users, the introduction of an Integrated Software Re-configurable Platform is required. Re-configurability aspects have to be deployed not only at the mobile terminal side, but also throughout the application architecture at the fixed part of the network. MOBIVAS perspective is the introduction of a modular architecture and components for the support, charging and provision of downloadable value added services offered by independent VAS Providers via an operator's network.*

1. INTRODUCTION

The MOBIVAS project [1] will introduce an Integrated Software Re-configurable Platform for the dynamic Value Added Services (VASs) provision to mobile users [2]. The main objective of MOBIVAS is to define, design and develop an integrated application architecture and prototypical implementation of software platforms and systems for the interaction and download of available VASs. The various VASs will be provided by independent Value Added Service Providers (VASPs) interconnected to an Operator's network via a VASP network infrastructure. Towards this goal new specialised network components are introduced to the core and access network of an operator. The functionality of these components takes advantage of existing protocols and standardised components, placing minor requirements for modification or enhancement of well established procedures.

The various VASs will be supported in addition to the basic services provided by the various operators over several network types (e.g., UMTS [3][4], GPRS [5]). Therefore, apart from the necessary mechanisms for service download and VASP interconnection, a dynamic accounting and billing scheme should be introduced. The generic architecture and software modules to be introduced are to be modular and evolutionary to cope with the required "openness" of the overall platform. Several solutions are to be considered for the component development in order to achieve this requirement [6].

The rest of the paper is organised as follows: The generic architecture and interfaces of the MOBIVAS components are presented in chapter 2. In chapter 3, the necessary accounting/billing scheme to be introduced in the MOBIVAS platform is described, while chapter 4 comprises the conclusions.

2. GENERIC ARCHITECTURE AND INTERFACES

To support the necessary functionality for downloading VASs, new software modules will be deployed in the existing access and core networks [7]. The new modules are the Access Network Added Intelligence (ANAI), the Value Added Service Manager (VASM), the Charging-Accounting and Billing (CAB) System and the Layer 4+ switch (L4+sw). The ANAI is placed at the Access Network, while the VASM and the CAB modules are located at the operator's core network, along with the L4+sw, which interconnects the VASPs network to the operator's network. The generic architecture of the MOBIVAS components is presented in Figure 1.

To provide and adapt the service offering according to the mobile terminal's capabilities, MOBIVAS supports a terminal classification and negotiation procedure between the mobile station (MS) and the VASM. Within this framework the ANAI will provide the required functionality to support the enhancement of the terminal capabilities and the downloading procedure between the MS and the VASM.
Once the MS registers at the operator's network, the user will be able to request from the VASM a Look-Up Service (LS) that contains a list of VASs (with a range of available versions of each VAS) the MS can execute along with associated information (e.g. short description, tariffing information). An essential part of the overall MOBIVAS functionality that must be provided by the ANAI is the efficient downloading of the LS from the VASM towards the MS. After the user at the MS selects a VAS to use, the ANAI will provide the appropriate signalling communication towards the VASM and the VASP in order to initiate the respective procedure for downloading the corresponding service components.

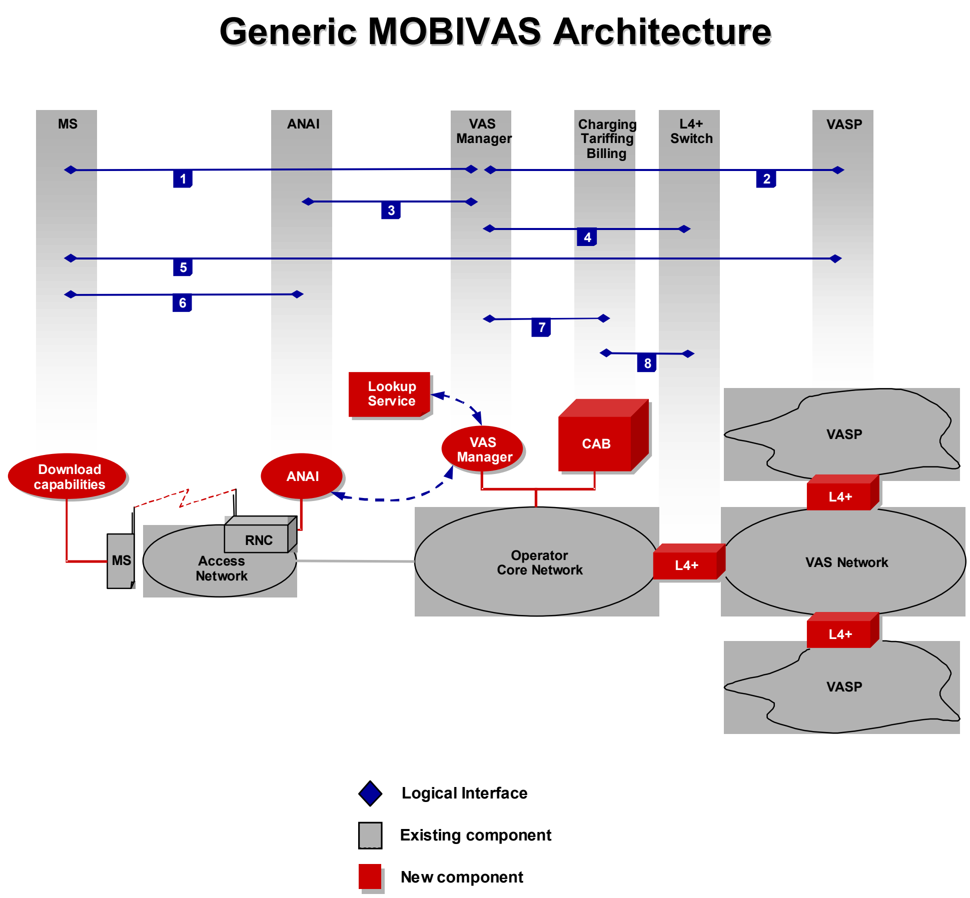

Figure 1 Generic MOBIVAS architecture and preliminary interface identification.

In addition to the download of service components, the ANAI will also support the dynamic download of protocols to the MS. This will allow the dynamic reconfiguration of the protocol stack at the MS, thus facilitating access through a variety of access networks and forming the basis for a much broader service provision scheme.
Furthermore, to support the efficient execution of VASs, a protocol proxy scheme will be supported by the ANAI. In this scheme, the protocol stack at the MS is split into two parts: a lightweight part that executes at the MS, and a more resource-demanding part that is executed in the access network. A suitable protocol – possibly a Last Hop Protocol – will be used for the communication between the two parts. This scheme will lead to a greater economy of resources at the MS, thus facilitating prolonged VAS sessions.

The VASM is situated at the operator core network and it is likely the most complicated and sophisticated component within the MOBIVAS architecture, since it coordinates the required procedures for the seamless and consistent provision of the VASs to the mobile users. To support these VASs the VASM has to cater for the dynamic introduction and registration of new VASs from various VASPs, based upon qualitative, beneficial and accounting criteria. In addition, the VASM keeps track of all offered VASs in an appropriate database, the VAS DB, in order to be able to provide this information to authenticated users through the requested LS. The LS formulation is based on information contained in the user profile and the results of the preceding terminal capabilities negotiation procedure, through which the VASM is informed about the actual and enhanced (due to ANAI) technical capabilities of the requesting MS, so as to adapt the produced LS to them.

Another important network component in MOBIVAS is the L4+sw that is installed "at the edge" of the operator's core network. The various VASPs will offer their services by connecting their network infrastructures to the operator's network via the L4+sw. The L4+sw will support the efficient identification of the transit traffic flows that belong to a VAS session between a MS and a VASP. The examination of the transit traffic at the L4+sw will be performed with the necessary resolution that will allow the identification of traffic flows on a per-user, per-session and per-service level. The L4+sw shall also format all charging information related to VASs usage as records that will be delivered to the CAB system.

To make the added value of the MOBIVAS infrastructure more apparent to the users, the operator's network will support the provision of each VAS with a corresponding quality of service (QoS). The exact scheme that will be selected by the network operator for the management of QoS for VAS traffic should be interoperable with the scheme employed at the L4+ switch for the identification of transit VAS traffic. Furthermore, the QoS scheme employed at the core network must correspond and be interoperable to the QoS schemes provided by the access network, to provide a consistent QoS level on an end-to-end basis between the VASP and the MS.

Based on the aforementioned functional behavior of the various MOBIVAS elements the interactions between the main components of the platform are:

Interactions between MOBIVAS core network components:

- The L4+sw interacts with the VASM, since it must be informed about the addresses of the contracted VASPs and VASs and instructed how to classify the incoming data flows (i.e. which data it has to collect for the CAB system) (interface 4 in Figure 1).
- The VASM interacts with the CAB system for the provision of the VAS tariffing and accounting information that relates to each specific VAS (interface 7 in Figure 1).
- The L4+sw also interacts with the CAB system to deliver the collected data related to the VAS usage (interface 8 in Figure 1).

Interactions between MOBIVAS core network components and VASP network:

The operator's network and the VASP network are interconnected through Layer 4+ switches. The operator's core network infrastructure is used as a transit network for the transfer of service data and content from the VASPs to the access network and the mobile terminal. The VASM should be able to interact with the contracted VASPs for:

- Dynamic registration of its VASs to the VAS DB that contains all VAS versions/editions and respective details (e.g. description, tariffs, required terminal and network capabilities) for each one.
- Dynamic update/de-registration of its VASs.
- Exchange of information about the usage of their VASs and the amount that is due to each VASP.

The above interactions take place over interface 2 in Figure 1.

Interactions between MOBIVAS core network components and access network

- Between VASM and ANAI: The ANAI should act as an intermediate component between VASM and MS regarding the information that has to be exchanged during the terminal capabilities classification and service negotiation procedures. In MOBIVAS, the ANAI caches locally popular or location dependant services to facilitate efficient access to them. To develop this functionality, it is required that the ANAI exchanges information with the VASM, since the latter knows the exact repository of these services in the VASPs network and can provide all the relevant information to the ANAI (interface 3 in Figure 1). Furthermore the ANAI should be triggered when necesary to initiate a protocol downloading procedure towards a MS or to act as protocol proxy server for the requesting MS.

- Between VASM and MS: To support the terminal classification procedure [9], the provision of the LS and the user authentication procedure. Also, to support the negotiation about QoS requirements and the protocol stack or proxy architecture to use for a specific VAS or application and to provide some indicative information to the end user about the tariffing characteristics of the VASs (interface 1 in Figure 1).

Interactions between mobile terminal and access network

- Between MS and ANAI: To support the identification and downloading of protocols at the MS and the implementation of a protocol proxy approach, where the major processing load of the application or protocol in use at the MS is actually realized at the ANAI. Also, to support the exchange of information between MS and VASM that is required for the terminal capabilities announcement and the service negotiation procedures, as well as for the downloading of popular or locally cached services to the MS (interface 6 in Figure 1).

Interactions between mobile terminal and VASP network

- Between MS and VASP: To support the downloading of the movable part of each VAS at the MS's execution environment, as well as the execution of the VAS (interface 5 in Figure 1).

3. CHARGING ACCOUNTING AND BILLING SYSTEM

The design of the CAB system for VASs is a crucial point of the MOBIVAS platform. To achieve a real-world applicable solution, an integration of charging, accounting and billing processes for VASs is required [10]. The introduced CAB system has to incorporate the existing functionality of the operator's related components and in addition to provide supplementary capabilities for the requirements imposed by the MOBIVAS functionality (e.g., the user must be able to gain information on the price of a VAS before or during its usage, itemised billing for every VAS). The CAB system is located in the operator network and consists of 4 major components, shown in Figure 2

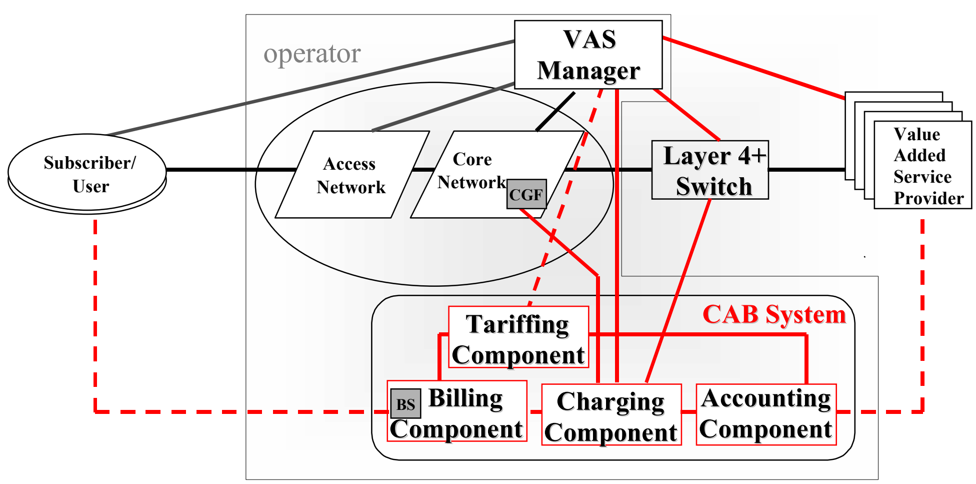

Figure 2 The Charging, Accounting and Billing System

The Charging Component receives from the L4+sw VAS Detail Records (VASDRs) for the usage of VASs and also receives Call Detail Records (CDRs) from the operator's Charging Gateway Functionality (CGF). The CGF collects information for each MS from the Serving GPRS Support Node and the

Gateway GPRS Support Node, which are serving the MS [11]. This charging information concerns the radio network usage, the external data network usage and in general the usage of network resources. The charging component performs specific activities, such as processing of the contents of each record and correlation of VASDRs and CDRs that concern the same VAS usage event. For each chargeable event related to a VAS, the Charging Component creates two records, the billing and the accounting record, and forwards the former to the Billing Component and the latter to the Accounting Component. It also forwards the CDRs received from the CGF to the Billing Component. For the usage of basic bearer services and any value added services that may be provided by the operator, the Charging Component receives only CDRs and creates a corresponding billing record for each chargeable event.

The Tariffing Component is relevant with the tariffing and market policy and consists of databases with customer specific and service specific accounting parameters and the sharing of charges between the operator and the VASPs [12]. The Tariffing Component also contains various pricing models according to which the Billing Component calculates the charges. During the registration of a new VAS, the VASP specifies not only the tariffs but also which pricing model should be used. These pricing models may combine technical and economic aspects, such as volume of resources used by the customer, along with marketing criteria.

The Accounting Component receives accounting records and in co-operation with the Tariffing Component processes the apportioning revenue between the operators and the VASPs. It is also responsible of informing the VASPs – via the VASM – about the usage of their services and the amount that is due to them. This component is also involved with the revenue of charges between the home network operator and a visiting network operator in case of roaming.

The Billing Component receives billing records and based on the pricing models and the tariffs that it gets from the Tariffing Component, calculates the cost of each chargeable event and generates detailed bills. Most existing Billing systems are not standardised and their functionality is specified by the operators. Thus, it is likely that they cannot provide significant foundation for the new requirements arising in MOBIVAS (e.g. itemised billing for all services). In case the operator’s Billing System is standardised, or evolutionary, the MOBIVAS Billing Component could enhance the functionality of the existing Billing System for the new requirements to be fulfilled. The CAB system has an interaction with the VASM that is used to exchange data for tariffing and accounting, e.g. to change the tariffs, or to notify the users about the pricing model and the respective tariffs of a requested VAS. In case that a new VAS is registered, the VASM should inform the CAB system about the tariffs, the apportioning revenue between the operator and the VASP and the pricing model applied to the VAS. Also in case of an update or de-registration of a VAS the CAB system should be informed.

According to this proposed architecture and functionality, the CAB system interfaces with the L4+sw, the Operator, the VASM, the MS and the VASPs.

The interface with the Operator’s core network is used to receive CDRs from the Operator’s Charging Gateway and possibly to get any customer specific and service specific parameters, necessary for billing and accounting process.

Since the L4+sw generates VASDRs and sends them automatically to the Charging component, the interface with the L4+sw is used to get the VASDRs.

The CAB also communicates with the subscriber/user to issue the bills. In MOBIVAS, we assume that each user will receive only one bill for accessing and using VASs and typical Operator’s services. CAB is also connected with the VASPs to inform them about the usage of their services and the amount that is due to them.

4. CONCLUSIONS

The MOBIVAS perspective is to ensure the provision of downloadable VASs to mobile users by independent VASPs. Towards this goal new network components are introduced that place minor requirements on the existing infrastructure while at the same time enhance the overall network capabilities. In MOBIVAS new dynamic procedures are deployed such as the MS capabilities negotiation and terminal classification as well as the downloading of protocols and services with diverse QoS requirements. Finally, provision is taken to support the charging, accounting and billing procedures to enable the dynamic introduction of new VASs and a flexible billing process for the users.

5. ACKNOWLEDGEMENTS

This work has been performed in the framework of the project IST MOBIVAS, which is partly funded by the European Community. The Authors would like to acknowledge the contributions of their colleagues from Thomson-CSF Communications, Hellenic Telecommunications Organisation, NEC Europe LTD, University of Athens, Ecole Nationale Supérieure des Télécommunications, Technical University of Berlin, OTE Consulting, UNIS, IDATE, Innovators.

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