Personalized services for virtual home environment

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Abstract

This paper will discuss the telecommunication techniques used for personalizing services for virtual home environment (VHE). First a brief overview is given of the ideas behind the concept of VHE. Both users' and service providers' points of view are covered. A glimpse is cast to the current situation on the telecom market and then some scenarios of VHE are introduced and briefly analysed to see whether they are feasible commercially or technically.

1 Introduction

Today's teleoperators are in a wind of change. Telecommunication monopolies have been mostly abolished in Europe, PSTN networks are anticipated to become non-profitable, mobile communication has grown beyond expectations. These are just few good reasons for teleoperators to start researching new and innovative sources of revenue instead of grasping to the current business models. One innovation and interesting concept is Virtual Home Environment (VHE) which is defined as a concept for Personal Service Environment (PSE) portability across network boundaries and between terminals. Basically it means that future teleoperator's subscribers are consistently presented with the same personalised features, user interface customisation and services in whatever network, whatever terminal (within the capabilities of the terminal and the network) and wherever the user may be located [8].

Service creation and management has relied earlier and mostly relies still today on telecommunication equipment vendor specific systems. Standardisation has been tried earlier but it has not been very successful in practise. Due to convergence of IT and telecommunications industry there are now more stakeholders and players in the market than earlier. This means that standardisation of interfaces has become more interesting and perhaps lucrative for teleoperators. OSA API [6] and Parlay group [2] attempt to develop technology-independent and vendor-independent Application Programming Interfaces (APIs) enabling third parties to develop applications that operate in multivendor environment and across operator boundaries. This seminar work tries to give an overview of the technologies, which can be used to create personalised services in Virtual Home Environment and gives some scenarios in which VHE could be used successfully.

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2 Overview of the Virtual Home Environment

The concept of the VHE is such that UMTS users are consistently presented with the same personalised features, user interface capabilities and services in whatever network, whatever terminal and whereever the user may be located. The exact configuration available to the user at any instant will be dependent upon the capabilities of the USIM, Terminal Equipment and Network currently being used or on the subscription restriction (e.g. user roaming being restricted). A user with her (U)SIM in another terminal, should receive maximum capability provided depending on the limitation of the terminal. For example if the terminal currently in use does not support a specific service then this will not be available to the user, however the user should be made aware of this in a straightforward manner [11].

VHE is currently under development, i.e. many specifications are drafts or initial drafts. However, it has been specified in conformance with 3GPP specifications and GSM releases and thus VHE can be implemented gradually. Some sort of VHE can be already implemented using CAMEL (more about CAMEL in chapter 4.1), but most of the virtual environment can be utilised when 3rd parties can participate to the development of the services.

VESPER[1] project's Dissemination Plan was completed already in September 2000 and project final assessment has been scheduled for December 2002. VESPER (Virtual Home Environment for Service PErsonalization and Roaming Users) aims to define, demonstrate and promote a service architecture for provision of VHE across a multiprovider, heterogeneous network and system infrastructure.

Currently there are no full implementations on the Virtual Home Environments, since the specifications mostly are related to the GSM Release 5[1], which has not been deployed yet. Actually, even GSM Release 4 has not been yet deployed, so there is still time to plan before all this will be realised into existing services.

2.1 Bringing The Intelligence Out Of The Network

Traditionally the network has maintained all the information. In PSTN the user equipment maintains no subscriber information. All the needed information is maintained by the PSTN switch. When GSM was introduced, also the concept of Subscriber Identity Modules (SIM) was introduced to the common. This meant that subscriber indentity was in a separate card, which could be inserted in any Mobile Equipment (ME). This made it possible to switch ME without making changes in the GSM network (excluding possible changes in Equipment Identity Register). This opened the real competition between ME vendors, like Nokia, Siemens and Ericsson, and created totally new market. GSM introduced also worldwide roaming (being a mobile network), which gave a boost to inter-operator activity like billing and roaming agreements. This has inevitably caused some standardisation in the inter-operator billing, like e.g. creation of TAP3 standard[2].

[1] 3GPP uses a system of parallel "releases". More information can be found from http://www.3gpp.org/specs/releases.htm

[2] http://www.gsmworld.com/using/billing/index.shtml

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Next step in the development seems to be the standardisation of service management interfaces, enabling third parties to provide services to the network without actually owning the network and without knowing the technical details of the implementation of the network. This feature of open interfaces is required to fully implement VHE. 3GPP specifications assume that this will be materialized through OSA APIs but also non-3GPP standards can be used.

This way Virtual Home Environment requires de-coupling the networks and services from each other. So far telecommunication services have been provided to subscribers as bundled service packages, like business subscriptions and private subscriptions. This is because managing large amount of subscribers with a centralised Customer Care System (which most of the teleoperators use) is difficult, if every subscriber has their own user profile and all changes to it must go through a centralised system. In VHE the user profile is not anymore centralised and this is discussed more in chapter 5.

In VHE concept the network implementation is hidden from the application layer by using e.g. OSA APIs and the network is also hidden from the client (residing in PDAs, PCs, Mobile phones) by using Mobile Execution Environment (MExE) or SIM Application Toolkit (SAT) between the network and client. This enables the services to be implemented without detailed knowledge about how the network or terminal capabilities are implemented.

The service capabilities (specified in UMTS 22.05) are the basic building blocks which can be used to build service provider specific supplementary services which are VHE services. These services are used to complement and personalise the basic telecommunication services (bearer services and teleservices)[11]. Examples of such service capabilities are:

- address translation
- call origination
- call control
- answering calls
- call termination
- user-to-user information

The list is by no means exhaustive. When we isolate the network capabilities into entities like this, the business logic can be exported from the network to application servers, that can use (hopefully) standardised APIs for providing network services.

One example of the development is the division of teleoperators to network operators and service operators. In some countries this is regulated so that teleoperator must divide the teleoperator functions into two entities. This supports the de-coupling of services and network from the business point of view.

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2.2 3rd Parties

Traditionally teleoperators have kept their telecommunication network well under their own control and have not let outsiders to interface the network equipment. However, in VHE concept there are Value Added Service Providers, who provide services other than basic telecommunications service for which traditional charges may be incurred. The user may access services directly from Value Added Service Providers and the serving network.The Home Environment does not support services obtained directly from VASPs or serving network outside home network. It should be noted that VASP has no service agreement with the Home Environment [8].

In order to get the 3rd parties into the business there are many things that must be considered before opening the network. One of those is billing which will be discussed in chapter 7 and the other is security which is discussed in chapter 8.

2.3 Service Lifecycle in VHE

VHE Service lifecycle according [9] differs from the existing telecom services. Next chapters will describe the service from both user and service provider perspective. As we see, personalisation of the service is taken into consideration in this service lifecycle better than in the current teleservices.

2.3.1 Service registration

To allow subscribers to discover a new service, services need to be registered before they can be used. Enough information needs to be conveyed about the service to allow subscriber to understand the purpose of the service and subscribe to the service.

According to VHE concept service providers who register their services do not necessarily need to be coupled with the teleoperator and they might be providing these services to competing operators. This can be only achieved by using open interfaces towards different networks.

2.3.2 Service Discovery

To generate a listing of available VHE capable services, the network needs to be able to provide a list of registered services. This allows service users to customise their home environment to provide those services they want to use and ignore the services they do not want to use. Another possibility is to have different services in different user profiles. Businessmen while travelling might want to have calls forwarded to their secretary or to their answering machine outside local office hours (which might be working hours in other continents).

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2.3.3 Service Activation and Modification of Service Data

During service activation the User Profile needs to be modified accordingly and possible charging issues resolved. If the User is using a prepaid solution, the application might need to check the balance of the account before proceeding. Charging is essential for services offered by third parties since today most services offered by third parties are not cost-efficient to charge, i.e. charging costs are a substantial portion of the revenue created by the service. In prepaid solutions the costs are considerably lower and thus this approach might prove to be successful.

2.3.4 Service Invocation

Invocation of a service can be either subscriber, service or network driven. Either a subscriber decides, that he wants to use the service now, or the network notices that a service needs to be activated (e.g. when a multimedia session is attempted to the subscriber) or a third party application, like alarm clock, decides to initiate some actions.

Charging is an issue also here, since e.g. if alarm clock fails for one reason or another, then payment should not be deducted from the account because the service could not be delivered.

2.4 Underlying technologies

In next three paragraphs the current GSM development is discussed and some opinions are stated. Some opinions are given and those are based on discussions with teleoperator employees in different countries. This means that some of the following statements are not based on data collected by extensive research.

2.4.1 Second Generation Mobile Phones

Introduction of GSM was a huge success in the end of the nineties in both technological and economical sense. It both brought the money invested to it back in multiples and also promoted new state of the art technology in form of advanced hand sets and digital technology. Analog mobile networks were considered old-fashioned and renewal of the network infrastructure was fast and furious. Since the transition phase was so fast, 3rd generation was thought to spread with same speed. This, however did not happen and it has left time for 3GPP and ETSI to make specifications and plan the next steps.

It is however possible to use in the future third generation services in second generation network via “service tunneling”. This method might prove to be very important for roaming, since 2G networks are currently deployed around the world, but 3G, being quite expensive investment, might not spread at the same speed. Service providers are not willing to invest into their service platforms, if the only users of these services are a small group of people living inside the 3G network. If the services are deployed rapidly, then also building the network, through increased ARPU, is more lucrative for teleoperators.

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2.4.2 General Packet Radio Service

GPRS is very often referred to as the 2,5G, because it basically introduces the packet switched data transmission on top of the circuit switched 2G GSM network. GPRS has been already deployed to several countries and GPRS Roaming agreements are negotiated already. Most VHE applications are not lucrative for the subscribers until the data transmission is packet switched. There is technically no reason why circuit switched data transfer could not be used, but it is typically in that case either too expensive for the subscriber to use that service or the teleoperator has to lower it's prices under a profitable limit. However, GPRS is a good platform to "practise" new packet switched services that are anticipated to emerge, when (or if) open service platforms will be introduced to teleoperators.

2.4.3 Third Generation Mobile Phones

3G or UMTS, as we speak, is currently in specification phase. Release 5 (in which most of the features enabling VHE are included) specification of 3GPP is being frozen early 2002, which means that it might take several years before we have concrete devices from several vendors to co-operate with. Building VHE applications, however, can be started before 3G networks, by following e.g. the VESPER architecture model. Although all the interfaces - like OSA - are not available today, applications developers should follow the design principles so that introduction of the APIs does not change the architecture of the application. VHE does not require 3G in order to work, since very basic VHE can be implemented using CAMEL and that works already in 2G network.

3 Feature Transparency

Feature transparency for the subscriber means that subscriber is delivered the same look and feel of services on any terminal in any network (taking into account the limitations of the e.g. bandwidth) and in any location (e.g. when roaming in a friendly network). In order to Valued Added Service Providers to deliver these services, new concepts need to be introduced to the network. One of the necessary components is Service Capability Server. Together with applications supporting SCSs one can implement VHE services that "follow" the subscriber from one network to another.

3.1 Service Capability Servers

Fig. 1 shows a part of OSA architecture in UMTS. The new idea is that instead of applications interfacing the core network resources, there is an "abstraction layer" in between, which hides the implementation of the core network from the application. The Service Cabability Servers (SCSs) in between provide the application enough information of the capabilities of the network in terms of Service Capability Functions (SCFs), so that application can behave differently in various networks.

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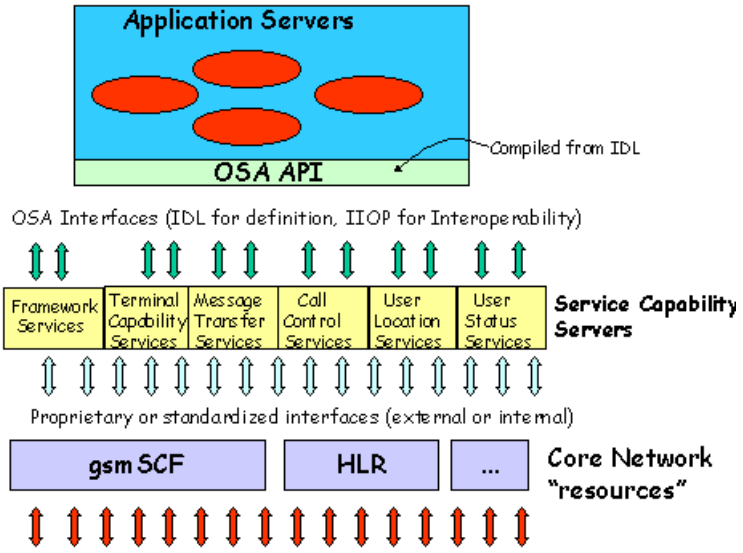

Figure 1: OSA Interfaces for UMTS. http://www.w3.org/2001/03/WSWS-popa/paper59/

4 Existing toolkits

The following service toolkits can be used to implement VHE services or platforms. These are briefly introduced here to give the reader a glimpse of the technologies under the concept of VHE.

4.1 CAMEL

Customised Application Mobile Enhanced Logic network feature enables the use of operator specific services by a subscriber even when roaming outside the home network [7]. This makes it possible for the subscriber to take services with them and thus enables creation of a basic virtual home environment. This works currently in the GSM networks which have CAMEL capabilities and is the most mature technology of the technologies listed in this chapter.

4.2 MExE

Mobile Execution Environment is a standardised execution environment within a mobile station and enables the usage of MExE services, which can be in either home network or visited network. MExE also enables a service provider and mobile station to negotiate the supported capabilities, which is a key issue also in VHE [4].

One of the high level requirements of MExE is the ability of the user to personalise services and the ability of the user to personalise the user interface. This way users could e.g. select the services using their mobile phone and that would change their user profile some way. The changes could be then available on the users laptop, if user chooses so. Interesting

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is to see the effect of this standardisation to PDAs. Already there are PDAs available that work as a mobile phone, so the convergence of these two has already begun in practise.

4.3 USAT

Universal SIM Application Toolkit is very similiar to MExE, except it defines a standard execution environment for applications stored on the USIM/SIM card [3]. This way applications could be "carried" with the SIM and it could be inserted into mobile equipment or even into a WLAN card (already implemented as a joint effort of Nokia and Sonera) and this way services could be used with reliable identification of the subscriber and this would even enable easy billing of these services through normal GSM billing function. Call Detail Records (CDRs) could be created by the service that is used through this kind of system.

Personalisation of the services would be done to the SIM card and thus the module would be part of the user profile. One of the requirements for USAT is that users should be able to personalise applications by means of parameters, if such parameters are made available by the application. This enables e.g. storing bookmarks to the SIM card to be used later in a browser or other tools.

4.4 OSA

Open Service Access is an attempt to standardise the interface and create an application programming interface between the service logic on higher layer and network resources on the lower layer. Network functionality offered to applications is defined in terms of a set of Service Capability Features (SCFs). These SCFs provide functionality of network capabilities which is accessible to applications through the standardised OSA interface upon which service developers can rely when designing new services [5].

If this concept will materialise, then service management will face totally new challenges and the service portfolio of a single teleoperator can grow both through own development and 3rd party development. It is essential for teleoperators that this is rolled out in a controlled manner so that e.g. billing issues are taken into consideration.

5 User Profiles

The User Profile is the collection of all subscriber data, that consists of Personalised data (like UE interface preferences set within the capabilities of the UE and serving network) and User Services Profile (preferences associated with subscribed services) [8]. The User Profile data can be either dynamic or static, which means that applications need to be prepared to situation where the User Profiles change during the execution of the applications. User Profile data may also include indirect references to external data, which means that applications may need to query data from external sources in order to find out the preferences of a certain subscriber.

Standardised User Profile data may be located according [8] in one or more entities, like:

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1. Network Elements (HLR, HSS)
2. User's (U)SIM Application
3. Mobile Equipment
4. Application specific databases in Home Environment and HE-VASP

3GPP specification divides the User Profile data into two categories:

1. Personalised data (Service independent data, like UE interface capability preference set)
2. Service specific data (e.g. preferences associated with subscriber services)

Since a single subscriber can have multiple user profiles (although, only one active at a time) this means there is considerably more data multiple locations in this kind of approach, than in the traditional telecommunications networks. Synchronising this data will be a challenge for anyone trying the manage the whole. The idea behind this approach, however, is not to have a centralised control of the services, but to provide an open service platform for the various services providers in the market.

6 Stakeholders

New releases of GSM technology and VHE bring new players to the market and rephrases the roles of the current stakeholders. In this chapter we will discuss those stakeholders from the service personalization point of view.

6.1 Users

One obvious benefit of the VHE to the users of the network services is that they are offered more possibilities for personalisation and more variety in services. Introduction of financial services, location based services, multimedia messaging, etc. might turn mobile phones and home PCs into more than just a device of oral communication.

What users are propably looking for is easier services and better ways of communication. Entertainment should not be forgotten, since that has sometimes paved way or even financed the development of more "professional" services. Average money spent on communication devices and services has increased in the recent years considerably in countries who have a good GSM coverage and there is no reason why this development could not happen in other countries too when the coverage grows.

6.2 Teleoperators

Operators are propably already waiting for new services, since they seem to be the only chance to increase Average Revenue Per User (ARPU). Now that building networks is

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proven to be expensive - especially after huge 3G license fees - operators most likely are not eager to invest into anything that cannot be proven commercially feasible via efficient charging and billing function. It has been already several years proclaimed that only providing a communication channel or telecom infrastructure will not be profitable. Higher level services are predicted to be the most profitable future source of revenue.

6.3 Value Added Service Providers

VASPs are the new players on this market. With SMS services teleoperators have already practised co-operation with 3rd parties and experiences seem to have been generally good. Both parties have been able to get their share of the revenue. If teleoperators are able to open their networks as planned, then being a VASP might prove to be fruitful for small IT companies, which have suffered from the decrease of teleoperator investments after year 2000.

7 Charging and Billing

Charging and billing function of a PLMN is something that should not be ignored when designing new concepts and services. So called Internet-services: WWW, FTP, DNS, etc. have no built-in charging mechanism, which has led to situation where all these Internet services are free of charge. This is naturally one reason why popularity of Internet-services is so great today. Only the access to Internet is charged by ISPs and since competition is hard, the prices stay low.

One of the requirements for UMTS charging and accounting is that they should enable the Home Environment to provide a prepaid service and to enable the serving network to support that prepaid service for the home environment's subscribers [10]. This is naturally a key issue for those operators that have only prepaid subscribers. Many operators have both post- and prepaid subscribers that are entitled currently to different set of services due to the fact that some services of today do not support real-time deduction of prepaid account.

Roaming is also an issue here, since VHE concept requires that the services can be transported transparently from one network to another, even if it means co-operation with another teleoperator. Luckily we have today experience of this kind of activity through GSM roaming. Co-operation has also pushed the standardisation. For example, TAP3 standard has played a role in here. Since interoperator billing is already working today, there should be no problems to expand this co-operation to VHEs.

8 Security

According to 3GPP all access to User Profile information shall be secure. Before any transactions, it shall be possible for both the sender and receiver to identify the other party. This enables VASPs to create various services utilising either personal or public data of the subscriber in the service.

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The user profile maintenance in a secure manner is a challenge for any operator, because the subscriber information can be in practise scattered all over the network and the user equipment of the subscriber. Following items are dictating the future development of interactive applications that need user data from external sources:

- User Privacy
- Telecommunications Acts
- Laws about privacy

These need to be taken into consideration in every phase of development: design, implementation and roll-out. In some countries laws might be more strict than in others. And since VHE should work in several countries - to be commercially viable - this might prove to be trickier than one might expect.

9 Scenarios

Examples from more practical point of view. These scenarios describe two possible services enabled by VHE. Both services could be implemented already today by using a litlebit different kind of methods but in the examples VHE capabilities are used on purpose.

9.1 Service scenario 1: Global Alarm Clock

A global alarm clock service could utilise virtual home environment by storing alarm information of the subscriber to the user profile or the subscriber schedule could be in an external database. Let's say a businessman travels to another timezone and has a calendar in his VHE. By using a mobile phone he can check today's agenda and ask his assistant to schedule a meeting for tomorrow morning 8 AM in Brussels, Hotel Le Plaza. When his assistant makes the reservation in Finnish timezone to the calendar, the VHE is notifies that alarm clock should go off at 7 AM in the current timezone where the businessman is located the previous night (we make the bold assumption that timezone does not change during the night). This requires that VHE service can ask from the serving network the time and date of the businessman. If we want to deliver the local news to the businessman in the morning, VHE service can contact the nearest news-provider and ask from the businessman in the morning, if he wants to pay 3 euros for the news of today. This requires that serving network has a capability to offer it's own services (like the news service) to the VHE service automatically. To make this all work in heterogeneous networks and equipment (the businessman should be able to upgrade his mobile phone to a newer model with color display in the airport) it is essential to have a concept like VHE.

9.2 Service scenario 2: Intelligent Business Call Forwarding

An intelligent call forwarding agent could be implemented so that when a mobile terminating phone call occurs to the subscriber, the subscriber would be notified of the price of the

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call and given options, where to divert the call. Optionally this could be automated so that when a person is out of the country, all phone calls not originating from certain numbers outside local office hours could be forwarded to her assistant/answering machine. This alone does not require any VHE properties, but if the subscriber would like to control this service from various terminals and through various networks (IP, GSM), then the concept of VHE is needed. If we want to make this call forwarding service indistinguishable with both SIP (Session Initiation Protocol) and SS7 signaling, we definitely need an abstraction layer between the service and the serving network. This abstraction layer could be implemented using OSA and VHE concept.

10 Conclusions

As a conclusion we can say that VHE is as a concept very attractive and justified direction of development. However, as we have seen it requires very much co-operation from the telecom industry vendors to make this all happen. Maybe even so much that nobody is willing to make their equipment compatible with the standards mentioned above, because it could mean for the brave pilot vendor some losses in the market share, if they make their equipment “too” interoperable. Standardisation is already in good shape. Now we are merely waiting for the implementations to gradually arrive for the end customers.

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