MANAGING HETEROGENEOUS SERVICES AND DEVICES WITH THE DEVICE UNIFYING SERVICE
Implemented with Parlay APIs

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Abstract: Due to the ubiquitous explosion of the Internet and the fast proliferation of heterogeneous networked devices and services, the end user are faced with a formidable task in managing it all. The Device Unifying Service presented in this paper is a novel powerful concept that allows anyone confronted with multiple devices and services to administer and manage them by themselves. With this service, different devices connected to different networks offering different types of data and communication services can be integrated and handled in a straightforward way. It allows the usage of multiple devices simultaneously and the possibility of adding, removing or changing devices in a service session. The Device Unifying Service addresses personal service management for both communication services and data services. Communication services like a normal phone call can for example easily be transferred from a fixed phone to a mobile phone or an IP phone with multimedia capabilities with the Device Unifying Service. Additionally, a data service like a WEB browsing session can be transferred from a PC to a laptop or PDA including cached information like history and bookmarks. Providing an easy way of moving services between devices, the Device Unifying Service thus fulfils the vision of service portability in an elegant way. This paper presents the concept of the Device Unifying Service, a novel service that will take care of the management, coordination and configuration of all the devices that the user has at his disposal and provide service portability and adaptation of services to devices with different characteristics. Furthermore, this paper will reveal how the first version of the Device Unifying Service has been implemented using Parlay APIs and H.323 technologies.

Key words: Service Portability, Management of Networks and Services, Personal Communications, Mobility Evolution, VHE, IP/mobile technologies, Open APIs, Interoperability and Cooperative Control, Personal Network Management.

1.   INTRODUCTION

The main concepts of the Device Unifying Service (DUS), developed within the Eurescom project P1101, has already been described in previous papers [1,2], and will therefore only be given in brief in this paper.

The Virtual Home Environment (VHE) [3] is an important portability concept of the 3G mobile systems that enables end users to bring with them their personal service environment whilst roaming between networks and also being independent of terminal used. Although considering multiple terminals, the VHE concept addresses only the usage of one terminal at the time and the swapping between terminals. It is thus envisaged the needs of using mu ltiple device simultaneously and the needs of coordination such that devices collaborate and provide a coherent user interface.

Nowadays the user is confronted with several different devices such as a plain-old telephone, a mobile phone, a cordless phone, and a PC or a workstation as well as more simple devices like microphones, loudspeakers, TV screens, digital cameras etc. These devices might very well be autonomous in that they are able to function individually and independently of each other, but the proposed service will allow the user to manage them all and hence consider them all as one big terminal - the Virtual Terminal.

Another important issue is the combination of mobile and stationary devices. The user might visit places away from his home domain where there are stationary devices offering different types of services, e.g. printers, screen displays etc, and the DUS will allow the user to include these in his Vi rtual Terminal, i.e. it will offer a dynamic configuration of the Virtual Terminal depending on what devices and services are available on any given time.

The DUS will manage data services as well as communication services, and it enables moving of data sessions. For example, an e-mail that is halfway written can be transferred to another device before continuing with the writing, and a web browsing session could be transferred with history, bookmarks and all between devices.

This paper describes the different aspects of the Device Unifying Service and the Virtual Terminal concept. The functional requirements are identified and the system architecture is discussed. Finally, the implementation of the first version of DUS, which utilizes Parlay [4] call control and a Parlay-H.323 gateway, is described.

2.   THE DEVICE UNIFYING CONCEPTS

2.1   Device unification and coordination

Since many communication devices, e.g. mobile and fixed phones, may have a limited user interface, the combination of these devices with various other devices with different capabilities into a Virtual Terminal as illustrated in Figure 1, may result in much better user interfaces and hence enhance the offered services.
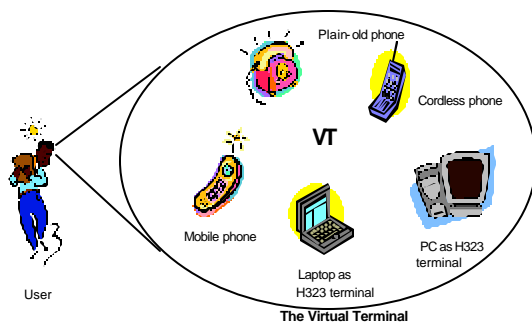

Figure 1. The Device Unifying Service

During a service session, a user may want to use one or more elementary devices with just input and output functionality in addition to his communication device. Examples of such elementary devices can be a big screen display, loudspeakers, a microphone etc. In other cases the user may want to reroute the voice or data streams coming in to his mobile phone to other, more convenient devices such as a fixed phone, a PC etc. This can be done via the mobile device using technologies such as Bluetooth [5], but due to limitations of the mobile device, it might prove a better alternative to introduce the Device Unifying Service and let it handle this.

With this concept, all the different devices will be considered as one big terminal with multiple input and output capabilities. The user terminal will no longer be an integrated and recognizable device but a set of distributed devices that allow access to certain services, e.g. multimedia communication services, various computing services etc.

2.2   Virtual Terminal management

The Device Unifying Service will allow the user to define, add and remove the devices that are included in the Virtual Terminal at any time. The user's many terminal profiles and user profiles on different devices will be replaced by a unique user profile defined once for all in the Device Unifying Service. Whenever this

profile is set up or updated, it will automatically be accessible from all other devices contained in the Virtual Terminal.

The profiles can also be set up to specify different personal preferences when it comes to subscription of services, user interfaces on particular device types etc so that the user will be offered the same services and experience the same look and feel regardless of where he is and what particular device he is using. The only requirements are that the device in question supports such services and such user interfaces.

2.3   Service portability and adaptation

Service portability and adaptation to devices with different characteristics are another important feature of the DUS. Moving a telephony call from an ISDN phone to an IP phone or GSM phone will be made possible and the signaling and media are adapted to comply with the end-point. Likewise, a data session can be transferred and adapted from one PC to another, from a PC to a laptop or to a PDA. This is illustrated in Figure 2.
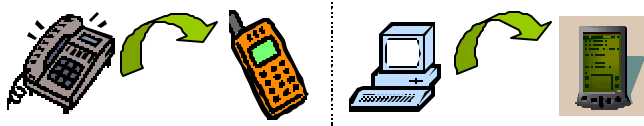

Figure 2. Service portability for communication services and data services

2.4   A personal secretary

The proposed service will be user centric instead of device centric in that it will be possible to address a person directly instead of addressing one of his devices, as illustrated in Figure 3.
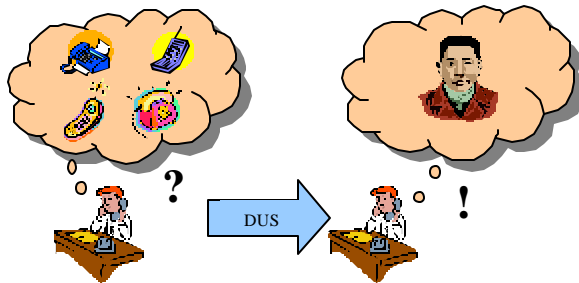

Figure 3. DUS as a personal secretary

The Device Unifying Service will be responsible for handling available devices, which may include a variety of personal or public devices. Anyone wishing to communicate with him will dial up his Device Unifying Service, which in turn will contact the user. In other words - the Device Unifying Service will function as the user's personal secretary.

The Device Unifying Service will offer personal mobility to the end user in that there are no fixed relations between the user and any specific device. In this way, the different identities of the different devices will become transparent, but the identifier belonging to the Virtual Terminal will stay unchanged.

3.   FUNCTIONAL REQUIREMENTS

The functional requirements of the Device Unifying Service describe what functions it should be able to perform. The following are identified as the main functional requirements of the DUS:

?   Initiating services – The user should be allowed to initiate any services through his Device Unifying Service.
?   Receiving services – The user should be able to receive any incoming services via his DUS.
?   Using multiple devices – The Device Unifying Service should allow the user to combine and use multiple devices as if they where one in the same session, both simultaneously and successively.
?   Configuring the devices – The Device Unifying Service should help the user to automatically configure his devices whenever this is necessary.
?   Managing the Virtual Terminal – It should be possible for the user to dynamically manage his Virtual Terminal, i.e. specify which devices are components of the Virtual Terminal, handle different kinds of services, define his different personal service environments, set up his preferences, access and edit his user profiles, read his mailbox, edit his address book, modify his schedule etc

These requirements apply for both the communication services part and the data services part of the DUS, and from the user's point of view, no great distinction between data and communication services should be noticed.

4.   LOGICAL SYSTEM ARCHITECTURE

In order to realize the described service, a terminal management and coordination function is needed – the Device Unifying Service. In short, such a function should have the following capabilities: It should continuously maintain, monitor and update the configuration of the Virtual Terminal, i.e. it should always

know exactly what devices are present and active in the Virtual Terminal. It should also be able to multiply and deliver streams from applications to respective devices and to unify and deliver streams from devices to respective applications, when multiple devices are active in one session. This function should be located on a server connected to a standard IP-network, which is again connected to other networks, e.g. Internet, GSM/ISDN network through gateways. This conclusion regarding the location of the management logic is in agreement with other research projects' conclusions [6].
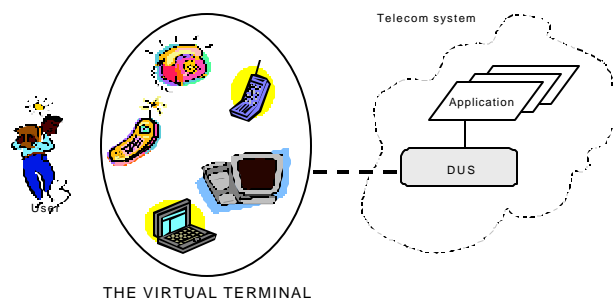

Figure 4. The logical system architecture

Figure 4 shows the proposed logical system architecture of the Device Unifying Service. Other applications are only aware of the DUS and not of the user's many devices. They will deliver services to the DUS, which again has the responsibility to ensure that the delivery to the user is done through the most appropriate device – a device within his Virtual Terminal. The DUS thus manages the users' various devices and services, while the user manages the DUS itself.

5.   DUS COMPONENTS

In the design of DUS different management components are drawn up. Figure 5 shows the different components and how they are linked together.
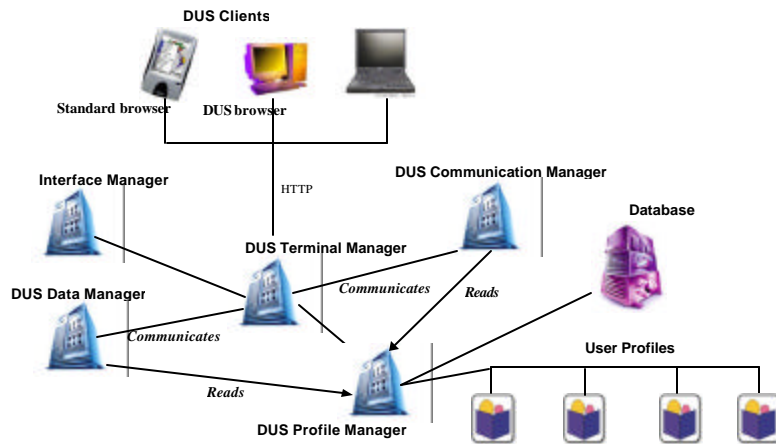
Figure 5. The DUS components

The different DUS components provide different types of functionality and are implemented as java classes.

?   The DUS Clients are clients used to access the DUS management service. A standard web browser can be used to manage communication services (making calls, adding devices to an existing voice session, transferring calls etc.), but for the data services (e.g. transferring a WEB session) a special DUS browser, developed within the P-1101 project is needed.

?   The DUS Terminal Manager is the way into the DUS Communication Manager or the DUS Data Manager. It is reached by the DUS clients by HTTP and communicates with the DUS Data Manager and DUS Communication Manager using CORBA.

?   The Interface Manager provides different functions for generating the user interfaces, which are returned to the screens of the user's devices. These can be in the form of HTML or WML to suit different terminals with different capabilities.

?   The DUS Profile Manager. This component stores the different profiles within the system. It also provides a range of functions to manage each profile. It can be accessed by the DUS Data Manager and DUS Communication Manager and provides information needed for the management of the data and communication sessions.

?   The DUS Communication Manager handles the DUS communication sessions, i.e. voice sessions, mu ltimedia sessions etc. This is the component that handles call control and sets up and tears down connections in the network between the actual devices. It reads from the DUS Profile Manager to get necessary information from the Database.

? The DUS Data Manager handles the management of the DUS data sessions and allow data services to be transferred between devices.

? The Database contains the User Profiles and communicates with the DUS Profile Manager using JDBC.

? The User Profiles contains the information about the DUS users, their different devices, services, preferences, environments etc.

Together, these components make up the Device Unifying Service.

6.   IMPLEMENTATION OF DUS VERSION 1.0

The first version of DUS has been implemented and deployed on Telenor's research labs at Fornebu, Norway. It has been implemented on an IP-based network with the components pictured in Figure 6.
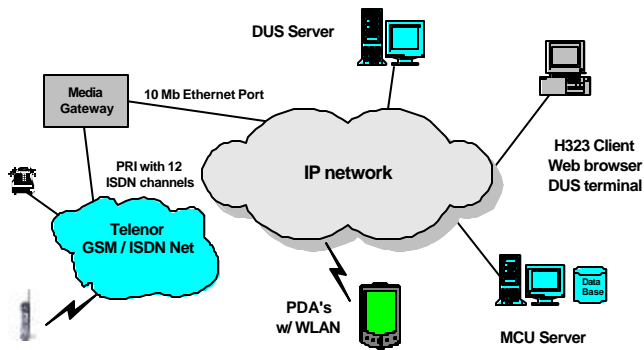

Figure 6. The physical parts of a DUS implementation

The DUS implementation contains the DUS server that contains the actual DUS application and a MCU server that is capable of mixing multiple media streams. Figure 7 illustrates how the DUS application is connected to the user terminals via the MCU server that mixes the media streams in a communication session.
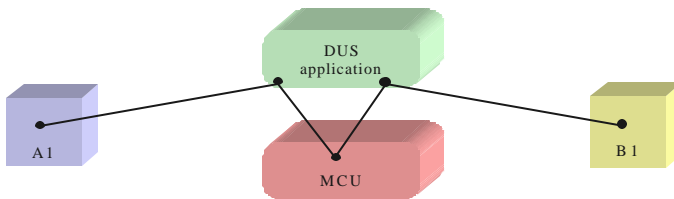

Figure 7. Connection between DUS application, MCU and user terminals

The DUS server also has access to a database where the user profiles, the device profiles, the address books and the schedules are stored. The DUS user can access and administer the service from a standard PC with a Web browser or from a PDA as indicated in the figure.

The DUS application itself runs on a standard PC with an industry standard operating system such as Windows, Unix or Linux. It is implemented in Java with development tools from Borland [7] and a Parlay[1] compatible development platform from Appium Technologies [8, 9]. The server machine running the DUS application has a Java Virtual Machine (JVM) installed and it contains a WEB application server (Apache/Tomcat), and a user profile server. JDBC is installed to ensure communication with the user profile server. In Figure 8, the components of the DUS application server are shown.
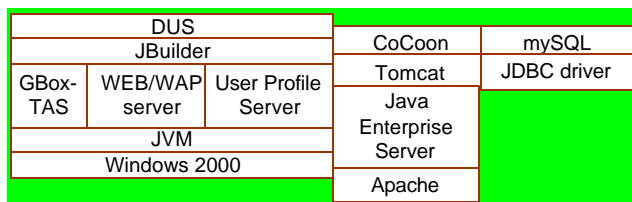

Figure 8. The DUS application server

The DUS application uses a Parlay-H.323 gateway from Appium technologies to handle call control for IP telephony. This contains an implementation of the Parlay APIs that are used for the actual call control and the signaling to and from the DUS server is performed by H.323 [10]. Such a call set-up example is shown in Figure 9. The GSM/ISDN network is connected to the DUS network through a signaling and media gateway from Cisco systems [11] so that both IP telephony and GSM/ISDN telephony can be managed by the DUS. The DUS network is also connected to the Internet.

Some of the most important Parlay APIs used in the DUS application are createCall, routeReq, routeRes, release, handleCall, getCallSessionID, getCalledAddress and getCallingAddress.
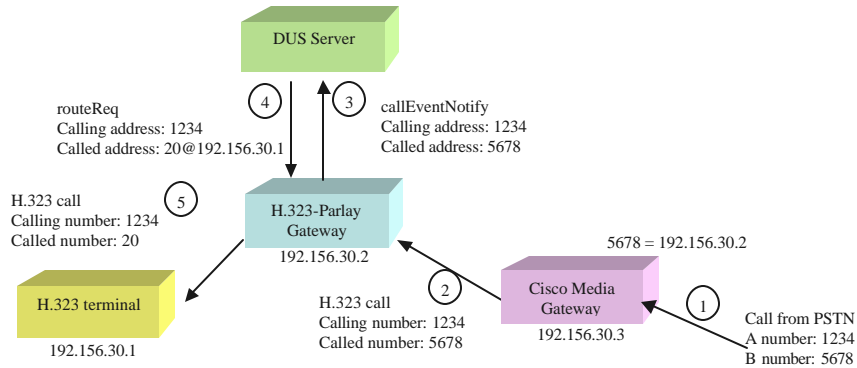
[1] Parlay APIs version 2.1 is used.

Figure 9. Incoming call via the H.323 - Parlay gateway

Version 1 of DUS that has been implemented so far consists of two parts: A communication services part and a data service part. The communication service part includes the following functionality: session creation, session teardown, adding devices to an existing session, removing devices from a session, session transfer between two or more devices, e.g. transferring a session from a fixed phone to a mobile phone and receiving services on most appropriate devices. The DUS have a globally unique identifier, so that the user can receive services through the DUS. This identifier consists of an E-164 number and a H.323 address so that it can be addressed by both traditional telephony via the gateway and IP telephony directly. The data services part provides transfer of data sessions like web browsing (including history, bookmarks etc), e-mail etc. In addition, the user may manage his profile and environments and modify a list of his own devices, an address book containing his contacts and a schedule that defines different environments according to the time of day. All this is accessible to the user from an ordinary web browser on a PC, laptop or PDA. These two servers are combined and integrated into one DUS server offering both communication and data DUS services.

With the DUS version 1.0 four of the five identified functional requirements are already realized. Only the configuration of devices requirement is left for further releases.

7.   THE DUS 1.0 MANAGEMENT INTERFACE

The DUS version 1.0 offers its functionality to the user by an easy-to-use management interface. When subscribing to the service, the user will be given a username and a password, and should then be able to log on to the service from any PC, laptop or PDA connected to the Internet and with a web browser. A DUS homepage will appear, and from there it is easy to navigate between the different functions. The display in a traditional browser will naturally differ slightly from the

PDA display, but the services they are offering are essentially the same. In this section, some selected screenshots from the standard browser version of the DUS interfaces are exhibited.
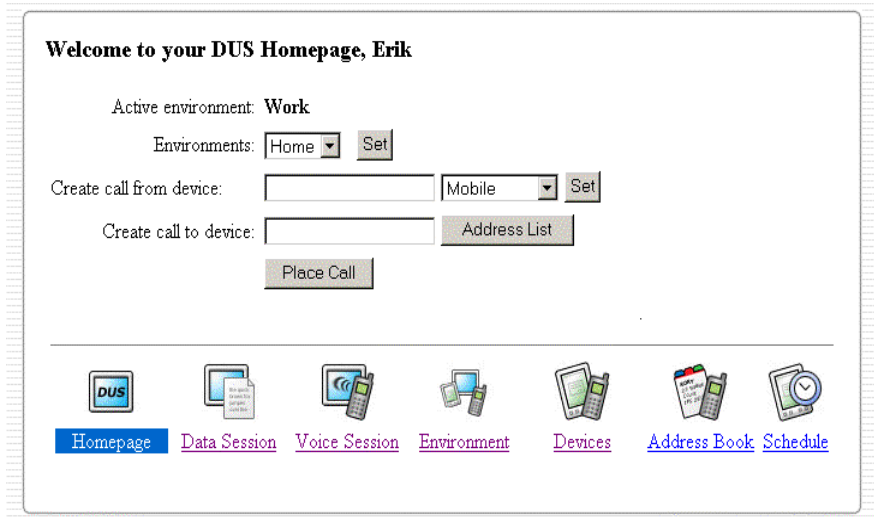

Figure 10. The DUS Homepage

In Figure 10, the DUS homepage that appears as soon as the DUS user has logged in is shown. From this menu, the user can create a new call from any of his devices to any user. He can use the address book to call one of his contacts or type in the number directly. At the bottom of the screen, different icons allow for easy navigation between the different DUS management functions.

Figure 11. DUS voice session management

Figure 11 shows the DUS voice session management interface. From here, new devices can easily be included in an ongoing communication session, devices can be removed from the session and the whole session can be transferred to new devices. Different types of devices like ISDN phones, GSM phones or IP phones can be included in the same session.

Figure 12. DUS environments management

In Figure 12, the DUS environment management is shown. From here, the user can set one of his environments, e.g. work, home, travel etc, to active, meaning that incoming calls will be routed to a device present in that environment. One can create new environments and define what devices that belong to the different environments. A device can belong to as many environments as desired, and for example the user's mobile device will typically be defined in all environments. The active environment can also be set by a default value or according to a predefined schedule.

In addition to the displays shown in this article, similar user interfaces allow management of data sessions, as well as management of devices, address book and schedule.

The DUS user interfaces are offered as Java Server Pages (JSPs) that the user can request from standard client browsers on either a PC or a PDA.

8. CONCLUSION

In contradiction to the commonly accepted assumption that the communication devices of the future will be integrated devices integrating several functions into one mobile device, this paper expect another trend towards several personal and public

devices, both mobile and stationary, each offering different functionality to the end user, and each with a different network connection. These devices might be autonomous in that they are able to function individually and independently of each other, but they might also be coordinated so they can act together as one big terminal – the Virtual Terminal. The outlined service is an approach to allow the users manage its own Virtual Terminal and its own services through a management interface over a network.

This paper has presented the concept of the Virtual Terminal and described a novel service - the Device Unifying Service that will realize the Virtual Terminal. The requirements and functionality this service should offer is outlined and the design and architecture are discussed. A first version of the service has been implemented and the concept is thus proven. However, before the service is ready to be deployed as a large-scale commercial service in the real world, additional work should be done. Some of the technologies that would be desired to enhance the value of this service, i.e. service discovery and announcements via Bluetooth, location awareness, SIP etc. are still immature. When these technologies are more mature, they can be incorporated in DUS and add considerable value to the DUS user. Other aspects such as security and billing issues are not considered in much detail. Nevertheless, the first version is ready for deployment and will be introduced to real users in field trials shortly. The feedback from these surveys will unquestionably indicate how to improve version 1.0 to subsequent version.

The DUS can be of interest to a number of different service providers, as it does not require any heavy infrastructure to be deployed. Access to an IP network and some computers is all it takes. Operators and service providers offering this service can differentiate themselves from their competitors. It can also be offered as an enterprise service that incorporates office devices, mobile devices and home devices. Regardless of how the service is offered to the user, it will provide a valuable service that will be more and more relevant to the user as the number of different devices he has to relate to increases. The Device Unifying Service thus has a promising future deployed as a commercial service for heterogeneous device and service management.

ACKNOWLEDGEMENT

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