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Infrastructure of audiovisual services - Communication procedures

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HSTP-MMSM
Technical Paper on Service Mobility for new Multimedia Service Architecture

ITU-T

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Summary

This technical paper identifies the possibilities to deploy service mobility bearing also in mind the provision of multimedia services within the context of a new multimedia protocol, which is currently under examination by SG 16. The underlying network structure is considered to be an IP based telecommunication network like but not restricted to the NGN (Next Generation Network) as defined by ITU-T. Beside of an overview of the different aspects of service mobility within the context of an abstract model of multimedia services the document analyses different variants for handling the service control in a roaming and handover case and determines basic requirements with regard to the realization of multimedia service mobility. Further work is required in order to define the detailed requirements and appropriate mobility protocols.

Change Log

This document contains Version 1 of the ITU-T Technical Paper on "*Service Mobility for new Multimedia Service Architecture*" approved at the ITU-T Study Group 16 meeting held in Geneva, 22 April – 2 May 2008.

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1 Scope

The scope of this document is to identify the possibilities to deploy service mobility bearing also in mind the provision of multimedia services within the context of a new multimedia protocol, which is currently under examination by SG 16. The underlying network structure is considered to be an IP based telecommunication network like but not restricted to the NGN (Next Generation Network) as defined by ITU-T. Beside of an overview of the different aspects of service mobility within the context of an abstract model of multimedia services the document analyses different variants for handling the service control in a roaming and handover case and determines basic requirements with regard to the realization of multimedia service mobility. Further work is required in order to define the detailed requirements and appropriate mobility protocols.

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3 Definitions

3.1. Home-centric service mobility: Usage case in which the visited network is used only as a proxy, while the service control remains in the user's home network.

3.2. Heavyweight services: services whose service logic is written for the exact combination of hardware and software available in a specific network [2].

3.3. Lightweight services: services that are independent of the network infrastructure and thus can be used regardless of the user's current network [2].

3.4. Mobility: Ability for the user or other mobile entities to communicate and access services irrespective of changes of the location (point of access) or technical environment (terminal) [ITU-T Q.1706].

3.5. Nomadism: Ability of the users to change their network access point on moving. In case of changing the network access point, the user's service session is completely stopped and started again [ITU-T Q.1706].

3.6. Roaming: ability for a user to function (to access services according to their user profile) in a serving network (using an access point of a visited network) different from the home network.

3.7. Visited-centric service mobility: Usage case where service control is handled by the visited network, rather than the user's home network.

3.8. xDSL: Any of the various types of digital subscriber lines technologies [ITU-T G.992.3].

4 Abbreviations

3GPP	Third Generation Partnership Project
AAA	Authentication, authorization and accounting
AP	Access point
API	Application Programming Interface

CDH	Collaborative Document Handling Service
CR	Correspondent Result
EDGE	Enhanced Data rates for GSM Evolution
FMC	Fixed-mobile convergence
GSM	Global system for mobile communications
HSS	Home Subscriber Server
IMS	IP Multimedia Subsystem
IP	Internet protocol
mSCTP	mobile Stream Control Transmission Protocol
NGN	Next Generation Network
OSA	3GPP Open Service Access architecture
P-CSCF	Proxy Call Session Control Function
PSP	Possible service performance
QoS	Quality of service
QPT	QoS Profile Table
SCF	Service Capability Features
S-CSCF	IMS Serving Call Session Control Function
SIP	Session initiation protocol
SLA	Service level agreement
SMH	Service mobility handler
SOR	Service Offer Request
UE	User equipment
UMTS	Universal Mobile Telecommunications Service
URI	Uniform resource locator
VoIP	Voice over IP
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless local area network

5 Introduction

Service convergence has obtained an increased focus on the deployment of multimedia services like video telephony, video conferencing or video broadcast over telecommunication networks. The development of the Next Generation Network (NGN) by ITU creates an opportunity for customers to ubiquitously access subscribed services by a variety of terminals and network connections. Thus, service mobility becomes an important design issue with regard to network and service development. Service mobility defines the ability of a user to access during an ongoing session a particular (subscribed / multimedia) services, irrespective of the location of the user and of the terminal that is used for that purpose.

Service mobility also implies the possibility to suspend any running service on one device and to pick it up on another one. An example of service mobility could be the switch (handover) of a video call from a mobile phone to the office phone of a user. It is not mandatory that the transition between locations and/or terminals be seamless. The service presentation depends on the given network support and the terminal capability. The user is notified of the constraints if the services cannot be accessed in a personalized fashion. An overview of a general architecture for service mobility is given for instance in [1], [2]. Descriptions with regard to the support of service mobility with SIP and to the support of mobility for multimedia with SIP are available in [3] and [4], respectively.

6 Multimedia service architecture

In general, multimedia service architecture descriptions are only considered to determine the requirements for standardizing service capabilities and will not result in the services themselves being standardized. Regarding the multimedia service architecture, ITU-T Recommendation F.700 [9] gives a generic model description. Hereby, multimedia services are built up by combining "communication tasks" and organizing their interaction. A communication task is considered as a functional entity of a multimedia service, which performs its communication features. Each communication task handles a set of media components in a synchronized way, in order to convey and control information types such as audio or video. Media components are individual (monomedia) components, which handle functions related to each independent medium such as capture, coding and presentation. With regard to Communication tasks, [9] mentions "conversing", "conferencing", "distributing", "sending", "receiving" and "collecting". This list of tasks is not exhaustive but can be extended by defining new ones or by the refining existing tasks. Concerning media components, "audio", "video", "text", "graphics", "Pictures "(pixel based) and "data" are identified in [9].

Figure 1 shows the relationship [9] between a multimedia service, communication tasks and media components.

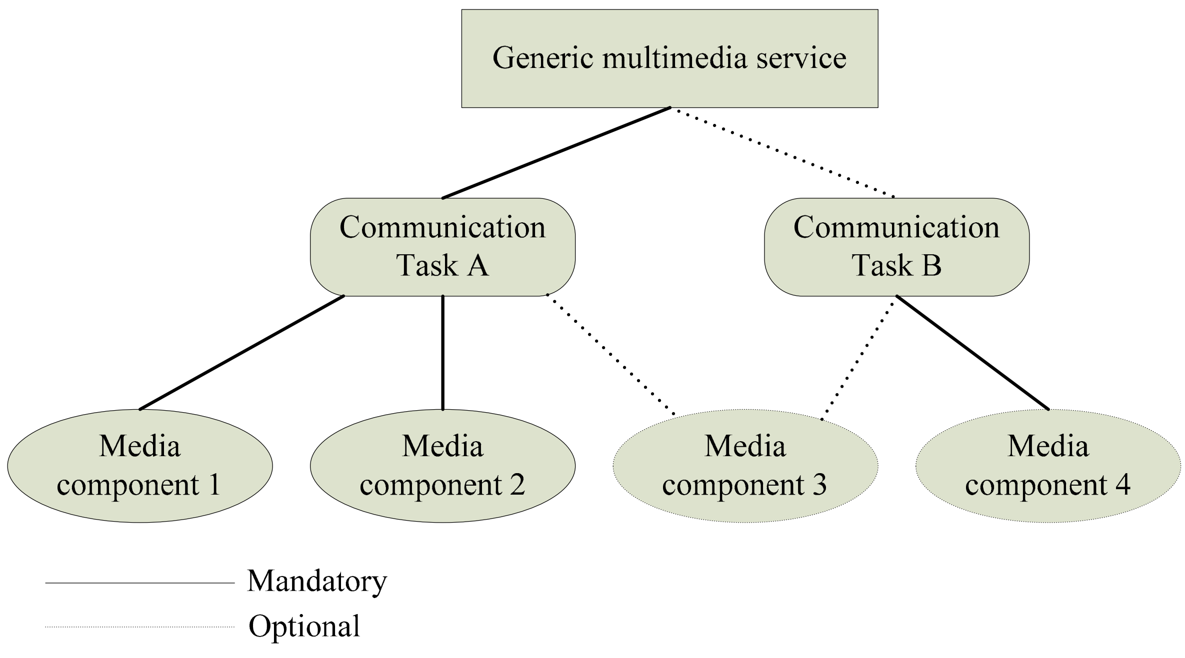

Figure 1: Reference Model Generic Multimedia Service

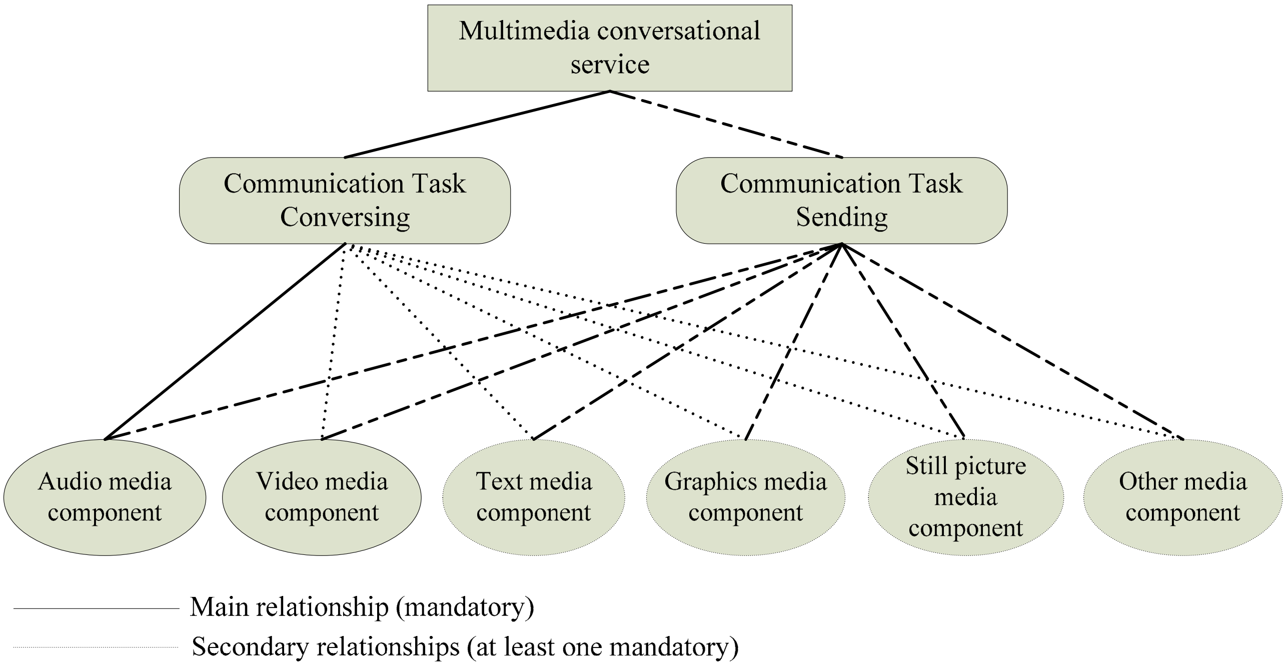

Figure 2: Example multimedia conversational service

The communication tasks and the media components form the basic set of communication capabilities from which a specific multimedia service can be built up. Using the multimedia conversational service as an example, Figure 2 shows the relationships between services, communication tasks and media components according to ITU-T Recommendation F.703 [11].

According to the used media components used, multimedia conversational services can be further divided into:

- Videophone service: audio and moving pictures and optionally various types of data
- Voice and data services: audio and various types of data
- Text telephony: real time text, optionally combined with audio
- Total Conversation service: moving pictures, real time text and audio
- Collaborative Document Handling Service (CDH): real time text, data and possibly graphics (see also F.702 [10])

In addition to the modular elements on the different levels, control and processing functions are required to operate the service.

7 Mobility management

Mobility management defines the set of functions and procedures used to provide mobility (§3.1). This could be facilitated through the use of various wire line or wireless access technologies to enable users to communicate over heterogeneous network environments.

7.1 Roaming and service support

Roaming (§3.6) is one of the fundamental mobility management procedures. Considering the roaming activities of a user, two basic methods [1] for the service support can be distinguished:

The visited network is used only as a proxy, while the service control remains in the user's home network (*home centric service mobility*), see Figure 3. The service proxy can be seen as a mobile agent that mediates the requests between the terminal and the service running in the home network or the appropriate service provider domain. Details of the service access are hidden from the mobile terminal. Users may subscribe to multimedia services from several providers, but all those services are accessible via their home network. They always register with their home network, which always controls the session. To have access to subscribed services in a visited network it is necessary that the visited network supports basic capabilities like the appropriate bandwidth. Besides the concurrent provision of different instances of a specific service type to several users in one or more visited networks, no special changes in multimedia service implementation are required to achieve service provision.

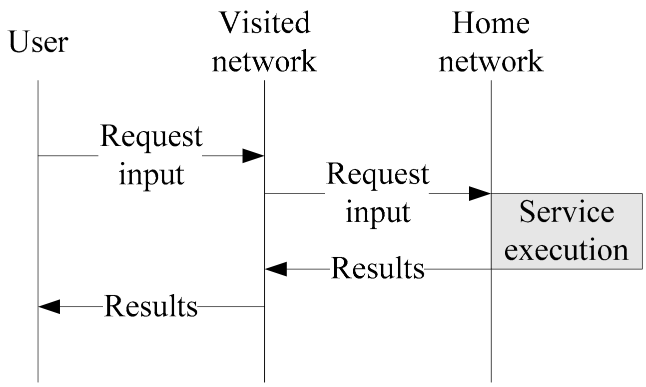

Figure 3: Service execution using the home network

The following example will illustrate the home centric service control of a roaming user in a simplified way.

After a user (A) has registered to the visited network, he wants to do a video call to his friend B. A sends an appropriate request (for instance in a SIP based environment via INVITE message) to the proxy server of the network he is visiting. The proxy server directs this request to the user agent of A's home network. The user agent checks the request against the user profile of A and triggers the appropriate application server (here for video call). Furthermore, the request is forwarded to B's terminal. After a successful reservation of the appropriate resources under the control of B's home network, B's terminal acknowledges to A (e.g. SIP 200OK) and the media flows can be started.

Network roaming with control from home network is supported by the IETF Session Initiation Protocol (SIP) [3] and will be also integrated into the NGN (service control by S-CSCF of home network).

Contrary to the "proxy"-variant, the service control can be also handled by the visited network *(visited centric service mobility)* according to appropriate roaming agreements and SLAs between home operator and visited operator (see Figure 4). If a requested multimedia service type is not available in a visited network and no other means are foreseen, the service will not be offered to the subscriber. Alternatively, one can also consider a further option where a new instance of the requested service type is dynamically moved from the home network or the home service provider respectively to the visited network. When a service provider receives a request of a user for a specific multimedia service type from the currently visited network, a new service instance is created and assembled by the service creation entity. Under the control of the service handler of the home network, the new service instance is moved to the visited network. The visited network registers the service in its domain, and interacts with the service handler to setup the service according to the new environment.

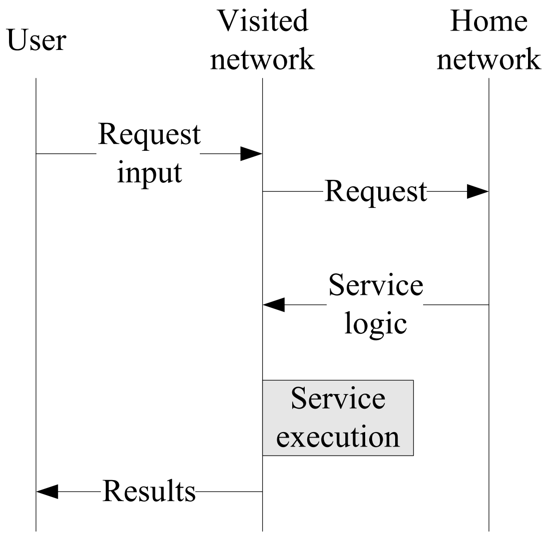

Figure 4: Service execution using the visited network

The components of a service that will be moved to a serving network vary depending on the type of service. For *lightweight* services [2], all components are bundled into a service package and then moved to the visited serving network. Examples of this type of service could be voice / video sessions over IP (as long as the used terminal supports the appropriate transcoder) as well as Internet based services. A possible implementation of network roaming with control from visited network using SIP in the context of lightweight services is described in [3]. In the example above of users A and B, execution of the video call would be handled directly by an appropriate application server of each visited network. For *heavyweight* services [2], not all components are transferable and can be easily adjusted for use on different platforms (for example, advanced multiparty multimedia conferencing facilities as well as services which require specific database components). Some components of a service instance created by the service provider may stay in its network, whereas others may move to the serving network. A general description of distributed multimedia service composition with statistical QoS assurances is given in [5]. Examples for such kind of roaming support are Java-based applications. Their logic is contained inside .class or .jar files. In case of the visited terminal is capable of running Java, simple downloading of those by the service provider is needed in order to enable the appropriate service. It has to be noted that the inclusion of service components transfer from the home network towards a visited network increases significantly the complexity of a visited centric solution with regard to administrative and operational issues. So far, a visited centric approach with or without the transfer of media components is neither required nor supported by the NGN. For mobile networks, 3GPP has included visited centric service mobility without transfer of service components into the standardization by the definition of Local Breakout Services.

7.2 Profile and profile handling

Usually, the change of network access or terminal may also imply changes of the working conditions of the user [1]. The service presentation needs to be adjusted to the capabilities offered by the specific network access point and/or terminal. In case of the current access/terminal does not support all required media components, the service delivery has to be degraded appropriately (e.g. in case of a video call the change to a pure voice terminal would require the suspension of the video component). Hence, an appropriate control logic that determines the possible service delivery is needed, and it is based on available information with regard to type of service, user policies and user preferences, type of used devices as well as capabilities of the current network access.

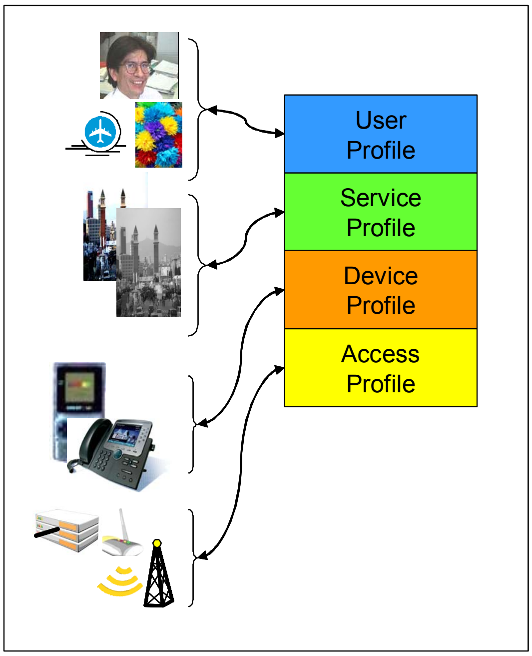

Figure 5: Profile Information

As shown in Figure 5, there are different locations where this information will be stored and maintained: on service provider side, on network provider side (in case of NGN, the network provider may also act as a Service provider), as well as locally on the user device [3]. Generally, it can be classified according to the following criteria

- **User relevant information (user profile):** The user profile includes all user specific information like authorization information, authentication information, accounting information, subscribed services/service preferences, mandatory and optional media components (presentation preferences), preferred quality degrees regarding the different media components (e.g. delay, resolution), user controllable policies for application adoption, preferences regarding access. Furthermore, the user profile may also include information about the current context e.g. the current location of the user, the status of a user (e.g. at work, on leisure), as well as organizational information.
- **Device relevant information (device profile):** The device profile is an important means to support terminal roaming. The requested content has to be rendered properly according to the capabilities and characteristics of the device, which is currently used. Important information contained is hardware characteristics like available storage, performance and used OS, as well as information on supported audio and video codecs.
- **Network relevant information (access/network profile):** Streaming multimedia content requires very strict conditions for QoS, such as end-to-end delay, bandwidth, and jitter. Dependent on the currently used type of network the service performance may vary according to the offered network capabilities. Before a service can be started, these capabilities have to be evaluated. To do so, the network profile is used.
- **Content relevant information (service/content profile):** The content profile contains metadata information about a multimedia service as type of media components, coding format (e.g. H.264), required storage on user device, required protocol (H.323, H.324, SIP, etc.), available service variants (e.g. colour, black and white), administrative information (e.g. release), possible application adoptions.

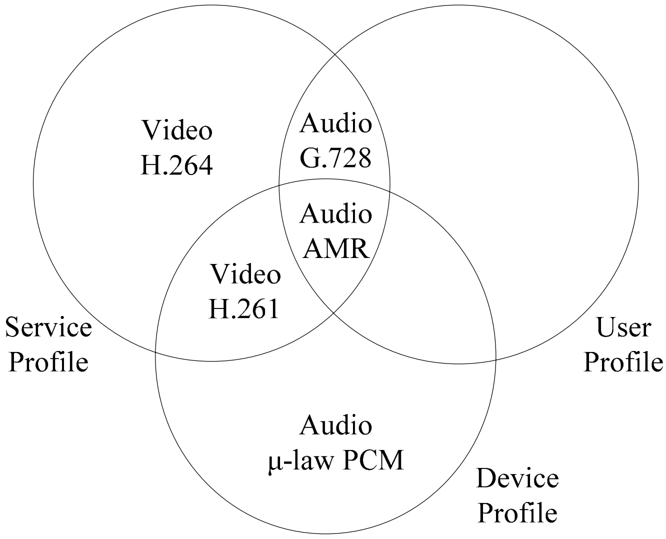

Figure 6: Profile adaptation

A comprehensive overview on the different types of profiles can be also found in [16]. Maintaining a copy of parts of the profile locally on the user device (especially the user profile and the device profile) may reduce possible delays with regard to the negotiation of the available service components according to the device capabilities, the available quality degrees as well as the user preferences. It shall be noted that replication of profile information is to be avoided if possible. For instance, in case of the NGN environment, information of the current location of a user is handled by the home subscriber server. If this information can be retrieved by an application, no additional maintenance of the current user location is necessary at application level. Generally, the mobility support with regard to multimedia services also requires appropriate means on the application level to adapt a given service according to the current network and terminal capabilities. The selection of appropriate service components and quality degree has to be based on the appropriate merger of service and user profile in the context of the limitations of the currently used network access and of the device.

Figure 6 illustrates this process using different types of audio and video codecs that are assigned to user profile, service profile and device profile. Considering this example, the result of merging service profile, user profile and device profile will allow the delivery of a speech service using an AMR audio codec.

7.3 Change of terminal and network access

In case of the invocation of a multimedia service the appropriate service performance adaptation according to the given user and service profile as well as to the given capabilities of the used terminal and network access will usually be performed within the context of the service set up/ QoS negotiation. This is the typical situation in case of the nomadic use of telecommunication services. The situation differs when a terminal change or network access change should not cause a total abandonment of any ongoing media stream. A typical example is the handover of a terminal between two mobile/wireless access points. According to the current capabilities of the new network access, the media streams associated with the active multimedia service have to be adapted within the given constraints of the given user profile and service profile.

Figure 7 illustrates the mentioned scenarios, based on an underlying (simplified) NGN architecture. It consists of an IP core network and several IP-based access networks with fixed wired, fixed wireless and mobile access support. The mobile access includes the infrastructure necessary to support packed based services by using UMTS or EDGE technology for the transmission on the air interface. The fixed part contains multiple access routers with either fixed access points (e.g. xDSL) or wireless access supporting radio technologies like WLAN or WiMAX. The core network interconnects access networks to each other, and to other networks; media processing functions are supported as necessary. Network attachment as well as resource and admission control functions are contained in both the access and core networks. Fixed/mobile convergence with regard to the offered services is achieved by the IP multimedia subsystem (IMS).

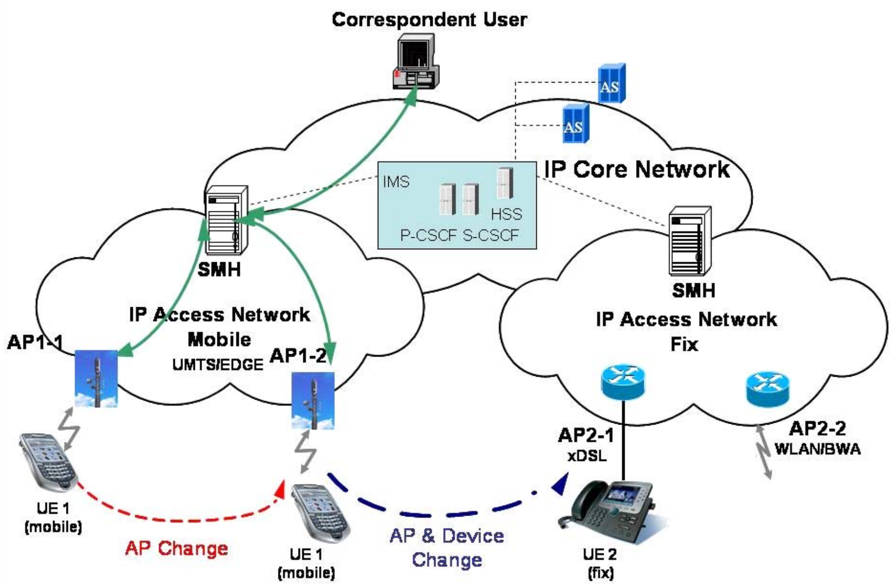

Figure 7: FMC Telecommunication network architecture including service mobility

IMS provides session setup and control, as well as connectivity between different user equipment (UE). Core Components of the IMS are the Serving Call Session Control Function (S-CSCF), the Proxy Call Session Control Function (P-CSCF) and the Home Subscriber Server (HSS). The S-CSCF acts as central SIP user agent [4] and covers session setup and control. It also interfaces as portal function towards service platforms (AS) which are either external (third-party provider) or internally operated by the FMC network provider. The P-CSCF acts as SIP proxy and forwards messages to and from the UE. The HSS functions as database which includes AAA information with regard to network access, information on public and private user identities or information on the accessibility of the user. Each access network and the IMS core are managed as self-contained IP domains. The considered NGN provides mechanisms to allow a device to change network point of attachment (terminal mobility) as well as the ability of a user to maintain the same user identity (e.g. SIP URI), irrespective of the terminal used and its network point of attachment (user mobility). Considering a FMC network, *user mobility* is supported by IMS and SIP, and *terminal mobility* is supported by UMTS, EDGE, WLAN and WiMAX.

7.4 Service mobility handling entity

Service mobility is provided by a specific functional entity named the service mobility handler (SMH). Considering an IP based communication system with mobility support, the SMH always relies on appropriate entities for the support of terminal and user mobility. Regarding the location of the SMH, no specific requirements are posted. The SMH may occur once within a given communication system or it may consist of different instances which coordinate among each other by appropriate communication protocols. In case of the NGN example given in Figure 7, a SMH instance is located at the edge between the core network and each access network. Core functions of the SMH generally are:

- control of media components during an ongoing multimedia session in cooperation with the other service control elements of the considered communication system (e.g. IMS, in the NGN case)
- service adaptation for each media component as well as for each communication task

- service adaptation of the current media streams, if required by the respective user site

In case the considered communication system is not the NGN nor it does support transparent transport layers, the SMH handles additionally:

- routing of data packets from and to old and new network access points (AP), including address translation and packet duplication
- control of switching[1] of media streams (handover) between APs of its own domain as well as between AP's of different domains

To be able to control the switch of media streams the SMH maintains address information of APs and registered devices within its own domain as well as addresses of potential handover candidates of other domains together with their related SMH (e.g. IP addresses, link to the appropriate GPRS Support node for UMTS access network). For the successful adaptation of multimedia services to the current capabilities of used device and network access in consideration of possible service variants and user preferences, the SMH maintains a QoS Profile Table (QPT) for the duration of a multimedia session. This table contains the following elements: user profile, content profile, device profile, correspondent result and possible service performance. User profile, content profile and device profile have been already described above. By merging the different profiles and by adaptation to the given network and device restrictions the local service profile can be determined. The local service profile has to be merged with profile information of the correspondent access/user in order to generate the possible service performance (PSP) which can be applied to the current multimedia session. A general algorithm to be performed by the SMH can be found in [18]. The algorithm consists of two phases (see Figure 8). The first phase is related to service initiation (roaming case) and provides the initialization of the service/ session related QPT. The second phase is related to service execution and controls adaptation and handover of the different media streams in case of device change and/ or change of network access.

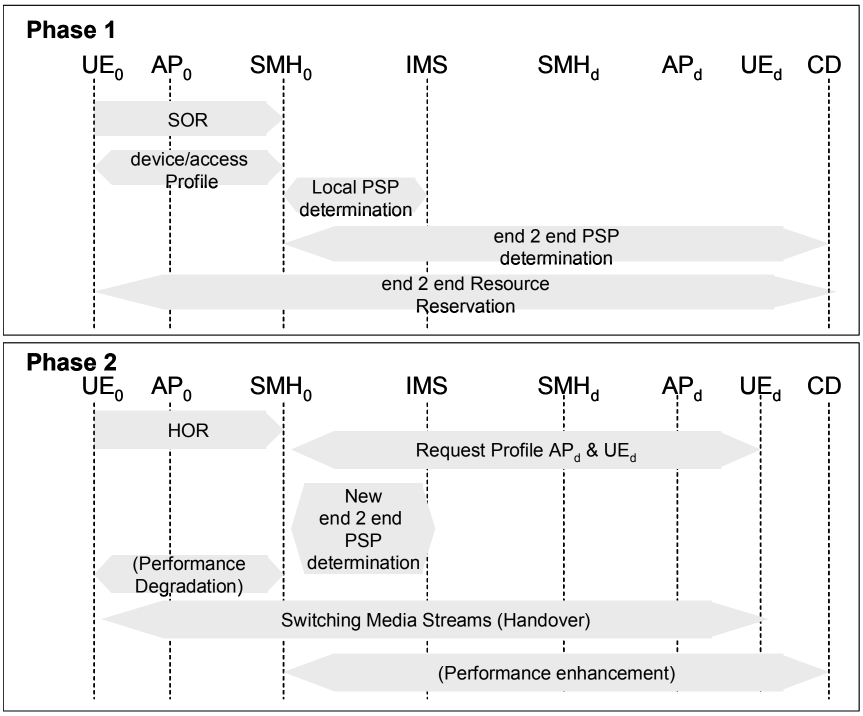

Figure 8: Mobility handling

1 Alternatively, the session continuation can be also achieved according to 3GPP TR 23.893 [19] by an appropriate re-establishment from the involved terminal site when connected to the new AP.

Phase 1: Service initiation

1. After network registration and reception of an IP address from the current access domain, a Service Offer Request (SOR) is initiated by the user equipment (UE) towards the SMH. Triggered by the reception of the request the SMH initializes a QPT related to the requested service. Furthermore, the SMH requests the profile data from UE as well as from the currently used AP in order to store them as device profile and access profile entries. Concurrently, it forwards the UE enquiry to the appropriate IMS CSCF.
2. The CSCF requests user profile and service profile from AS and HSS. By the match of service profile and user profile, it determines possible service adaptations and service variants under the given constraints for a specific user. Original user and service profile, as well as the derived matched profile, are forwarded to the SMH.
3. The SMH analyses the matched user/service profile and adapts it according to the stored device and access profile (local PSP). Having stored this information for further processing the determined local service performance is then sent back to the IMS.
4. Under control of IMS, the current context of the correspondent site regarding user profile, service profile, access and device profile is determined (the Correspondent Result, or CR). By the match with the local possible service performance, which was received from the SMH, the end-to-end PSP is derived and conveyed back to the SMH and to the correspondent site.
5. Having updated the QPT with the received information (PSP, CR), the SMH sends a response to the UE, which includes the calculated PSP in order to trigger the resource reservation process. As soon as the resource reservation is finished, the multimedia application can be started in line with the determined profile.

After finishing the initialization phase, the associated QPT now contains entries which reflect the current situation regarding service profile, user profile, device profile, access profile as well as the context of the correspondent site. During the service execution, a handover may be initiated either automatically by the device (e.g. AP with better signal level in case of wireless or mobile access) or by an explicit command of the user (e.g. forced device change). The details of the appropriate protocol for handover initiation and AP announcement are not considered in this document; appropriate protocols can be found in [20]. In case of a handover initiation, the algorithm described below has to distinguish two situations that require a different handling of the involved media streams:

- the device and user profile of the new AP and/or UE include the current profiles
- the current profiles include device and user profiles of the new AP and/or UE

Both situations are explained below. In order to reduce complexity, an explanation of conditions for an abnormal termination of the algorithm (e.g. denial from user side for reduced service performance) is omitted.

Phase 2: Service execution

1. A Handover is initiated from the current device UE_0 by sending a Handover Request message via the current AP_0 to the current SMH_0. The Handover Request message contains the identification of the targeted AP (AP_d) and/or of the targeted device UE_d to which the session is to be switched.
2. Performing an analysis of the received identifications with maintained address information, SMH_0 determines if AP_d belongs to the same domain as AP_0. In case of a device change, it also determines with the support of IMS whether UE_d is online (that is an IP address is assigned to UE_d) and whether it is connected to AP_d.

3. SMH_0 requests the profile information of AP_d and/or UE_d and determines in coordination with IMS the new possible service performance PSP_d. Hereby, the stored information of matched user-and-service profile as well as the correspondent result are used. If different domains are involved, SMH_0 gets the required information by the support of the appropriate SMH_d (Profile Request/ Profile Response).If PSP_d allows to keep the current media streams, step 4 can be skipped.
4. If PSP_d requires an adaptation of the current media stream because of decreased service performance (e.g. reduced bandwidth allows only voice and text), SMH_0 triggers in cooperation with IMS the appropriate actions by UE_0 as well as by the corresponding device (e.g. termination of not supported streams and/or adaptation of the current streams by adaptation of media components and communication task according to the new performance conditions). After confirmation of the end-to-end adaptation from both devices, the handover of the adapted media streams is performed according to step 5.
5. The handover of the media streams has to consider if different domains are involved as well as if a device change occurs (e.g. mobile to fix or vice versa). In case of UE_0 switches between two network access points AP_0 and AP_d within the same domain the algorithm complies with [20]: Under control of SMH_0, handover is started by duplication of each stream. SMH_0 forwards any data directed to UE_0 to AP_0 as well as AP_d for delivery. Furthermore UE_0 is informed by the Handover Command to switch from AP_0 to AP_d. After reception of the handover command UE_0 begins to switch the reception of data streams from AP_0 to AP_d. As soon as UE_0 is able to process data packages from UE_d, it responds via AP_d with a Handover Complete message to SMH_0. The reception of the Handover Complete triggers SMH_0 to stop the delivery of data packets to UE_0 via AP_0. In case AP_0 and AP_d belong to different domains, SMH_d needs to become involved additionally for address translation as well as for relaying all data packets to and from AP_d. For this purpose (also considering security reasons), a tunnel is established between SMH_0 and SMH_d before the start of the handover execution. In case the handover also involves different devices UE_0 and UE_d, the process starts in the same way as described above: SMH_0 forwards any data directed to UE_0 via AP_0 and also to UE_d via AP_d. Opposite to the scenario of one device, the handover complete is triggered by a user command on UE_d site to indicate the ability to handle the media streams by UE_d. This message triggers SMH_0 to stop the delivery of data packets to UE_0 via AP_0.
6. If PSP_d allows (in line with the stored user and service profile) an enhanced service performance, SMH_0 triggers the appropriate actions between the involved devices (e.g. switch on further media streams or adaptation of the current streams according the improved QoS performance conditions). After confirmation of the resource reservation from the involved communication partners (UE as well as correspondent device) towards SMH_0, the service adaptation is completed.

It shall be noted that SMH_0 does not release control of service execution until the service is aborted or released by the involved communication partners (UE or correspondent device), even if additional handovers to further APs or UEs happen. Thus, SMH_0 can be considered as an anchor device with regard to the Service Handover. The user experiences an acceptable performance (slight decrease of video quality, partly noisy voice) as long as the handover does not involve different IP domains. As soon as the handover involves different domains, the service performance decreases significantly in fast decreasing access conditions (breakdown and re-establishment of the media streams). Main reason for this decrease is the additional latency caused by the additional tunnel establishment and signal transfer between SMH_0 and SMH_d.

8 Capability analysis

Having considered the general aspects of multimedia service mobility, a short analysis of existing protocols follows with regard to their ability to support service mobility in accordance to the roaming scenarios that are described in the previous clause (see Figure 9).

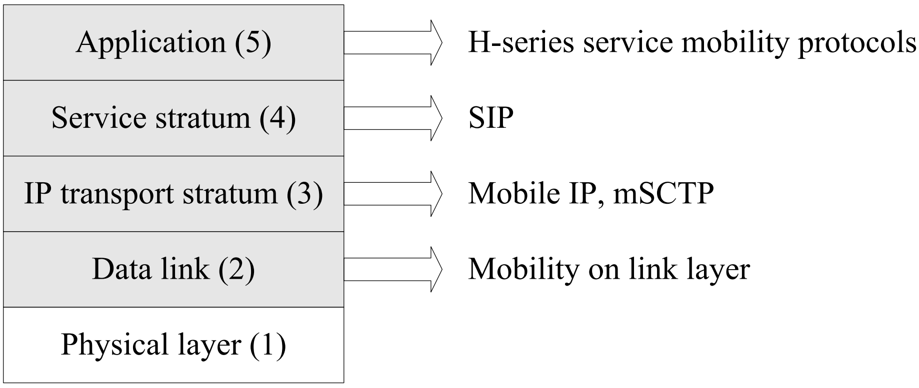

Figure 9: Mobility Management on different network layers

Mobility protocols at layers 1 and 2 (physical and data link layers) are technology-specific and adapted to the specific type of access (e.g. protocols for terminal handover in GSM/UMTS networks). This kind of protocols offers no means to support multimedia service mobility like defined before. On the network layer, the Mobile IP protocol defined by IETF can be used to realize personal mobility as well as terminal mobility but it contains no mechanism to handle the appropriate service profiles of a mobile user. The mobile Stream Control Transmission Protocol (mSCTP) extends Mobile IP by allowing the (seamless) handover of media streams of an ongoing session on the transport stratum. Further mechanisms at higher layers are required to support functions like profile adaptation in case of the new network access does not support the same features like the old one. With regard to the Service Stratum, SIP is able to support multimedia service mobility. In case of a home-centric service mobility scenario, all mechanisms are available to allow the home network to maintain control of the user’s session and services. Media information (e.g. data formats of the media streams) can be agreed and adapted between communication partners. Stateful proxies within the network store the call state. With regard to a visited-centric service mobility approach, SIP allows transfer of the control of a session from the home network to the visited network upon roaming. SIP does not offer means to move service components from the home network to the visited network like it was described above for visited centric service control.

The protocols mentioned above also do not support an appropriate adaptation of media streams according to the current network and terminal conditions, considering also the constraints of the given user and service profile. Additionally, the protocols in the ITU-T H.500-series [13] support today only personal and terminal mobility.

Consequently, the following items could be considered for the future work in the context of H.323 extensions[2] as well as in the context of the ongoing advanced multimedia system standardisation [21]:

- Production of detailed requirement specification for multimedia service adaptation, considering the constraints of the given user and service profiles as well as the offered capabilities of the used network access and terminal

[2] Even though the ITU-T H.500-series is not a candidate for the support of multimedia service mobility within an NGN environment, it could be extended to also support service mobility within an H.323-based multimedia system.

- Specification of the functional architecture of the SMH entity, including the possibility of using the SMH in the context of different IP based system architectures (not necessarily tailored for NGN)
- Specification of the appropriate protocols

The work items mentioned above will also require a close cooperation with QoS-related Questions within ITU-T.

9 Essential requirements

The following text contains some essential requirements from the multimedia application point of view with regard to the service mobility support offered by the NGN service stratum:

- A user, who is roaming into a visited network, needs to be able to utilize services as provided in the home network recognizing the given constraints of offered capabilities by the currently used access and device. The usage of the home network and the visited network is to be based on service profiles within the subscription and roaming agreements between operators. In case of any service limitation (e.g. prepaid services) with regard to the home network, these limitations must be either fulfilled by the visited network or otherwise prevented.
- The underlying network layers support the access to network and terminal capabilities at the application layer.
- In case of a home centric scenario, the home network needs to be able to decide on the service delivery in a visited network.
- In case of visited centric scenarios, the visited network may provide a required service like a video call using different technologies (for instance IP based video telephony instead of CS based UMTS video telephony), based on the available subscription information and on the serving network conditions. If the service profile does not allow an alternative delivery and the requested delivery method is not available in the serving network, the service is not to be offered.
- If the serving network for whatever reason is no longer able to provide the currently invoked multimedia services over the currently assigned access but it can provide equivalent services (fully or partially) over a different access to the user, it needs to support the appropriate service transition.
- With regard to real-time conversational services including real time text, the protocols necessary to support multimedia service mobility may not increase the total latency (end-to-end delay) as given in G.114 [22] (i.e. total latency not to exceed 150 ms).
- Service mobility management related functions are to ensure an effective interworking with the mobility management protocols of the underlying network layers, to guarantee full functionality with regard to user and terminal mobility and to enable handover of an ongoing media stream between different network access points (while in motion).

Besides the requirements mentioned above, there exist many further requirements for multimedia applications like sensitivity against transmission errors, packet delay or inter- and intra-media synchronization. Due to the fact that such requirements are not mobility-specific but valid for any multimedia architecture, they are not addressed here and left for further investigation in the context of the general design of new multimedia protocols and architecture. Multimedia services and the associated service mobility aspects need to be considered in the context of the NGN APIs. The purpose of these APIs is to shield the complexity of the NGN, its protocols and specific implementation from the service implementation and enable the deployment of multimedia service mobility (home centric, visited centric) within an NGN environment. 3GPP Open Service Access architecture (OSA) [6], [7], [8] defines standardized network interfaces (Service Capability Features) which allow service development independently from any physical network structure and support the transfer of service logic within a heterogeneous environment across multiple operator networks.

10 Accessibility support

In addition to the requirements listed in clause 9, it is important to consider the needs of persons with disabilities. Services should be accessible to disabled users and should operate in a way that provides functional equivalence for the user. ITU provides guidance for inclusion of accessibility requirements in Recommendations through the use of the FSTP-TACL Accessibility Checklist [23] and the Accessibility Guidelines in ITU-T F.790 [24]. As an example, deaf persons use relay services that convert between text and voice or between sign-language and voice. These services have a third-party office that provides the conversions. Connections might exist between the office and each party to the call together with connections directly between the two ends. Calls like these will need special study if service mobility is to be maintained.