Realization of a Push Service for Media Points based on SIP

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Abstract- **Broadband wireless access systems provide a mobile user with wireless access to a fixed infrastructure, e.g. the Internet/Intranet. In general, such systems provide only fragmented islands of coverage. Media Point is a service concept which enhances the capabilities of such broadband wireless access systems in combination with a 2G or 3G mobile system. This paper analyzes how fragmented islands of Media Points can be integrated into the public cellular infrastructure and thus make applications and services accessible to the public. The components that can together form a Media Point network are identified and their functionalities are defined. Finally, SIP (Session Initiation Protocol) as a means to provide managed push-services to the public is described.**

Keywords: Media Point; SIP; push service; fragmentary broadband wireless access; integration; cellular infrastructure.

1. INTRODUCTION

The integration of broadband wireless access in the public cellular infrastructure is currently one challenging issue of the multi-standard management that will have an impact on the future of the service provision in telecommunication networks. The creation of hot spots inside the UMTS networks is expected to provide dedicated broadband push services in geographically restricted areas. These services could be accessed through so called Media Points, which are broadband wireless access points integrated in the public cellular infrastructure, as shown in Figure 1.

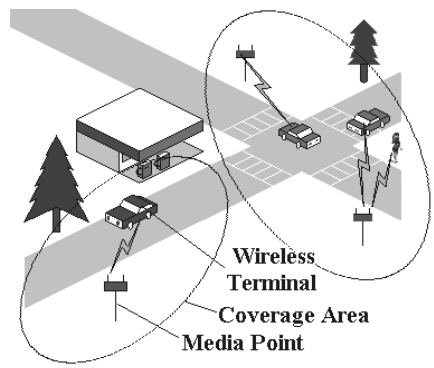

Fig. 1. The Media Point scenario.

The islands of fragmentary broadband wireless access created through the use of Media Points aim also to balance the traffic in the whole network. For example, numerous mobile Internet users that regularly visit popular news sites, could make use of broadband wireless access providing them by push services with their personalized information. Push services could also be used for the delivery of e-mail, music, and video.

It is assumed that mobile terminals are ready for multi-mode operation, incorporating cellular (GSM, GPRS, UMTS) and broadband wireless access technology. Whenever they detect a Media Point coverage area, then they try a connection establishment. Within this study we are concentrating on stationary and low mobility usage. No optimizations for high mobility usage are considered.

Numerous mobile terminals are expected to remain in a certain locality for quite a long period of time. This may occur while waiting, parking, moving slowly, or standing. Given that the terminal resides within the coverage area of a Media Point, the requirements concerning the session set-up time or the mobility support are not demanding.

As well as this, Media Point access could be used in public transport. Here Media Point coverage can be provided within busses, trains and the like. However, we do not discuss in this paper the connection of this mobile Media Point to the fixed infrastructure.

The Media Point is similar to the Infostation concept, as they both aim to provide "many-time, many-where" coverage [6]. This kind of coverage is more than sufficient for some types of applications. There are types of information that are only relevant for specific locations. As well as this, there are other types of information that are not urgent. So mobile users could wait until they are inside the coverage area of a Media Point.

Our approach of the Media Points differs from the Infostation concept [5] in that we do not try to create a new protocol. The protocol that is used to perform the signaling between the Media Point components is the Session Initiation Protocol (SIP) [1], a standardized and widely accepted protocol. An already standardized and tested protocol has the advantage over the personal developed protocols that the possibility of existing errors is lower.

Further on, we exploit the capabilities of the cellular network, namely the capability to localize terminals and to manage the Media Point System while not in Media Point coverage. However, details on the interface to the cellular network are beyond the scope of this paper.

2. ENVISIONED SERVICES

By means of push services, an access of personalized information could be made possible. We have identified the following information classes that can be supported by a Media Point system.

2.1 Electronic mail

A configuration that triggers waiting mail to be transmitted to and from the mobile terminal as soon as it enters the coverage area of a Media Point is envisaged. In addition the terminal should be able to trigger a mail exchange via a 2G or 3G cellular network in case no Media Point has been available for a predefined period of time and if the user wishes so.

2.2 Accessing favorite web pages

Personalized information can be made accessible to the user by pushing subscribed content. Each user should be able to configure his own profile and thereby personalize the service.

This configurable narrowcasting technology has many advantages regarding its use in Media Point networks:

- A fragmentary radio coverage is sufficient for giving the user the impression of having an omnipresent access to content concerning those topics, which are of interest to him;
- Users can rely on qualified push source to get their content. The experience and authority of such content providers will make it possible for users to get high quality information;
- Users no longer have to check their favorite sites to find out if the information contained has changed, as they can automatically receive a notification whenever this happens.

2.3 Online music access

Given that the Media Point system's average throughput is sufficient, audio files can be pushed to mobile terminals. Hence, a service providing personalized radio could be offered. This service should be configurable by the user. Once these preferences are adjusted, only music of pre-selected genres as well as advertisements mapping to the user's profile are transmitted to specific subscribers whilst news and traffic information could be similar for all involved users.

3. SYSTEM COMPONENTS

We have identified four types of logical components that can together form a Media Point network: the *Media Point Service Controller (SC)*, the *Media Point Controllers (MPC)*, the *Media Point Transceivers*[1] *(MPT),* and the *Mobile Terminals (MTs)*. Due to their dependencies all system components are arranged in a hierarchical manner as depicted in Figure 2. It has to be noted that, in the actual network, one physical node may include the functionality of several logical components.

The Media Point Service Controller is the central component of a Media Point network and provides the interface to the cellular network and the Internet. It supervises all Media Point Controllers belonging to that particular network. Each of the Media Point Controllers administers a group of Media Point Transceivers, which are usually located in close geographical proximity. A group of Mobile Terminals is finally associated to each of the Media Point Transceivers.

As the central component, Media Point Service Controller is responsible for maintaining the user database, which is a subset of the central database maintained in the mobile network. Further, it is responsible for caching and reformatting the content, and directing the content to appropriate Media Point Controllers. The database contains the user profiles, e.g., the URLs of the users' favorite web pages as well as the users' main areas of interest are stored in this database. A user interface, e.g., in form of a web interface, is provided to allow a

[1] The Media Point Transceivers are also referred to as "Media Points" since they are the small points of connection the user perceives.

user to adjust his profile whenever this might be necessary. Furthermore this database contains information regarding the users' presence. This information will be able to be received from the Presence Server [2] that is described in the following paragraphs. In our scenario, the Presence Server will be considered to be incorporated in the Media Point Service Controller.

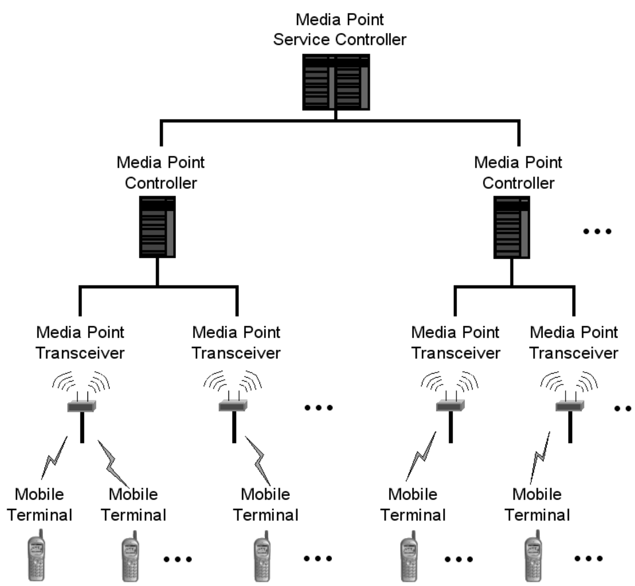

Fig. 2. Hierarchy of the Media Point system components.

The reformatting of content carried out by the Media Point Service Controller is necessary due to the fact that a service originally having pull character (e.g. browsing the web, polling e-mail) is to be provided through a push protocol. In case the content is of interest for many subscribers, spread over the network, the data may be transmitted via multicasting to Media Point Controllers to reduce the network traffic.

The most important task of a Media Point Controller is to cache content prior to its delivery. This has the advantage that the bandwidth on the air interface allocated to one particular user can be utilized efficiently since additional latencies are avoided.

The Media Point Transceivers (access points) are mainly responsible to provide the terminals with wireless access to the Media Point infrastructure. Based on the knowledge of an established wireless link between a transceiver and a Mobile Terminal, the terminal's location can be determined by the Media Point Controller.

4. ENABLING TECHNOLOGIES

4.1 Push of data

SIP (Session Initiation Protocol) has the capability to include all types of information (e.g. a HTML page) in its body with use of the MIME format. This offers the opportunity of pushing a HTML page instead of the usual HTML pull concept [4]. SIP is also used for signaling in the Media Point scenario, hence it is worthwhile using the same protocol for the whole Media Point architecture for both pushing data and signaling. If different protocols would be chosen, compatibility problems might be faced between the different protocols while implementing the Media Point scenario in practice.

4.2 Session (re-)establishment

SIP has been chosen as a means of session initiation and reestablishment as it can invite both persons and machines, such as a media storage service. The Session Initiation Protocol (SIP) [1] has been standardized within the Internet Engineering Task Force as a norm for the creation and termination of multimedia sessions. Although SIP has originally been intended for the invitation to multicast conferences and (unicast or multicast) Internet telephone calls, it is flexible and can easily be extended with additional capabilities. Even arbitrary signaling payload of any MIME [7] media type can be conveyed.

SIP is an application-layer control protocol designed to be independent of the lower-layer transport protocol. Presently UDP is preferred as the default transport protocol but TCP is also supported.

4.3 Content representation

A universal means of handling an extensible set of different formats for non-textual messages or messages consisting of several parts each of them being of a different media format is defined by the Multipurpose Internet Mail Extensions (MIME) [7] standard. The MIME format is used in the Media Point system to encapsulate user data in SIP messages.

4.4 Session description

SDP (Session Description Protocol) [8] could be used as a means of describing a session, as it is designed to describe session invitation, session announcement, and other forms of multimedia session (e.g. multimedia conference) initiation and as a result it is appropriate for session description in the Media Point scenario.

5. SIP [1] AS AN ENABLING TECHNOLOGY OF THE MEDIA POINT SCENARIO

In the Media Point scenario we consider that one singular Media Point Service Controller is responsible for the clients of its domain. On the other hand, many Media Point Controllers, Media Point Transceivers, and Mobile Terminals do exist. The Presence Server is considered to be incorporated in the Media Point Service Controller, but when the message flow charts will be presented, it will be shown as a different component in order for the reader to create a better understanding of the message flow charts.

For the creation of the message flow charts it will be considered that a Mobile Terminal comes at a random point of time inside the coverage area of a Media Point Transceiver that belongs to a Media Point Controller and wants to establish connection with the Media Point system.

5.1 Media Point Service Controller subscribing to the Presence Server

The way Media Point Service Controller subscribes to the Presence Server [2] in order to receive actual information about the current location of its clients is presented in Figure 3.

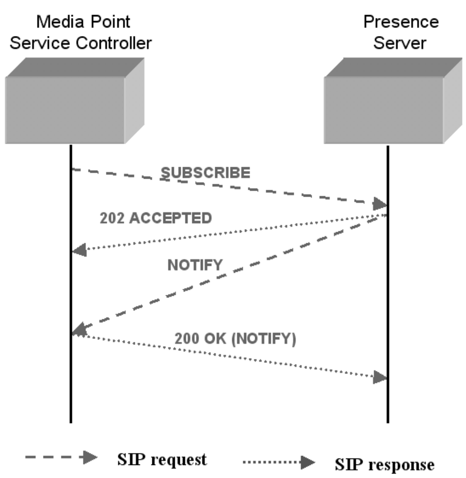

Fig. 3. Media Point Service Controller subscribing to the Presence Server.

The Media Point Service Controller sends a SUBSCRIBE [2] to the Presence Server in order to request to be always informed about the actual location of a specific Mobile Terminal. If the SUBSCRIBE is accepted by the Presence Server, then whenever the location of the Mobile Terminal changes, it receives a NOTIFY [2] with the information about the new location of the Mobile Terminal. In case that the SUBSCRIBE is not accepted, then it means that the Media Point Service Controller does not have the right to be informed about the location of this specific client.

5.2 Connection establishment between the different components

The connection establishment between the different Media Point components is presented in Figure 4.

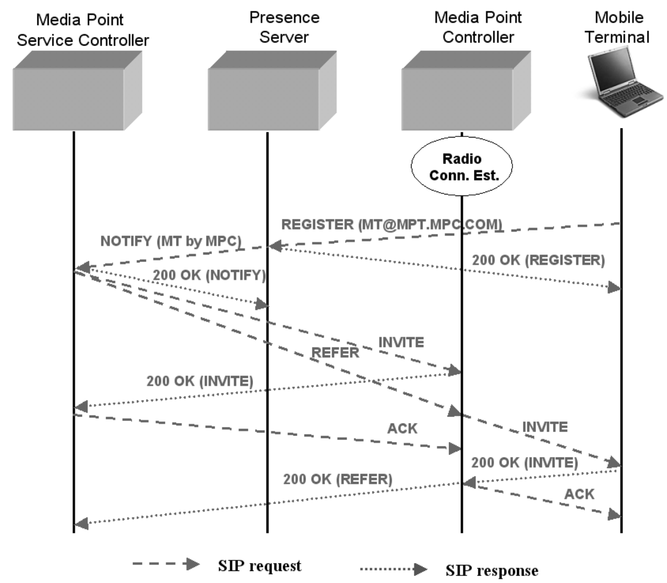

Fig. 4. Connection establishment between the different Media Point components.

A Mobile Terminal (MT) that arrives in the coverage area of a Media Point Transceiver (MPT) creates a radio connection with the Media Point Controller (MPC) where the Media Point Transceiver belongs to. Then it sends periodically refreshed REGISTER [1] requests to the Presence Server with its location information. The REGISTER request is sent periodically whenever a radio connection exists so as for the Presence Server to be able to know when the Mobile Terminal is away with the use of a timeout when it is receiving no REGISTER from it. The Presence Server responds with an OK [1] and by searching its database finds out whether the location information received from the REGISTER is the same with this stored in its database that was received with the previous REGISTER. If the location of the mobile terminal remains the same, the Presence server takes no action. If the location has changed, the Presence Server informs the Media Point Service Controller about the new location of the Mobile Terminal (SIP address SIP: MT@MPT.MPC.COM) with a NOTIFY message and the Media Point Service Controller responds with an OK. The Media Point Service Controller then sends an INVITE [1] request to the Media Point Controller in order to establish a connection with it. It also sends a REFER [3] message to the Media Point Controller with the location information of the Mobile Terminal so as to trigger a connection establishment between the Media Point Controller and the Mobile Terminal. The REFER is followed by an INVITE request from the Media Point Controller to the Mobile Terminal.

The INVITE is succeeded by an OK and an ACK [1] and thus, a SIP connection is established between the Media Point Service Controller and the Media Point Controller, and between the Media Point Controller and the Mobile Terminal. After the OK is received by the Media Point Controller, it sends an OK to the Media Point Service Controller indicating that the REFER message has fulfilled its purpose as a connection was established between the Media Point Controller and the Mobile Terminal.

Two separate connections are needed (Media Point Service Controller with Media Point Controller, and Media Point Controller with Mobile Terminal) so that the personalized data sent to Mobile Terminal, can be cached and wait for the Mobile Terminal to ask for them. The data are pushed with the use of SIP with a MIME body from the Media Point Service Controller to the Media Point Controller [4]. Application Servers (e.g. e-mail, web) exist in the Media Point Controller that aim to serve the Mobile Terminal with the data that have already been pushed there by the Media Point Service Controller, in case the Mobile Terminal asks for them.

5.3 The disconnecting process

The disconnecting process is depicted in Figure 5.

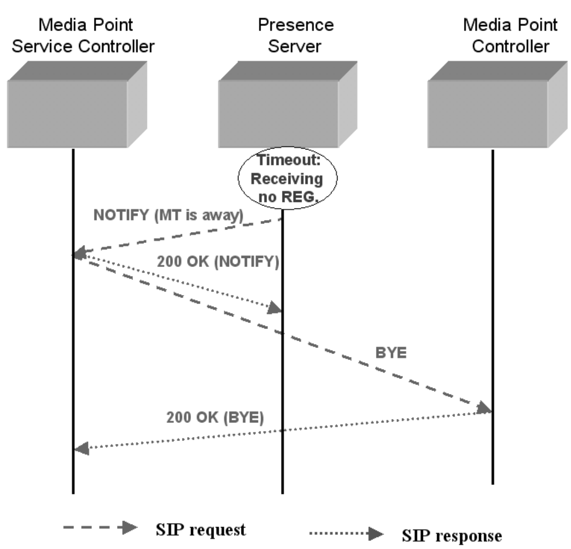

Fig. 5. The disconnecting process.

After the Mobile Terminal goes away from the coverage area of the Media Point Transceiver, there is a timeout inside the Presence Server and occurs as no REGISTER is received from the Mobile Terminal any more. So the Mobile Terminal is registered as being away and the Presence Server sends a NOTIFY with this information to the Media Point Service Controller which sends a BYE [1] request to the Media Point Controller, and as a result, the Media Point Service Controller and the Media Point Controller are disconnected. The data remain for some time cached in the Media Point Controller in case the Mobile Terminal appears in another or the same Media Point Transceiver that belongs to the same Media Point Controller so as to be able to retrieve its data more quickly. But after a specific point in time, the cached data in the Media Point Controller are erased.

6. CONCLUSIONS

We presented how islands of fragmented broadband wireless access, so-called Media Points, can be integrated in the public cellular infrastructure. The components of the Media Point scenario were described as well as the way how they can communicate with each other, such that users are able to access managed high-rate services whenever located within the coverage area of a Media Point. SIP as an enabling technology for session management and data delivery has been described, including the respective message flow charts.

In a next step we will implement the concept in a test environment. The prototype will be used to optimize parameter settings, like the frequency of registration and the lifetime of data within the cache. Interfaces to cellular networks will be described in a dedicated publication.

ACKNOWLEDGMENTS

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[2] The authors are responsible for the content of this publication.