

A Functional Architecture for User-Centric Multimedia Service on Mobile Station

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Abstract—This paper proposes a functional architecture on MS (Mobile Station) for MS. The proposed MS has several management modules and binding tables about authentication and session to provide seamless multimedia services. The binding table about authentication and session to provide seamless multimedia services. The binding table is managed in the MSS(Media Streaming Server) as well as HG(Home Gateway). The MS receives suitable multimedia services by measuring the available bandwidth between the MS the MSS. We implemented testbed which consist of simple home network environment including the prototype mobile station, media server and home gateway.

Keywords—Seamless Multimedia Service, IPTV, Mobility, Terminal Architecture, Handover

I. INTRODUCTION

With the important advent of multimedia services and the ubiquity of computing environments, the context-awareness in services access and service continuous is getting crucial. Services, especially the multimedia ones, must perform automatically offer to adapt the delivered content to the user expectations and his environment capabilities [1].

Our goal with the research we describe in this article is to develop a ubiquitous video-streaming platform for MS(mobile station) to let people enjoy continuous multimedia services at any time, in any location.

Today, even though much research has been done on home gateway system and seamless multimedia services, the effectiveness of context handoff and terminal requirement has not been clearly explained. In addition, there are many schemes have been investigated in the ubiquitous network environments such as streaming services and user recognition-based services are supported using hardwares, sensors and radio waves [2]-[4].

However, a mobile station, agent based terminal, has limits to receive services.

The situations are as below.

- A mobile station has no RFID reader.
- A user move to where sensors can't sense a user.
- A user move to where are provided by another service provider domain.

- A user move to another terminal which wouldn't receive suitable services such as the difference in bandwidth.

In these reason, this paper presents a functional architecture for mobile station to offer ubiquitous multimedia services. In order to provide user-centric multimedia services, a mobile station has management modules such as Context Manager(CM), User Profile Manager(UPM), Device Manager(DM), Query Manager(QM) and Service Manager(SM). To provide seamless service, we proposed service mobility mechanism with home gateway. A user can enjoy continuous services by sending/managing session information such as "UserID, RFID, IP, Port ContentID, TimeStamp" from a mobile station to HG(home gateway) and MSS(Media Streaming Server). HG and MSS manage and synchronize the information each other. In addition, to receive a suitable multimedia service, the mobile station measures the available bandwidth between the mobile station and the media streaming server.

In this paper we implement testbed which consist of simple home network environment including the prototype mobile station, media server and home gateway. We tested service switching time.

This paper is organized as follows. In section II, we describe about the related works. The proposed mechanism is explained in section III. In section IV, the test through implementation shows implementation result of the proposed mechanism. Finally, conclusion is given in Section V.

II. RELATED WORKS

In this section, agent-based user mobility mechanism is introduced and we look around the end-to-end available bandwidth measurement tools.

A. Agent-based user mobility mechanism

There are kind of mobility to provide seamless multimedia streaming services such as session mobility, service mobility, terminal mobility and user mobility [5]-[8].

Agent-based user mobility mechanism can provide that a user who enjoy multimedia service using mobile station like PDA, laptop computer and smartphone in the outer wireless network moves into the home network, and then the service needs to be continuous on another terminal in the home

network [1]. When the user moves to another terminal within the same home network, the terminal should be able to recognize the user identification and location, to get the information of the service having been served for the user from the HG(Home gateway), and to provide seamless service continuously using the information[1]. There are various methods that HG and MSS(Multimedia Streaming Server) recognize a user identity and a user location [2][4].

However, these methods have problems that all mobile station has a RFID Reader or a user must be located where sensors can sense a user.

B. End-to-End Available Bandwidth Measurement

Bandwidth measurement tools are classified as single hop capacity, end-to-end capacity, and end-to-end available measurement tools. Among them, various end-to-end available bandwidth Measurement tools are existed such as pathload, pathChirp [9]. In order to measure bandwidth, many tools are used depending on the metrics [7]. These metrics are capacity in a link or path and available bandwidth in a link or a path. Capacity means maximum transfer rate in a link and end-to-end capacity means maximum transfer rate in a path.

Pathload is a tool for estimating the available bandwidth of an end-to-end path from a host S(sender) to a host R(receiver). The available bandwidth is the maximum IP-layer throughput that a flow can get in the path from S to R, without reducing the rate of the rest of the traffic in the path [10].

PathChirp is a tool for estimating the available bandwidth on a communication network path. Based on the concept of "self-induced congestion," pathChirp features an exponential flight pattern of probes we call a chirp [8].

III. PROPOSED FUNCTIONAL ARCHITECTURE AND MECHANISM

This section presents functional architecture and mechanism for mobile station. In Fig. 1, the portability is supported in the ubiquitous network for the multimedia service.

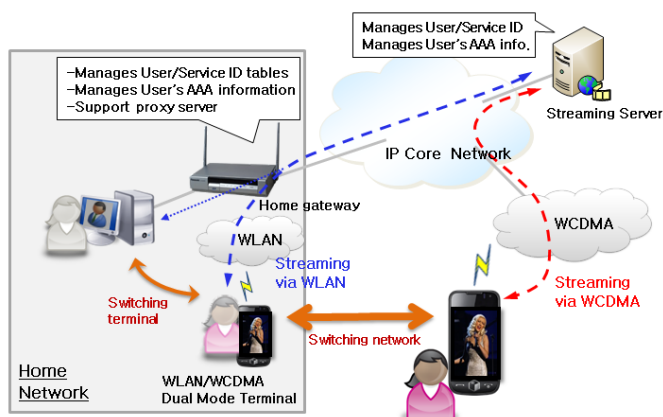


Figure 1. The service mobility concept by user movement

Fig. 1 shows that a user who enjoys multimedia service using dual-mode mobile terminal such as PDA, laptop computer and smartphone, called mobile station. There are

MSS and HG to support service mobility, and they manage the information which separation of User ID and Service ID. Proposed architecture and mechanism use integrated User ID which is the mapping system between RFID and User ID. So, any MS can recognize a user whether MS has a RFID reader or not. The HG includes NAT function, networking function, authentication function, binding table managing function and switching agent function. The MSS performs several things such as media streaming, binding table managing and measuring the available bandwidth. When a MS recognizes a user(e.g. RFID reader recognize a RFID or User log in the MS), the MS manages the User Information and register to HG and MSS. Fig.1 show that service information and user information are managed by MSS and HG. A user can enjoy multimedia service through the WLAN in home network. But when the user moves beyond the signal coverage of WLAN, the user performs the vertical handoff from Wi-Fi to 3G.

A. Functional Architecture

To provide the seamless multimedia service at dual-mode interface, we propose a functional architecture for mobile station. Fig. 2 illustrates functional architecture, which consist of five parts : Context Manager, User Profile Manager, Device Manager, Query Manager, and Service Manager.

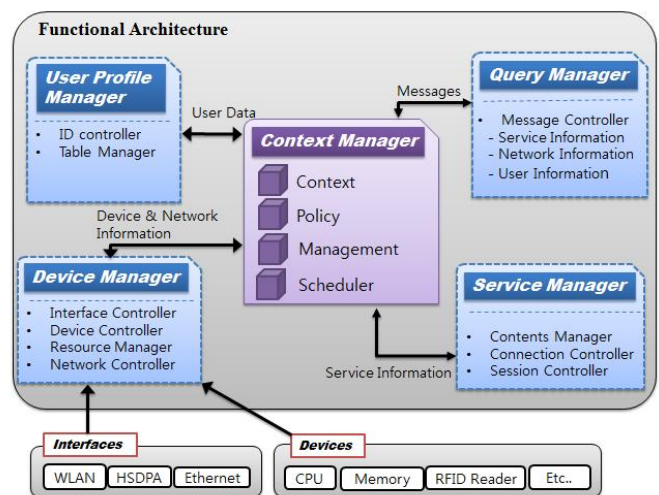


Figure 2. Proposed the Functional Architecture for Mobile Station

1) *Context Manager(CM)* : The CM is composed of a set of functions that context aware, the rule set for the effective situation, collecting information, management and task scheduling. It manages all of systems in the mobile station. When something is happened, the CM would aware and treat them. For example, when a user moved, the MSS got messages and so on.

2) *User Profile Manager(UPM)* : The UPM checks/manages the user identification when a user registration the mobile station such as UPM recognizes a RFID ID or a user inputs the User ID and Password. The UPM makes/manages a table

The initial request procedure of multimedia service as follow:

Step 1) When the MS recognizes a user registration, the MS checks the resource to receive the multimedia services. For example, how big size of multimedia can be received or what kind of network is connected.

Step 2) The MS requests the content lists to the MSS, and MS receives the content lists from the MSS. So, the user can choose the content to watch.

Step 3) The MS sends a user registration request message to the HG with the user information about location. If there is no problem about user registration, the HG notifies to the MS about the port which will be forwarded from the HG to the MS.

Step 4) The MSS measures the available bandwidth between the MSS and MS. If the MSS can stream the multimedia, the MS receives the service request ack message from the MS.

Step 5) After all signalling messages, the multimedia service is delivered by the HG in home network. The user can enjoy the multimedia service.

Fig 5. show that the procedure of service mobility when the user move/change the terminal in home network.

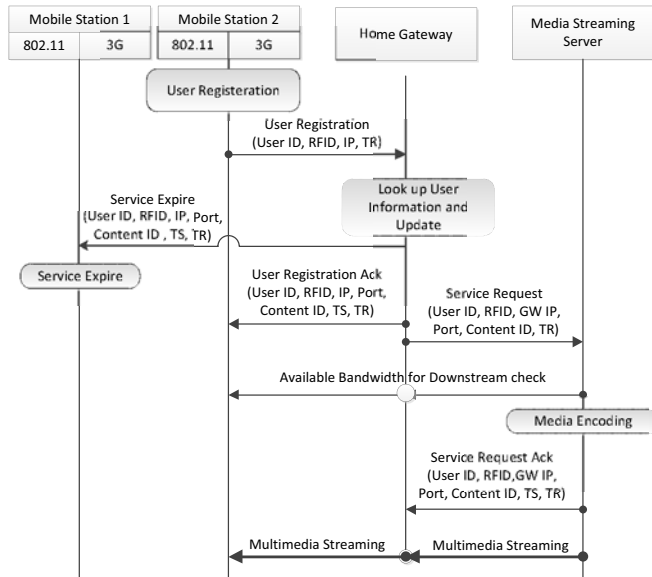


Figure 5. The procedure of service mobility in home network

The scenario assumes that the user is watching TV on the laptop computer in the living room. But the user wants to watch TV in the living room and RFID room. So, when the user moves to the living room and RFID tag approach at the RFID reader, the MS2(New MS) send the user registration message to the HG. If the HG has any information about user who is delivering a streaming service by the HG, the HG sends a service expire message to the previous MS. And then the HG sends a user registration ack message to MS2(New MS) and service request message to the MSS. The MSS measures the available bandwidth between the MS2 and MSS, again. And then the HG looks up the user information at the database. Through by these procedures, the MS can provide seamless steaming service when user moved.

Fig 6 show that the user who was provided the streaming service in home network move out of the house(the user can't be provided the signal coverage of WLAN).

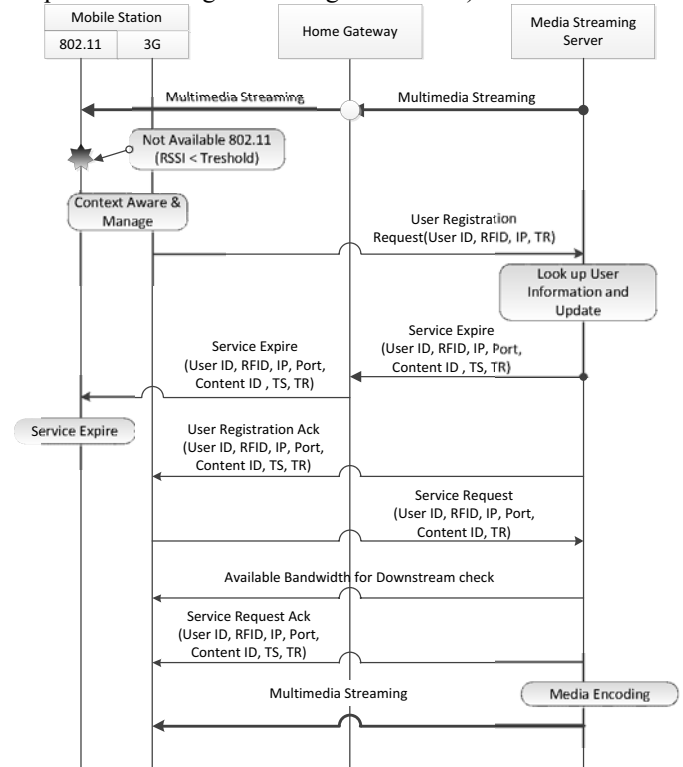


Figure 6. The procedure of vertical handover from Wi-Fi to 3G

The Network Controller of the DM(Device manager) in the MS measures the RSSI value periodically. If the RSSI value is lower than threshold, the Network Controller notifies to the DM(Device manager) which performs vertical handoff to 3G [5]. In this case, the multimedia service would be provided to the MS through by 3G directly from the MSS, because you know if see the Figure 1 the 3G(HSDPA) not connected to the HG(home gateway). Hence, we present procedures without home gateway in Fig 6. The remaining procedures are similar with before explained.

IV. IMPLEMENTATION AND PERFORMANCE ANALYSIS



Figure 7. An example of multimedia service environment

Fig. 7 show the three display equipments for testing. We implemented the proposed system in home and out of the house. In the house, this system is connected by the network through WLAN or wired-lan, and out of the house the MS is connected by HSDPA. The client 1 and client 2 can be connected by both wired-lan and WLAN. Client 3 is connected by WLAN or HSDPA. The scenario assumes that a user enjoys the multimedia service through by Client 1(big sized TV in the living room). He is moving to the room to enjoy the multimedia service by laptop computer. Suddenly, if he has to go to the supermarket to buy something, he would can enjoy the multimedia service through the UMPC continuously while he is moving.

Table 2. System Specification

Object	Attributes CPU	Memory	OS	NIC
MSS	2.5GHz	2GB	Windows 7	100Mbps
Laptop	2.3GHz	2GB	Windows 7	100Mbps
Desktop	2.2GHz	2GB	Windows 7	100Mbps
UMPC	800MHz	1GB	Win XP	100Mbps

Table 2 presents the system specification of demonstration environment. The desktop computer is connected to the big sized TV. The UMPC is portable computer such as PDA, smartphone and so on.

Table 3. Home Gateway Specification

Main Features
ARM 922T Core at 166 MHz
64MB Memory space
8Kb I-Cache and 8Kb
33MHz 32-bit PCI Interface
4 LAN Interface
1 WAN Interface
1 Wireless Interface

Table 3 presents the embedded board specification of home gateway.



(a) Video Sample of Wi-Fi (b) Video Sample of 3G

Figure 8. Video Samples Comparison WLAN(a) and HSDPA(b)

Fig 8. Show that video samples for WLAN and HSDPA. We can be found out that figure 8-(a) is higher quality than figure 8-(b). The mobile device screen is smaller than Tv and Monitor. Therefore, the video samples are suitable sized each device.

Table 4 presents the service switching time. We used WIRESHARK, network packets analyzing tool, to capture

packets are transmitted and received service between Wi-Fi and 3G. From the experimental result, we confirmed that proposed functional architecture can be used in home network.

Table 4. Multimedia service switching time (Wi-Fi to 3G)

Movement	Signaling Starting time(ms)	Service Starting time(ms)	Service Switching time(ms)
1	9811	9936	125
2	15843	15974	131
3	21077	21190	113
4	27013	27154	141
5	31125	31284	159
Average			134

V. CONCLUSIONS

This paper presents a simple way to provide continuous and bandwidth-adaptive IPTV service while switching the mobile terminals. We proposed a functional architecture and mechanism for mobile station to provide seamless multimedia services. In addition, the MSS measure the available bandwidth between the MSS and the MS to provide a suitable multimedia service. We implemented testbed which consist of simple home network environment including the prototype mobile station. As a result, we show the possibility that a user can enjoy continuous multimedia services at any time, in any location. And we've tested the switching time from WLAN to 3g and got 134ms switching time.

For further works, we'll research about how to securely, reliably and conveniently maintain and manage the binding tables on each entity. Moreover, we'll more study terminal mobility and user mobility to provide seamless multimedia service.

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