

Efficient Methods of Contents Sharing Between Digital Signage System and Mobile Terminals

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Abstract—Digital signage is a Digital Information Display (DID) which expresses traditional advertisements of outdoor billboards by digital. In early digital signage was limited to provide contents consists texts, images and videos, but now it is combined with the network so contents can be installed, operated and replaced from a distance. These days digital signage is coming into wide use as a public display infrastructure. The main role is to deliver information such as product or service advertisement, public information, to public users. Furthermore to increase the effect of advertisement, interaction with users and with user's mobile terminals is getting important. Thus, the transfer of contents between digital signage terminal and user's mobile terminals will occur frequently. In this paper, we suggest the structure of the digital signage system and the efficient method of content sharing through the diagram of the system structure and signal flow.

Keyword—About Digital Signage, Contents Sharing, Transform, Multicast, Mobile Terminal

I. INTRODUCTION

DIGITAL signage has become practical and widely used, allowing video and other information to be displayed over networks in a timely fashion on displays installed in various locations such as in stores, transportation facilities, hospitals or campuses [1]. Basically, electronic (i.e., digital) displays used

for digital signage offer new opportunities and advantages compared to traditional 'static' signage. For instance, it allows to display information such as news or advertisements, in the form of dynamic multimedia presentations containing audio, video, and animations [2]. Many products are already on the market, and the digital signage market is expected to reach US\$3.5 billion in 2011 [3].

Digital signage service is commonly used to display advertisement of a store at fixed location or mobile terminals. For a fixed location, it normally uses a big screen TV combined with networked computer to display advertisement. It plays advertisement contents on a designated schedule coordinated by the shop manager. For mobile terminals, when a customer approaches the coverage of a store's POAs (Point of Access), the prepared advertisements are supplied to the connected customer [4].

As digital signage become popular, it is required for digital signage to interact with mobile phones. Digital signage usually presents high-level information in its main page to attract people's attention. To get more detailed information, people need to search in depth in front of the signage. There are many cases that they do not access for the detailed information, because they might not want to spend their time at the signage or the digital signage can be located far away, not enough to interact with the signage using their body. In this regard, interaction between the signage and mobile phone is preferred to access and store the detailed information [5].

The size of exchange data between digital signage and user's mobile terminal is small at present such as discount coupons or URLs. However, the demand of high quality and large size of multimedia data will increase in foreseeable future. For example, the users who are watching the advertisement which is displaying on the digital signage terminal may want to get more additional information for the current advertisement or to watch the current or previous advertisement once more through their mobile devices.

In wireless network environment that has limited resources and many interactions with multi-user's mobile terminals simultaneously can cause the situation that can't provide seamless services because of the shortage of network

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bandwidth.

To resolve this problem, we suggest the efficient method about contents sharing between digital signage system and many mobile terminals. First, we can reduce the consuming network bandwidth by minify the size of multimedia data for mobile terminals. The display of mobile terminal is much smaller than the one of digital signage terminal. So, the high quality and large size of multimedia data is not necessary for the mobile terminal. We can transform the original data for digital signage into small size which is proper for mobile terminals and store to the digital signage terminal in advance. Second, using multicast to transfer the contents to mobile terminals can provide seamless service to multi-users with minimum network bandwidth.

In this paper, we present some related works in section II and suggest the architecture of the digital signage system for efficient contents sharing between digital signage system and mobile terminals in section III. In section IV, we explain specific method of efficient contents sharing between digital signage system and mobile terminals through the diagram of signal flow. Some implementations for application of this paper are in section V and we conclude the paper in section VI.

II. RELATED WORKS

In this paper, we present efficient methods to share the digital signage contents to mobile phones. While the digital signage system is promising business in advertisement, methods of interacting between digital signage and mobile phone or sharing the digital signage contents with mobile phone haven't been studied a lot so far.

Chua et al [6], investigated motivations behind mobile media sharing by using a diary study methodology to understand the motivational factors for media sharing behavior on mobile phones.

Strohbach and Martin [7] introduced the Interactive Display Wall and the Targeted Advertisement. The former is an interactive display wall with RFID. The latter is a targeted advertisement with QR code.

Mayrhofer et al [8], introduced a new method for device-to-device authentication by shaking two devices together and used movement patterns to pair the devices securely. They describe two protocols for combining cryptographic authentication techniques with known methods of accelerometer data analysis to the effect of generating authenticated, secret keys.

'DigitalSignageToday.Com' introduced several interaction technologies between digital signage and mobile phones in seven distinct ways such as DTMF(Dual Tone Multi-Frequency), SMS(Short Message Service), 2-D bar codes, Bluetooth, Photo recognition, Mobile Web and Location based. Some, such as DTMF and SMS, are already well established in the market place. Others are still on the drawing board [9].

Varshavsky et al [10], suggested a technique to authenticate neighboring devices by using knowledge of their shared radio environment based on physical proximity. They shows that it is

possible to securely pair devices that come within close proximity by using common radio profiles between devices close to each other to differentiate the pair of devices.

Sato et al [11], proposed Interactive Digital Signage (IDS) systems that is characterized by its displaying of visual contents on a larger display for interacting with mobile phones. They proposed a method for linking between digital signage and mobile phones which uses a contactless smart card or phone call to connect those two different devices.

Peng et al [12], suggested recognizing user gestures to pair the mobile devices. The main feature of recognition is measuring the distance reduction between two devices during user's pointing out gesture. Approaches for general mobile pairing can be also used for linking mobile phone with signage contents, but some features of interacting with the signage should be considered such as distances between signage and mobile phones, user mobility etc.

Rekimoto et al [13], introduced "SyncTap" that is a user interface technique for making a network connection between digital devices. When a user wants to connect two devices, he or she synchronously presses and releases the "connection" buttons on both devices. Then, multicast packets which contain press and release timing are sent to the network. Both devices make a network pairing each other by comparing this timing.

Liao et al [14], presented a mobile content sharing mechanism based on UPnP framework and wireless technology in digital home environment. Some investigations have carried on detailed research on technological and social issues around sharing media.

Yoon et al [15], proposed Decentralized cOllaborative Media content Streaming (DOMS) that realizes flexible media content sharing by exploiting collaborative segment-based streaming amongst Wi-Fi devices via the temporarily-established direct links. Rigorous analysis was done which resulted in a complex decentralized media sharing environment based on Wi-Fi Direct technology.

Oh et al [16], designed an extended use case based on SIP protocol for media access on DLNA-enabled devices from public IP. They proposed an extended DLNA media sharing architecture as a methodology provide services for accessing and sharing various media contents distributed over DLNA-capable devices, via not only a home network but also the Internet networks.

Fedosov et al [17], proposed a new way of sharing media content from mobile devices using seamlessly established communication sessions with a high degree of security. Federating media from the smartphone to larger display devices enables rich social experiences and sharing the content in more engaging manner.

As we listed above, the pairing methods with mobile phone for interactivity and some methods of sharing media contents in home environment can be used for sharing digital signage contents with mobile phones, but some features like limited wireless bandwidth or efficiency of sharing media contents should be considered. In this paper, we try to consider the efficiency of media content sharing between the digital signage terminal and user's mobile phones in wireless environment.

III. ARCHITECTURE

In this section, we provide the architecture diagram of digital signage system, digital signage terminal and mobile terminal. Then we explain the role of each component in the sub sections.

The architecture of digital signage system, digital signage terminal and mobile terminal is as shown in Fig. 1. The digital signage system consists of contents server, schedule server, profile server, digital signage control server, manager server and mobile terminal interworking server. In this system, those are connected each other by the wired or wireless network and the displaying contents of digital signage terminals are shared with mobile terminals.

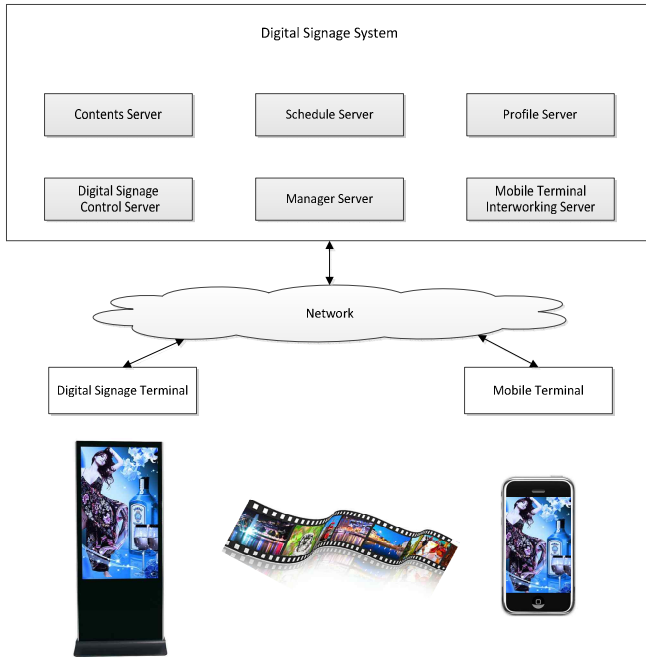


Fig. 1. Architecture of digital signage system, digital signage terminal and mobile terminal

A. Manager Server

The manager server makes the contents for digital signage and schedules the time to display. The advertisers can access for manager server to make contents like Fig. 2. They can configure the locations and types (video, image and text) of content components by manager client or web. Also they can schedule the display times of contents for digital signage terminals as shown in Fig. 3.

B. Contents Server

After finishing for making contents and schedules in manager server, the contents are uploaded to contents server. The contents server stores and manages all contents for digital signage terminals and provides the URLs about the locations of the contents to digital signage terminals so those can obtain the contents through the URLs.

C. Schedule Server

Similar to the contents server, the schedules made in manger

server are uploaded to schedule server. The schedule server stores and manages all schedules for digital signage and provides the URLs about the locations of the contents to digital signage terminal so it can obtain the contents through the URLs.

D. Profile Server

The profile server stores user's properties (User ID, Password, Authority, etc.) and digital signage terminal's properties (Terminal ID, Location, etc.) and provide the profile when any requests from other servers exist.

E. Digital Signage Control Server

The digital signage control server handles every work about digital signage terminals and performs the interface gateway to the other servers like a supervisor.

F. Mobile Terminal Interworking Server

The mobile terminal interworking server plays a role in handling every work about mobile terminals. The mobile terminal can access the digital signage system through the mobile terminal interworking server.

G. Digital Signage Terminal

The digital signage terminal is a Digital Information Display (DID) which displays the downloaded contents from contents server corresponding to the schedule that is obtained from schedule server. The user can watch advertisements or interact with the touch panel on the digital signage terminals.

H. Mobile Terminal

The mobile terminals can be any devices of user's such as smart phones, tablets or etc. In this system, the users can watch the current displaying advertisements or previous advertisements by web or applications in their mobile terminals.

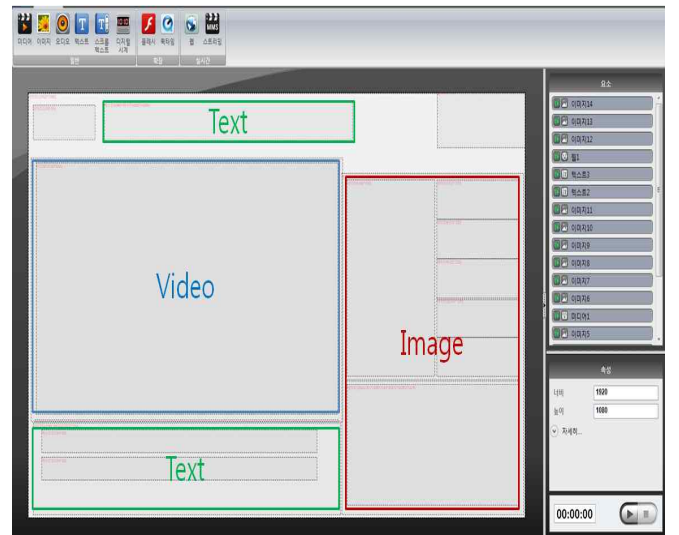


Fig. 2. Contents making for digital signage terminals in the manager server

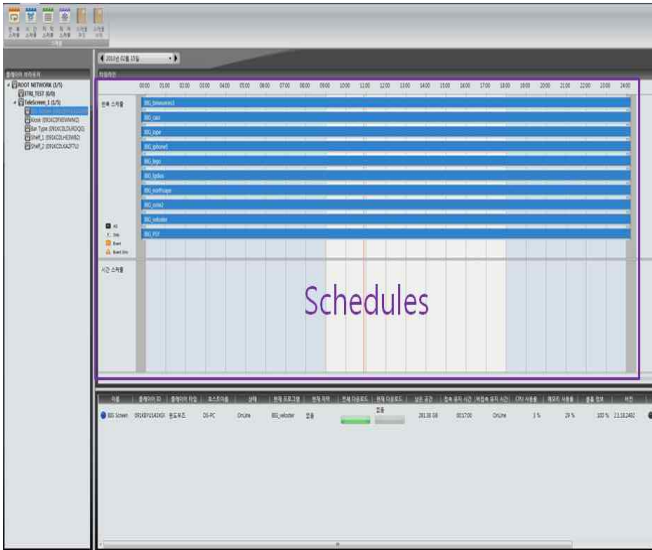


Fig. 3. Scheduling of the contents for digital signage terminals in the manager server

IV. SIGNAL FLOW

In this section, we explain the specific method for efficient contents sharing between digital signage system and mobile terminals using signal flow chart. We describe each step of the flow chart.

The signal flow of uploading the contents and schedules made from manager server and downloading the contents and schedules from digital signage terminal is shown in Fig. 4.

After the contents providers make the contents and schedules by manager server, manager server requests for uploading the contents and schedules to digital signage control server. The digital signage control server obtains the user profile from profile server to check authority for uploading contents. Then the digital signage control server uploads schedules to schedule server and contents to contents server each.

The contents server transforms the contents for displaying on the digital signage terminals to the contents for mobile terminals to minify the size of the contents for efficient contents sharing between digital signage terminals and mobile terminals. The contents for displaying on the digital signage terminals are the multimedia which has high rate and high definition because the screen of digital signage terminal is large. However, the mobile terminals don't need such high quality contents. It wastes the resources of wireless communications. So we reduced the quality of contents, however still enough to display in the mobile terminals, to share with the mobile terminals efficiently.

Then the contents server transfers the URLs to digital signage control server so that the digital signage terminals can download the contents and schedules.

The digital signage control server give the URLs for contents and schedule to digital signage terminal. And then the digital signage terminal downloads the contents and schedules through the URLs and plays the contents as scheduled.

Fig. 5 describes the process of contents sharing with mobile terminals.

The mobile terminal needs log-in to the digital signage system for content sharing. The mobile terminal requests for

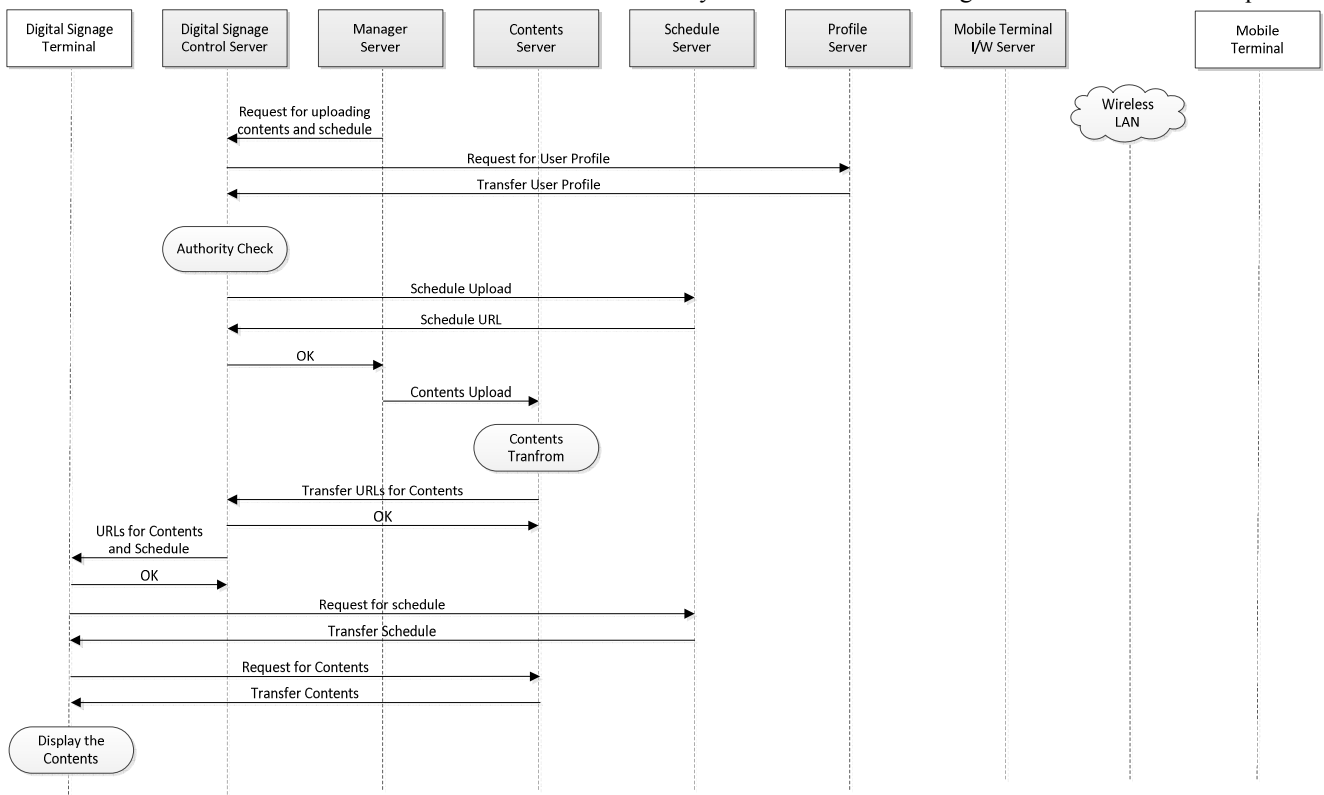


Fig. 4. Signal Flow for Upload/Download of Contents and Schedule

log-in to mobile terminal interworking server with the user ID and the password. Then the mobile terminal interworking server checks the authority for accessing to digital signage system by comparing with the user profile which obtained from the profile server.

After log-in, the mobile terminal can request for contents sharing about the contents which are displayed currently or previously to mobile terminal interworking server. The digital signage control server delivers the request to digital signage terminal and the digital signage terminal transmits the contents which are made for mobile terminals to networks by the multicast protocol. Then any mobile terminals which want the contents can obtain those by IGMP (Internet Group Management Protocol) JOIN message. By using the multicast protocol we can reduce the consuming network bandwidth to provide seamless service to multi-users with minimum network bandwidth in wireless network environment that has limited resources.

V. IMPLEMENTATION

A. Real Time Contents Sharing

We implemented a prototype of digital signage system to apply our effective contents sharing method. We made various types of digital signage terminals such as 'Kiosk' type, 'Shelf' type, 'Bar' type and 'Big' type. The digital signages receive contents from contents server and play the contents according to the schedule obtained from schedule server. Then the digital signages multicast the transformed content which is efficient for mobile terminals. We developed an android mobile application for sharing the displaying contents with the digital signage terminal. By using this, users can show the displaying contents of digital signage terminal on their mobile terminals. Fig. 6 shows the real time contents sharing of displaying contents of digital signage. They can show the previous advertisements or next advertisements also by sliding the media contents with his finger.

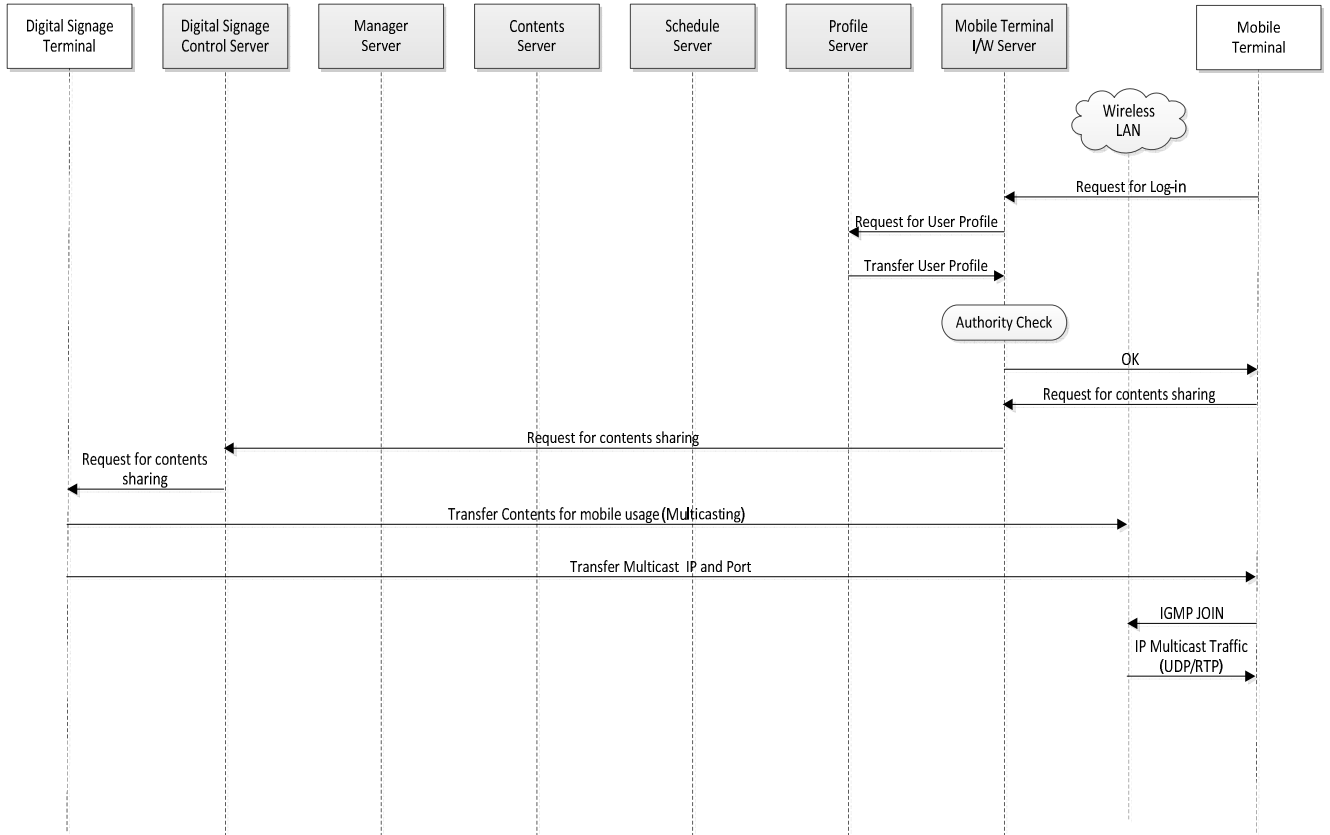


Fig. 5. Signal Flow for Contents Sharing with Mobile Terminal



Fig.6. Real Time Contents Sharing of Displaying Advertisements on the Digital Signage with the Mobile Terminal

B. Disaster Broadcasting

Similarly the real time contents sharing, this method can be effectively used in disaster broadcasting. By using the android mobile application the administrator of system can alarm the emergency through the digital signage terminals like Fig 7. The user's mobile terminal which is connected the digital signage system can receive the disaster broadcast as shown in Fig 8.



Fig.7. Disaster Broadcasting of Various Digital Signage Terminals

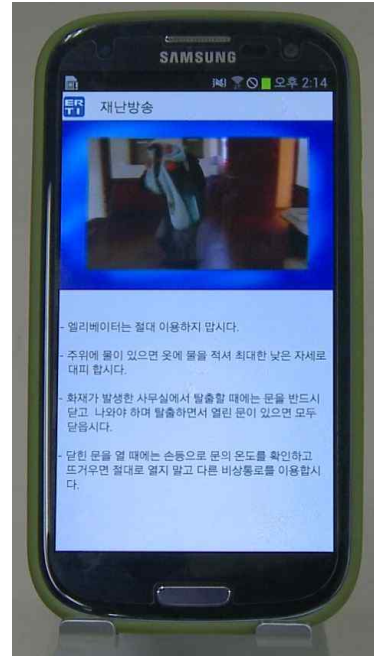


Fig.8. Disaster Broadcasting of Mobile Terminal

VI. CONCLUSIONS

Digital signage system is a display device that shows advertisement, information and other messages. As the interactions with user's mobile terminals become more important, the transfer of contents between digital signage terminal and user's mobile terminals occurs frequently.

There are issues related to networked digital signage systems such as real-time delivery of news signage, open formats of signage contents, efficient use of network bandwidth etc. [18]. Especially, because wireless network environment has limited resources, simultaneous interactions with multi-user's mobile terminals can cause the shortage of network bandwidth.

In this paper, we suggest the architecture of the digital signage system and the method for efficient contents sharing between digital signage system and mobile terminals through the diagram of architecture and signal flow. The key ideas of efficient contents sharing method are transformation of contents for mobile and transfer contents to mobile terminal through multicasting. This contents sharing method will be applicable to the disaster broadcast to the mobile terminals by using the digital signage terminals as relays.

For the future work, we can research for the optimization of the transformation of the contents for mobile terminal or we can consider the Dynamic Adaptive Streaming over HTTP method for contents sharing between digital signage terminal and user's mobile terminals.

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BIOGRAPHIES



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