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Development of a Second Screen Service for Personalized Contents Delivery

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Abstract

As people use smart devices while watching TV increase, recently, researches on a wide range of services linked with second-screen devices around the smart TV in the home network have been actively conducted. The study proposes a second screen personalized services in next-generation broadcasting service environment. Also, the service applies web technologies to realize additional information representation, wide connection of devices, and real-time content transmission.

Keywords: *Second Screen Service, Personalized, Web Technology, UPnP, Open Annotation Data Model*

1. Introduction

The proliferation of various mobile devices, such as smart phones and tablet PC, brought changes in the existing TV viewing behavior [1]. The viewing patterns are increasing that simultaneous use of a different media using personal smart device while watching TV. Second Screen technology has received an attention as a technique that corresponds to this user viewing patterns change.

In broadcasting, by interlocking second devices with Smart TV's, Second Screen Service based hybrid network can be made. Second Screen is a complementary to expand the TV viewing experience and offer more convenience and usefulness while watching TV. This allows second screen devices to also view the broadcasted contents and other web contents from the TV along with information about these contents. The concept of Second Screen Service in broadcasting is similar to the concept of devices collaborating whereas the TV and other devices are connected, allowing other devices to help the TV broadcast contents [2].

Currently, the abilities to find and control devices through techniques related to Second Screen Service and the techniques of contents deliverance are also being studied. UPnP(Universal Plug and Play), a technique that is receiving lots of attention for its ability to find and control a device, is able to perform multiple tasks. By using standard protocols, such as the IP network and HTTP, UPnP can automatically find services provided by home networks, and enable the ability to take control over it through diverse protocols, ultimately enabling devices between smart TV's and Second Screen Devices to be found and controlled.

Connection between devices and web related techniques exist but despite its increasing popularity, the current research of Second Screen Service is only applied in services for tests, and it is difficult to find any successful cases [3].

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In this paper, we research the trend of second screen service technologies and propose a scenario to enable the personalization of contents to combining hybrid broadcasting system.

2. Research Trends on Second Screen Service

In this study, we conducted a study on Web and TV Interest Group [4] organized by W3C-to see the research trends related to the second screen service. Web and TV Interest Group is an interest group to discuss technical issues and relations between Web and TV at W3C. For a detailed discussion of the use cases and requirements in connection with a Web TV, TFs was–conducted as shown in <Table 1>, but currently most of them are finished and some topics are being discussed in the entire IG.

Table 1. Web and TV Task Force

TF	Description	Process
Media APIs TF	Requirement of Download and recording on media, The Receiver Capability, Contents Metadata and Synchronization	Closed
Testing TF	Discuss testing requirements for Web and TV	Closed
Stereoscopic 3D Web	3D Video/Graphic Influence on Web Technology	Closed
Timed Text	Subtitle Issues relating to the content on the web	Closed
Media Pipeline TF	HTML5 Video, Audio and Media Interface Requirement for the TV service based on Web	Closed
Hone network TF	Requirement to discover and control the devices and service in local network	Closed
Web Media Profile TF	Guideline and Instructions for Interactive Media Services on General Browser Environment	On hold

Here are some examples presented at the Web and TV Interest Group Workshop.

2.1. A Flexible Multi-screen Solution Based on UPnP

The subject presented by the CableLabs is the new model that allows the smartphones, tablets and TVs to interact [5].

2.1.1. Synchronization: Synchronization is one of the important features to move from simultaneous experience to integrated experience. It is different to shop clothes online while the TV is turned on compared to purchase the cloth that an actor is currently. This requires the TV program contents information and a coordination method.

2.1.2. Screen Passing: People want to see the content through the best peripheral devices. This suggests the need for transferring content between devices. Displaying at the same contents on the multiple screens is the similar requirements use case. Modifying the context for a common method requires a standard.

2.1.3. Main Screen and Companion Screens: Main screen is TV and companion screen mainly act as a remote control. Primary screen provides a game board display and companion screen displays service in a game to each player. The standardization is necessary to make and conduct the requirements for complex and dynamic interface change.

2.2. LinkedTV Project : EU FP7 Project

2.2.1. Linked Television – a Concept for Future Web-TV interlinking: Linked Television is the future of TV consumption that TV and web contents are seamlessly interconnected and aims to have a single unified vision of experience [6]. For example, while the viewer is watching the news, a fingertip provides background information on the news story. In Linked Television environment, the viewer of the supported content seed can access the Linked Television applications running on the devices, to check which content has been consumed and enrichments, and annotation searching.

2.2.2. Linked Television approach and implementation: Linked TV concept is now being implemented on the Web. W3C Media Fragment URI specification defines a simple syntax to refer the spatial / temporal piece of some online media as a suffix of the URL and use short pieces of HTTP URI. The conceptual annotation depends on the web annotation model. Semantic Web proposes the re-use of URIs with a unique address that refers to the concept applied the same principle to the URLs referenced by the web and the content for the annotation of the digital content. Linked Data plan helps a new unique identifier for all of the concepts in terms of accepted concepts across the web. Reuse of existing web-based knowledge infrastructure is beneficial to LinkedTV. It follows the Open Annotation Model that enables flexible connection between the annotation subject(in this case, the seed content pieces) and the annotation object(concept that is recognized to be displayed on the corresponding piece). We can identify specific information about how the annotation created of whether the seed content is broken into pieces in annotation model of Linked TV, an expansion of Open Annotation Model. [Figure 1] it is a workflow of LinkedTV.

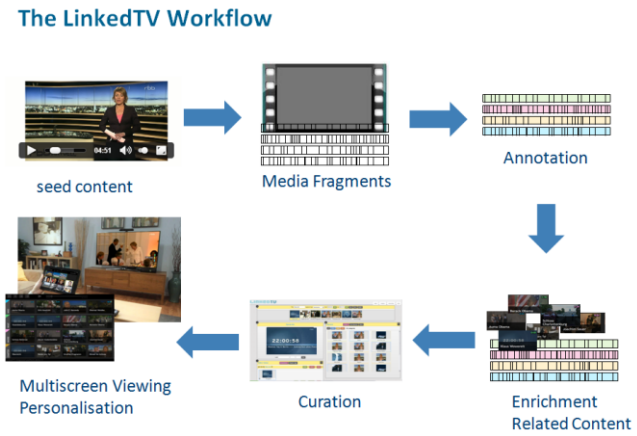

Figure 1. The LinkedTV Workflow

2.2.3. Linked Television and Broadcast TV – Key Facts and Lessons Learned: LinkedTV Workflow runs in a Web-based video, but does not run on broadcasting. This is because the cost of analysis on depth, real-time multimedia annotation is very much lifting. Second, HTML web ecosystem technology is used. HTML Web Stack and technology is more open and complete, so HbbTV 1.5 is transformed for the purpose of developing the demonstration, and for HbbTV 2.0+, these are needed. Third, the standard is used as it can be used in the concept / development step, however, it requires some proprietary solutions. MF URI compliant streaming server and back reference HTTP URI is needed, since it is not currently applied to the broadcasting service and play video provided from their streaming servers. Fourth, synchronization with the LinkedTV Toolkit and multi-screen of the server is required and also the REST API is required to

access the MF and annotations, such as 'GET data.linkedtv.eu/ {uuid} # t = 20.00,24.00 / annotation'.

3. Overview of Personalized Second Screen Service System

The main goal of this research is to show private devices through Second Screen Service, the additional and original contents displayed in public devices. This goal is mapped out in Figure 2.

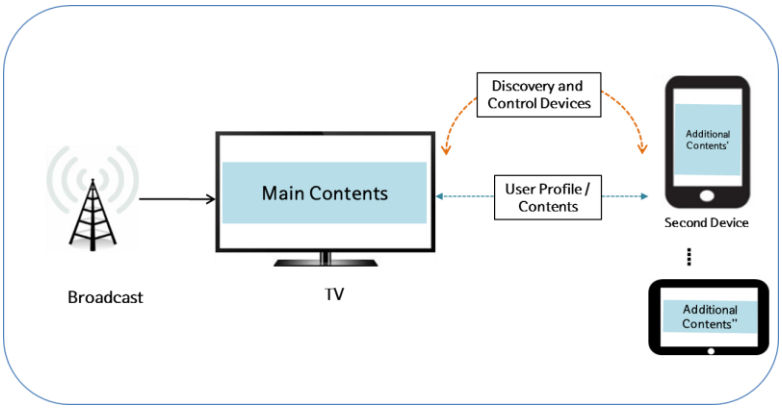

Figure 2. Overview of System

3.1. Construction of the Next Generation of Broadcast Content

In order to provide the personalized service in second screen service, construction of the next broadcasting contents which are applied web technology and personal preference information is the most important.

The next generation's broadcasting contents are made up of audio/video for main contents and metadata, additional contents, and annotation files. The main contents follow broadcasting contents, and existing broadcasting contents follow MPEG-DASH, being made up of segmented audio and video files. The metadata holds the URL information of segmented audio and video files. The additional contents also have a URL. The annotation files use the Open Annotation Data Model to organize the relationship between main and additional contents. It is the main technique of the personalized service [Figure 3].

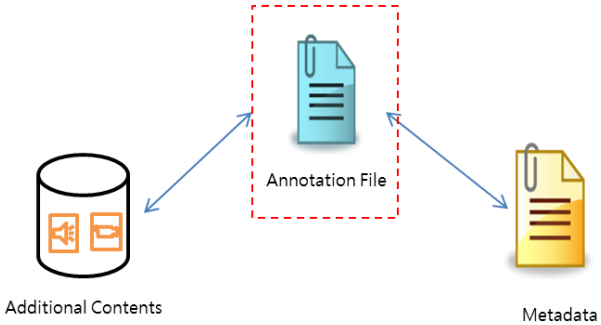

Figure 3. Construction of the Annotation File

3.2 Annotation Expression for Personalized Services

Open Annotation Data Model [7] is the method of representing a broadcast content and the additional content to the second screen. The model can represent the additional

contents as annotation to main broadcast contents and can define the broadcast metadata. The broadcast contents is expressed by assigning a "Target" and additional information is represented by the "Body". Figure 4 expresses the relationship between the broadcast contents and additional information using Open Annotation Data Model Graph.

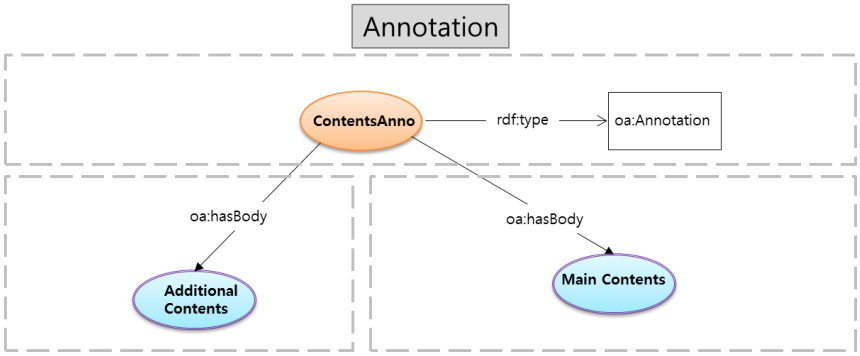

Figure 4. Relationship between the Broadcast Contents and Additional Information

The broadcast metadata includes the relationship between the broadcast content and the additional information contents, and the relations between the resources will follow the Open Annotation Data Model. The metadata create a file with RDF/XML file format. Figure 5 represents the state of the multiple additional contents belongs to one broadcast content. The additional contents, annotation, can be extended because it is an instance of the class. Annotation on square boxes is to express additional content information for a specific segment.

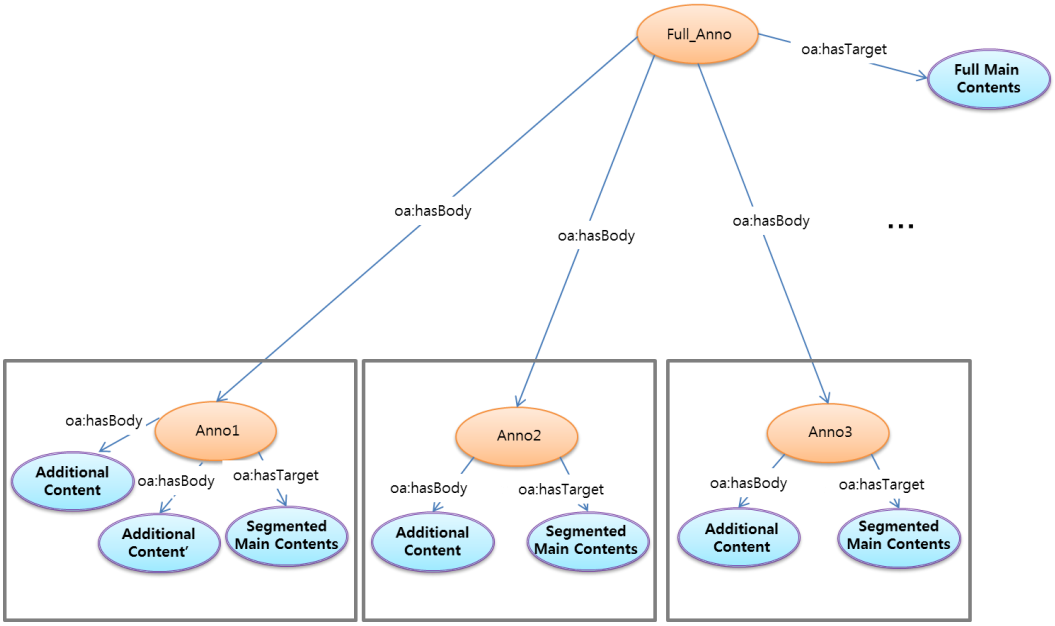

Figure 5. The Multiple Additional Contents belongs to One Broadcast Content

Basically, nodes that are represented in the annotation divided into Target including broadcast content resource and Body containing additional contents resource. Nodes are described in the respective regions have a unique UUID or URIs. Resources have the

individual format and type. The format and type represents a value of "dc:format" and "rdf:type".

Target expresses the relationship about the annotation of original contents using "hasTarget" and describes an OrderedList class for specific segment of broadcast contents. Body expresses the additional content node using "hasBody" as relationship and has the UUID or URIs of resource as node name.

3.3 Device Detection and Connection

In order to be delivered add additional contents that are delivered TV to user's second screen devices, it is needed that second screen devices obtain the information from TV. It could be implemented by setting of the control device and controlled device.

UPnP devices are composed of control points, services, and controlled devices. Control point is a device that can search and discover other devices. It can ask and receive services. Control point also functions as the client. A controlled device-is a device that can provide services to control point. It plays the role of the server. Depending on the role of each device, the libraries used to implement a web application is different. Therefore, to enable device-to-device discovery using UPnP, devices should be set to control point or controlled device.

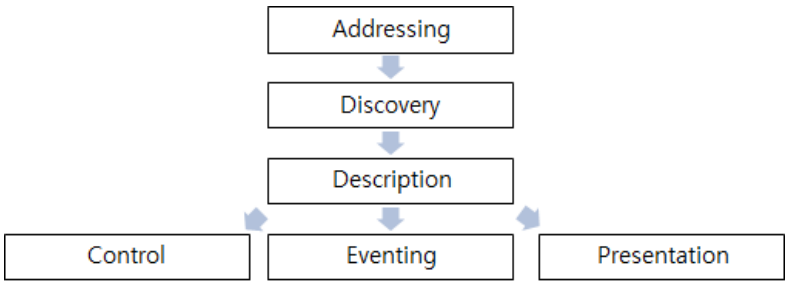

Figure 6. UPnP Networking

UPnP connection requires six stages: assign addresses, discover devices, earn certain techniques, control, event, and present [8]. In the stage of assigning addresses, if TVs and second screen devices access a common network and search the DHCP(Dynamic Host Configuration Protocol), these devices each receive an IP. In the stage of discovering devices, second screen devices use the SSDP(Simple Service Discovery Protocol) Protocol to search TV's. When a TV is discovered, the second screen device requests for the TV's technical and service technique documents. Then in the controlling stage, the information earned from the previous stage is analyzed. The second screen device then sends a command to the TV through SOAP(Simple Object Access Protocol)[9]. In the event stage, the changes in the variables that represent the TV's condition are watched over. As these are notified to second screen devices, second screen devices are operated [Figure 7].

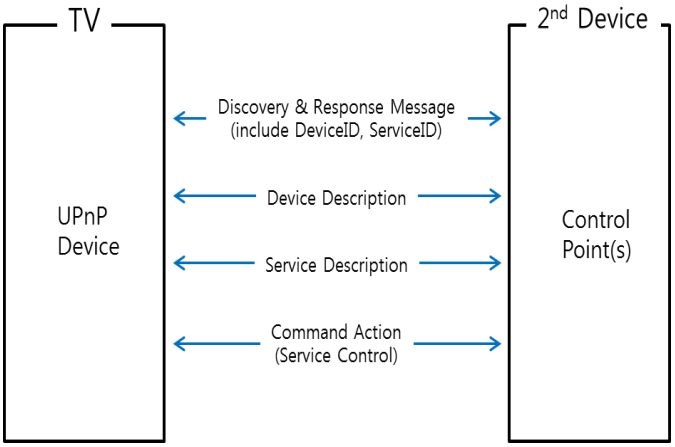

Figure 7. UPnP Connection Process

3.4. Real Time Additional Content Sending

TVs can send real-time additional contents to second screen devices. WebSocket use HTTP communication to allow connection among web browsers and among web servers. Therefore, applications installed on each device are produced by web apps and are able to support WebSocket. If a web app in a device is accessed, the app sends a request for connection to WebSocket through web servers. Then if the Web Servers and browsers connect, communication between these becomes possible [Figure 8][10].

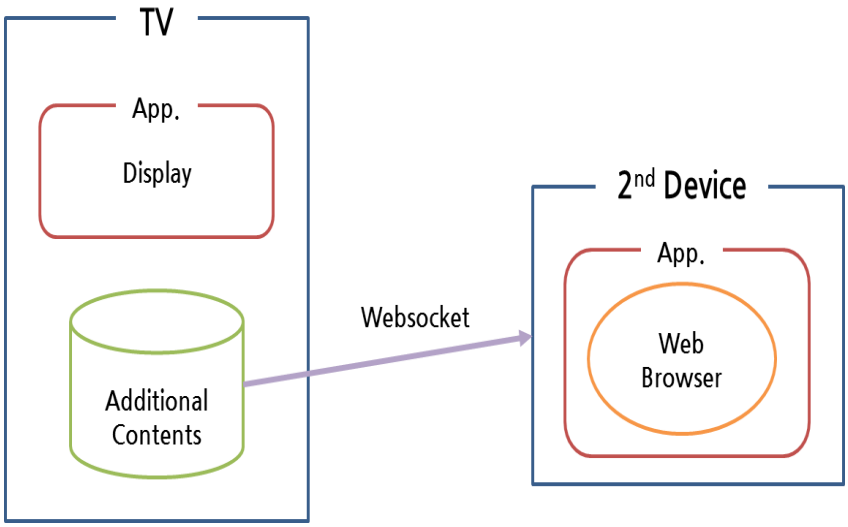

Figure 8. WebSocket Communication between Second Screen Devices

The server is built into the TV, and configures to play the broadcast the TV on the TV with the web page. TV servers have two parts, processing a set of functions, and storing the additional content data. When TV transfers the segments file number currently being broadcasted to a TV, the server checks whether they have additional contents. If the segment file verifies that the additional contents is present, a supplemental content item includes other value in accordance with the previously received preference value, and is sent to the second screen application, which is the client. The list is classified by transmitted value and displays each rows in the application of the second device. When the user selects an item in the list, the selected item is streaming from the server via Web Socket.

4. Implementation

4.1. Implementation Scenario

Second Screen Service takes place between public devices, such as the Smart TV, and private devices, like as second screen devices. While main contents are displayed in TVs, additional contents are played in second screen devices. The additional contents are related to the contents displayed in TVs, which allows the types of the contents to be changed when sent to TVs from second screen devices. . In order to play any additional contents in second screen devices, the techniques to connect a TV and a private device and deliver contents are needed. By using techniques of UPnP and WebSocket, these tasks can be achieved.

4.2. Implementation Results

First, second screen devices access service pages, and the laptop acting as TVs access web pages and play TV programs. The buttons for connection in service pages, which are in second screen devices, help attempt to access UPnP. When the Second Devices connect to the laptop, success message is displayed on the laptop. When the temporarily saved segment files start playing, the laptop sends second screen devices a message. This message, which is delivered by image buttons, says that the laptop has-each of the second screen devices' contents [Figure 9].

Depending on the preferences of the second screen devices, the location of the image button of preferred contents and nonpreferred contents are changed. If an image button is pressed in second screen devices, a request to assign additional contents to the right image is sent to a server. If the server accepts the request, the related additional contents are streamed. All of these, which includes image buttons and playing or displaying additional contents, occur real-time through WebSocket.

Figure 9. The Result Screen

5. Conclusion

As people who use smart devices while watching TV increase recently, researches on a wide range of services linked with second-screen devices around the smart TV in the home network have been actively conducted.

The study proposes a second screen personalized services in next-generation broadcasting service environment. Also, the service applies web technologies to realize additional information representation, wide connection of devices, and real-time content transmission.

We investigated the latest trends in the second screen service, and found out its limitations. Utilizing real-time content delivery technology and device connection techniques described in this study, it has been able to deliver real-time content delivery service platform independent of the device.

In addition, we have configured the next generation broadcasting systems can be transmitted, with various additional contents, and used the Open Annotation Data model to express the connection between the broadcast content and the additional content.

The contribution of this study is that the screen has achieved a second service that provides different services to each of the smart devices within the group and users share the TV. Also, by using standard technologies, services can now be provided without discrimination, by trying to share equipment and individual second screen connected, and content transfer research on any device.

As the starting point of this study, we expect the development and provision of additional services to take advantage of the additional customized information technology that can increase rich user experience and the broadcast content.

Acknowledgements

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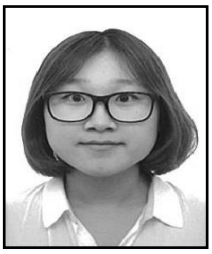

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