A Framework for Providing Dynamic Context-Aware User Interface of the Secondary Devices using the SmartTV in Home Network Environment

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***Abstract*— The growing number of smart devices having different capabilities, service providers want to provide a nicer user interface and experience to individual users with considering device status and other environments. And a second device also allows user to interact with the contents he/she is consuming. In this paper, we propose a framework for providing dynamic context-aware user interface of the second screen devices in home network environment. We have described an architecture of our framework and also simulated dynamic adaptive user interface for second device with IPTV service**

Keywords-component; Context-Aware System, Services for mobile devices, secondary device, Home Network

INTRODUCTION

In the past few years, the rise of smart devices such as smart tablet, phone and TV was extremely huge. Compared to the relatively monotonous interface and limited performance of feature phones, smart devices allow users to connect other devices and to access various applications. More people are using smart devices alongside TV to watch events and to search additional information related to contents. Because users want to get the suitable information they want quickly and easily by using smart device. For this reason, many service providers need to prepare a web UI for various resolution sizes, devices and browsers. Responsive Web Design (RWD)[5] is a key component to provide proper content efficiently for supporting for the heterogeneous networks and the emergence of mobile devices. RWD Techniques such as media query and grid style design let the presentation of content be tailored to a specific range of output devices without having to change the content itself. But not only device capabilities such as media type and display resolution but also user's dynamic/static states and preferences need to be considered to provide more suitable user interface and application.

With mobile devices on the rise, we will have to consider where, when and in what circumstances it is necessary to adapt the particular context of users. Context [1] is any information that can be used to characterize the situation of an entity. An entity can be a person, place and object that is considered relevant to the interaction between (a) users and applications themselves. In this sense, a context-aware service [2] is considered as a smart web service defined by Manes: "a web service that can understand situational context and can share that context with other services".

This paper describes technology and framework for scalable user interface where service policy, static/dynamic user state and device factors are used to adapt user interface. Most web service communication protocol between applications is based on web services standard protocol, such as HTTP and SOAP[3]. To make user interface adaptive dynamically in home network environment, we also use third-party system protocol like UPnP. The framework is applied and tested in real home network scenario with IPTV.

In this paper, we propose a framework for providing dynamic context-aware user interface of second screen devices in home network environment. This framework for scalable user interface can provide scalability in any XML based user interface. The remainder of this paper is organized as follows. After presenting the related work, we present our proposed framework for providing scalable second screen services. We summarize implementation issues and finally conclude our conclusions and suggest future works.

RELATED WORK

Secondary screen is an emerging trend in the consumption of television and other video media. The idea of a secondary screen in an interactive TV environment is not new and has been the focus of much research. The use of mobile technology as a tool for secondary interactions is now a viable option for television and other video media like IPTV service. While watching the TV, Users normally use their own second-screen devices respectively in the home network environment. Most second devices, unlike first device, have very different screen sizes, control and characteristics. Adaptive Source Multi Device (ASMD) is a concept to provide proper contents efficiently for supporting

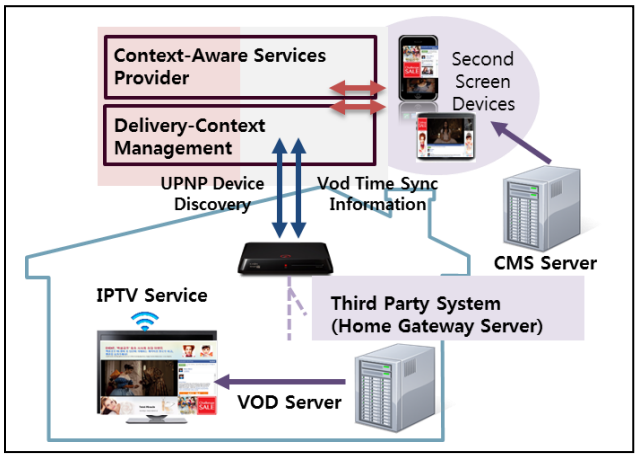

Figure 1. General architecture for context-aware service using third party system information through UPnP

for the heterogeneous networks and the emergence of mobile devices [7].

It is recommended that user interface of ASMD needs to be designed for multi devices, multi platforms, multi browsers, multi users and sensor/event. Many service providers usually create a mobile version UI and address for the adapted interface. Responsive Design is a new trend of coding web user interface with a fluid layout. Instead of creating different versions of a site for different devices, responsive design uses style sheets to make the site react to whatever screen size it is being viewed on. There are several ways to create a responsive web design including media queries. However, not only device capabilities such as media type and display resolution but also user's dynamic/static states and preferences need to be considered to provide more suitable user interface and application.

The leading industry standard for communication between networked devices in the home is Universal Plug and Play (UPnP) [9]. UPnP is a technology that enables devices to communicate with each other and helps developers of second-screen apps to discover and launch applications on smart TVs and connected devices.

In this paper, we use UPnP protocol to get first device information in real-time and to communicate with devices related to the first device.

PROPOSED FRAMEWORK

The proposed framework is a system to build second device user interface. The general flow utilizing proposed framework is illustrated in the Fig.1. This system automatically detects content what users are consuming with IPTV from VOD server. Content information such as content id, content playback time and total play time through UPNP are delivered to Delivery-Context Management module. Context-aware Services Provider module needs interpreted delivery-context from Delivery-Context Management module to apply to a service of second screen devices. Second screen devices dynamically aggregate

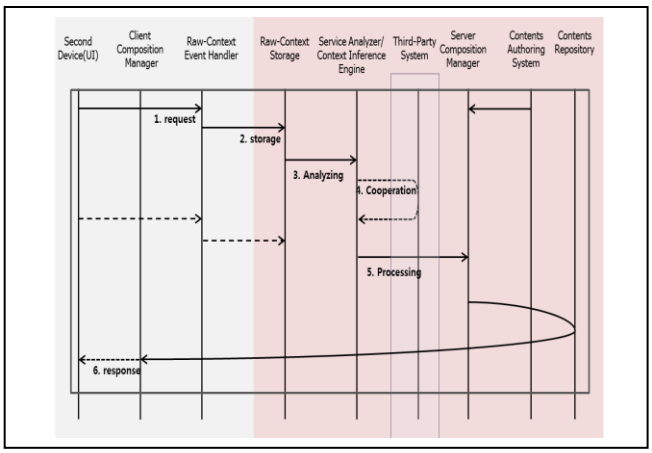

Figure 2. Flow of the Proposed framework

appropriate resources from Contents Management Server(CMS) using delivery-context. Fig. 3 shows the diagram of how deliver-context is transmitted in compliance with the proposed architecture.

A. *Delivery-Context Management Module:*

This module interprets raw-context from client and third party system.

- Raw Context Event Handler: Raw Context is defined as retrieved data in all kind of environment without analysis and inference. Static Delivery context handler collects static data such as a device specification from user interaction manger and perception engine. Dynamic Delivery Context Handler periodically gathers instant data such as camera sensor data, voice recognition results.
- Context Inference Engine: This engine gathers raw context and external context from third party system. In this part, External Supply Context Handler communicates with IPTV settop device that acquaints information of playing VOD through UPnP.

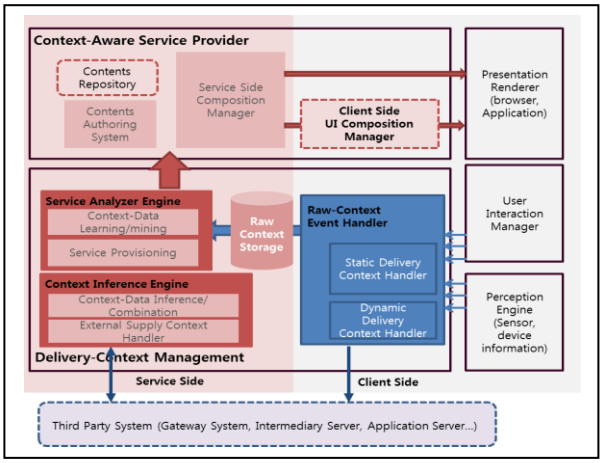

Figure 3. The architecture of proposed system for dynamic context-aware service

- Service Analyzer Engine: This engine analyzes service policy and provisioning, and transforms raw context into proper form to provide second screen service properly.

B. Context-Aware Service Provider Module:

- Contents Authoring System: In this paper, proposed framework uses Scalable Application Description Language (SADL)[6], pre-defined markup language based on MPEG-21 DIDL, to accommodate functions of selecting and filtering applications and to get proper resources with SADL parser. Contents Authoring System makes SADL document based on SADL schema.
- Service Side Composition Manager: SADL document needs to be adapted using results from engines in advanced of the server transmits it to client device. Service Side Composition Manager intercepts meaningful information from Delivery-Context Management Module and analyses with specific parser for SADL
- Client Side Composition Manager: After parsing process, the client gets the result document from the Server Side Composition Manager. If necessary, the result document from service side can be adapted to use other private client information with Client Side Composition Manager.

Fig. 4 illustrates a flow of how second device gets adaptive user interface using third party system such as IPTV Settop box. When a second device starts up, it first requests context access from Raw-Context Event Handler with initial user environment data. Raw-context Event Handler gathers multiple contexts and stores them at raw-context storage. In the next step, Service Analyzer/Context Inference Engine tries to infer from stored context data and to interpret to make proper information that Server Composition Manager understands. While inferring, Inference Engine cooperates with third party system in order to get contents information in real time. After inferred meaning context is derived, Server Composition Manager collects these data and forwards the client second device's access request to the CMS Contents Repository for composing user interface. If the processing is completed and the client device is compliant, Server Composition Manager forwards the access response to the client device.

SIMULATION

We simulated the framework in real home network environment. Delivery Context Management module crawled several delivery contexts such as device capabilities, user's preferences and information of playing video contents to adapt user interface dynamically. Context-Aware Service Provider allows framework to customize second screen user interface in accordance with analyzed delivery-context. We built one SADL document that describes all contents relationship, resources and conditions and simulated for

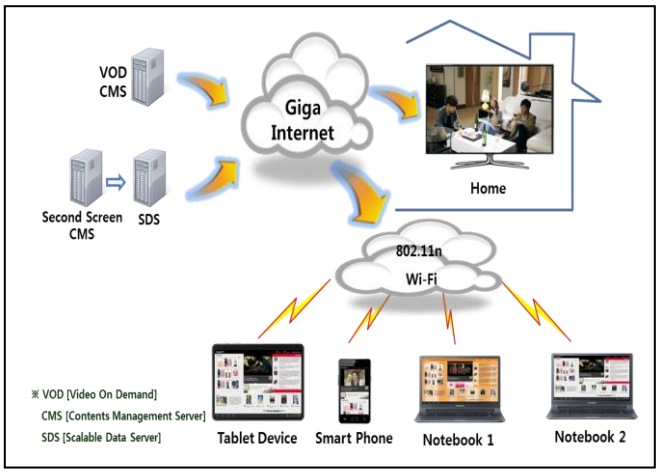

Figure 4. While watching a movie contents on the IPTV, a user is connecting a second-device. Service provider can offer much better service by proposed framework which detects user environment

smart phone, tablet device and laptop pc with IPTV set-top box. Product placement (PPL) is an advertising technique where companies pay a fee or provide services instead of a prominent display of their products.

TABLE I. INFORMATION FOR SECOND SCREEN SERVICE

Parameter	meaning	Value(example)
aid	Service id	372
ch	Channel number	12
Ip	Multicast IP Address	239.132.53.7
Vpid	Video pid	1579
apid	Audio pid	2579

TABLE II. DELIVERY CONTEXT USED IN PROPOSED FRAMEWORK.

Deliver context	Value
DCS_Device_Type	Tablet PC, General PC, Smart Phone
DCS_Contents_Name	Drama1, Drama2, Movie1
DCN_Contents_Time	0~total play time (second)
DCS_Contents_Chapter	1~ # of chapters
DCS_User_Gender	Male, Female
DCS_User_Preference	Shopping, Entertainment, Music

Second screen device services assist service provider in growing and improving their business by exposure situation of advertisement. In this paper, we implemented service that provides proper PPL and additional contents information for second devices.

In proposed framework, Service Analyzer/Context Inference Engine communicates with UPnP to get meaningful information. (see Table 1) This engine gathers value of parameter such as aid, ch, Ip, Vpid and apid by

UPnP. Through information gathered by UPnP, inference engine interpret and recommend adaptive contents.

Table 2 shows delivery context used in proposed framework. We simulated the framework for several delivery contexts such as device type, plying contents information and gender/preference of user. Fig. 5 shows reorganized user interface results under different situations.

Figure 5. A screen shot of the tablet pc showing adaptive user interface.

CONCLUSION

In this paper, we propose the framework for providing dynamic context-aware user interface of second screen devices in home network environment and prototype architecture. To provide a generic solution, the proposed SADL is implemented with MPEG-21 DID. We simulated the framework that can access static and dynamic contexts in real home network environment such as IPTV service through UPnP Protocol. Future work will be on designing more intelligent responsive framework system using multimodal input contexts.

ACKNOWLEDGMENT

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