A Mobile Internet Service Consistency Framework

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Abstract—**As more and more Internet services migrate to mobile terminal, it is very necessary to carry out the service consistency between traditional Internet and mobile internet when service convergence. Unfortunately, current frameworks can not satisfy the requirements of consistency of service, for the difficulties in realize the coherence and continuity of user experience. In this paper, we bring forward a service consistency framework to achieve the inter-service consistency by the introduction of service consistency platform and widget manager. This service consistency framework mainly adopts W/S framework on mobile terminal, while maintains B/S framework on traditional terminal to retain the existing advantage. This paper is concerned to utilize the framework to make user experience the "anytime, anywhere, anyway" Internet service.**

Keywords-Internet service consistency; service consistency framework; inter-terminal

I. INTRODUCTION

Recently, the traditional Internet corporations speed up the process of service migration to mobile field. As the same time, terminal equipment manufacturers and operators also join the mobile Internet industry [1]. These participants gradually become the core forces in this huge Internet industry.

These leaders capture the market rapidly by putting forward various mobile terminal solutions, integrating the resource of data, optimizing the user experience and developing mobile Internet service actively, adding to the advantages of brand, technique and capital [2].

However, all the enterprise will face an extremely difficult problem: how to migrate existing services to the mobile terminal or how to extend the mobile Internet service inheriting the advantages of traditional Internet. Some provided WAP or WEB sites that can be visited with mobile browser to end-user. Some launched online store to sell applications. And some are still in exploration.

Every attempt converges on the realization of inter-terminal Internet service. A method or platform may make

Internet service and mobile technology better fusion, optimize cooperation mechanism and realize the effective utilization of resources.

Current frameworks are unable to meet the requirement of coherence and continuity of experience because of the limit of platform or technique or others. We put forward our framework, not only settling down the difficulty but also maintaining existing advantage.

This paper is structured as follows, besides this introduction and the future work: Section 2 briefly discusses related work, which mainly proposes the concept of Internet service consistency and compares the realization used by three usual frameworks. Section 3 introduces the service consistency framework, including the design, the structure and the work flow. Section 4 presents a practical case based on the proposed framework.

II. RELATED WORK

A. Internet service consistency

Internet service should have three important elements, service data, service process and service display. Service data is the most interested thing to users. Service process is the work flow of service. Service display is the interface of service. All these are perceived by user as user experience.

It is inevitable to realize Internet services across different terminal. The display of traditional Internet service recurs to the computer terminal, called desktop Internet. The development of Internet is not limited to one terminal only. In fact, terminals that support access to Internet are rapidly increasing, including mobile terminals [3].

In this instance, inter-terminal Internet services that refer to one Internet service realized and appeared in different terminal.

It is necessary to realize service consistency of inter-terminal Internet services. End-users expect service can be consistent using different terminals. It means users can complete some parts of service in one terminal, and then continue completing rest parts in another. And at the same, there should be nearly no difference between terminals in the display of service [4].

Internet service consistency can be defined as inter-terminal Internet service maintaining the identity and

continuity of user experience. So we can conclude the characteristics of Internet service consistency:

- The terminal adaptation of service. The same service should be displayed and used cross different terminals. It is the fundamental of service consistency.
- The identity of service. It is composed of two elements, identity of service data, service process and service display. The identity of service data ensures that the inter-service is the same. The identity of service process ensures the flow of service is the same. And the identity of service display ensures the interface of service is the same.
- The continuity of service. It focuses on the continuity of service data, service process. The continuity of service data means that the data end-users is using or submitting on one terminal can migrate smoothly to another terminal. For example, we have seen a film for three minutes in computer, and then we can continue seeing the rest part of film in mobile phone automatically. The continuity of service process means that the process end-users are going alone can complete inter-terminal. Taking shopping for example, it is allowed users order a commodity in mobile phone, and then pay in computer.

Unfortunately, the increasingly emerging inter-terminal Internet service usually can not achieve the service consistency.

B. Current frameworks for traditional mobile Internet service

During the migration of Internet service from desktop to mobile terminal, the problem of service consistency also exits. According to the great advantage of traditional desktop Internet, we are inclined to discuss and modify the accessing framework in mobile terminal. Mobile Internet services should adapt all mobile terminals and maintain the identity and continuity of user experience with traditional service. Three frameworks are usually chosen to realize Internet service.

B/S (Browse/Server) framework refers to use browse to experience Internet service deployed in the remote server [5]. It is a classical framework accessing Internet service. Most mobile Internet service also prefers B/S framework no matter realizing with WAP or WEB technique.

C/S (Client/Server) framework is an accessing Internet service way using particular client [6]. Having a long magnificent history, C/S framework is also been applied widely on mobile terminal.

W/S (Widget/Server) is not a new framework that visits remote server using widget applications [7]. As a matter of fact, Widget applications appeared in computer desktop originally. The widget has been widely applied in mobile because of its small sizes.

However, as TABLE 1 showed, these frameworks can not achieve service consistency, especially in the continuity of user experience.

In terminal adaptation of service, B/S framework is very outstanding in respect that almost every mobile terminal has browser to visit Internet service. But C/S framework and W/S framework have to face this difficult problem. Services adopted C/S framework need to develop many clients to adapt different terminal, while services using W/S framework demand a widget engine installed in terminals [8].

In identity of service, services of B/S framework can be considered as a simpler version of traditional desktop Internet service. C/S framework usually made some modification of service process in view of the small screen and difficulty operation of mobile terminal. But the interface is friendlier because client technique has considered the display capacity of terminal. W/S framework is mostly for small services which are always parts of traditional services. Yet the interface of widget applications is closer to traditional one because widget technique is similar to web [9].

In continuity of service, no framework succeeds to realize because no method has been introduced to achieve communication between relatively independent terminals.

TABLE I. FRAMEWORK COMPARISON

Service consistency		B/S framework	C/S framework	W/S framework
Adaptation		very satisfied	Barely satisfied	Satisfied
Identity	Data	satisfied	satisfied	satisfied
	Process	More direct	Made some modification	Part of whole process
	Display	simpler	More friendly	closer to traditional service
Continuity	Data	Not satisfied	Not satisfied	Not satisfied
	Process	Not satisfied	Not satisfied	Not satisfied

From the above analysis, it is just the time to put forward a new framework to realize Internet service integration on mobile terminal.

III. SERVICE CONSISTENCY FRAMEWORK

Service consistency framework should resolve the problems caused by inter-terminal and maintain the same user experience. At the same time, Service consistency framework should not change the existing traditional Internet service.

A. The design of service consistency

Service consistency framework adopts B/S framework to keep the advantage in traditional terminal, and choose widget to realize the service in mobile terminal. In order to achieve Service consistency, some modifications are inevitable. A service consistency platform in charge of saving user service data and pushing the service to terminal and widget manager with responsibility for communication with platform and management of widget are introduced.

The service will break up to lots of parts. A corresponding widget is responsible for each part in term of contract. To provide inter-terminal service, a mapping table between service process and widget application should be offered to register in service consistency platform by service provider. A database or XML file (format mentioned as Part B) can be used to describe the mapping table.

Consistency framework consists of five parts: Internet service platform, service consistency platform, desktop Internet service display, mobile Internet service display, and access network. The components of framework are showed as Figure 1:
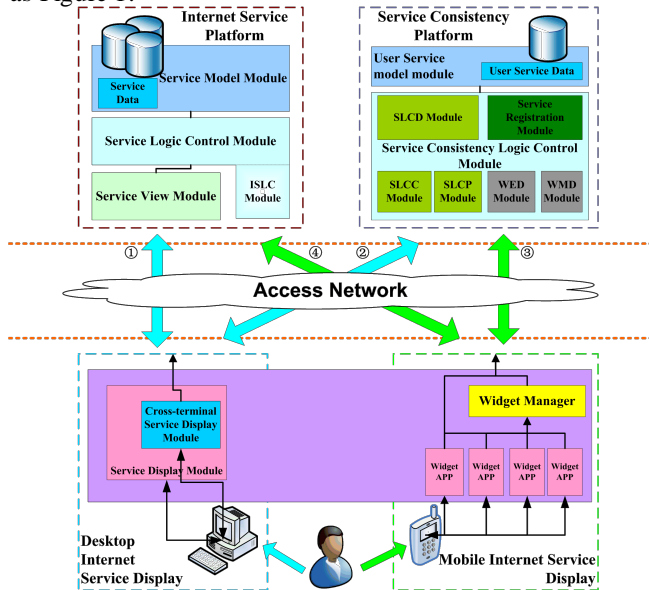

Figure 1. The components of service consistency framework

1) Internet service platform

Internet service platform can be divided into three modules: service model module, service logic control module and service view module.

Service model module is primarily to complete the encapsulation of service data.

Including inter-service logic control module (ISLC module) disposing inter-service, service logic control module based on service process deals with service data. After running successfully, widget application will access service logic control module directly to receive service data so that the identity of service data is realized.

Service view module takes charge of desktop Internet service display, while widget will display the mobile Internet service

2) Service consistency platform

Service consistency platform includes user service model module and service consistency logic control module.

User service model module packs user service data. User service data involved user information and service information what user just done and will do. Once having user service data, to realize the continuity of service is easier.

Service consistency logic control module comprises six sub-modules.

Service registration module handles the registration of inter-service. Only after registration, widget is available to download.

Service logic control of service customization module (SLCC module) realizes customization of service. User service data is gathered by this module.

Service logic control of user service data module (SLCD module) takes charge to save, and read, and modify, and delete user service data.

Service logic control of service pushes module (SLCP module) will push the related information to mobile terminal at appointed time. By this module, user service data reaches mobile terminal successfully.

Above modules accomplish the migration of user service data from desktop Internet service to mobile service. So the realization of continuity of service data achieves.

Widget engine download module (WED module) provides online download of engine. The widget engine is developed as software which can be downloaded. The problem of terminal adaptation of service is settled down.

Widget manager download module (WMD module) offers download of manager. Widget download module supply download of widget application. Widget manager can mange widget applications to complete the whole service process so as to the achievement of identity of service process. And widget manager makes the continuity of service process feasible.

3) Desktop Internet service display

Inter-service display module is added to achieve the display of service customization, while other modules of this part conform to existing framework.

4) Mobile Internet service display

Widget manager was introduced to communicate with service consistency platform and manager widget application.

Service is showed by widget application in mobile terminal. This ensures the identity of service display.

It is worth noting that widget manager starts widget application and transfer user service data to application. After that, application can directly communicate with Internet service platform.

5) Access network

Access network sees to data transmission between platform and terminal.

In conclusion, service consistency framework has the capacity of realizing Internet service consistency.

B. The work flow of integration framework

In Figure 1, the label 1 means that end-user firstly browses Internet service in traditional terminal. The communication in label 2 happens when user decides to customize service. Then, service consistency platform will interact with mobile terminal, just as label 3 noted. Finally,

mobile widget accesses Internet service platform to gain service data, showed as label 4.

We can notice that the data transmission of label 1 and 4 are just the same as B/S framework and W/S framework. So the most important flow is how terminals communicate with service consistency platform. And this flow can be divided into three parts and described as follow:
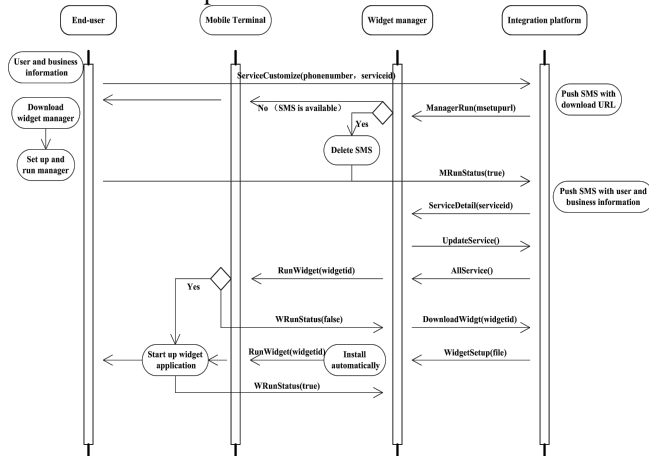

Figure 2. The work flow of integration framework

Firstly, it is very important to make sure whether widget manager has set up in the terminal. Service consistency platform pushes SMS to mobile terminal and waits confirmation message. Widget manager will send successful message to platform immediately after intercepting SMS if manger has been running in the terminal. Else user can download widget manager according to the URL providing by SMS. When set up successfully, widget manager shall send confirmation message to the platform then. The format of SMS should be:

http://<serviceurl>/Download/<widget manager>

Secondly, updating mapping table is completely necessary. Mapping table is one-to-one mapping of widget application information and service information. Only known the latest mapping table, widget manager can accurately arrange widget application to show service. Service consistency platform will push SMS with user service data and application identifier to mobile terminal when receiving confirmation message. Widget manager will obtain this SMS, and then request to update the mapping table. A sample XML can be used to update the map with the following table format

    <widget application information:
     WidgetId(Unique),
     address of download,
     app description;
     service information:
     ServiceId(Unique),
     service description; index1, index2…>
    The format of SMS should be:
    http://<serviceurl>/WidgetID/index1&index2&...

At last, widget manager dispatches widget application to display service. Manager finds the right application identifier from the mapping table in terms of application identifier pushed and tries to start it. We deem that the failed message means the application has not been set up. Manager will refer to the mapping table and download the application. Then installation and startup will accomplish automatically with the help of widget manager. The platform will receive the application running successfully message from manager.

From the above work flow, inter-terminal Internet service based on service consistency framework does not bring more burdens to end-user. The complete automatic of process makes the service realize seamless inter-terminals. End-user can feel nothing different especially after widget manager and application have been installed.

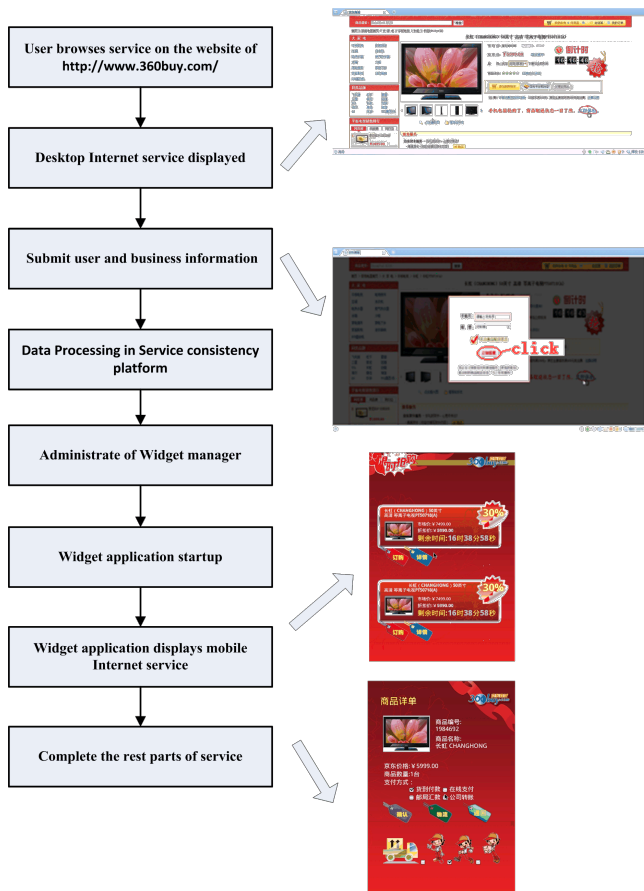IV. IMPLEMENTATION BASED ON SERVICE CONSISTENCY FRAMEWORK

Figure 3. Implementation of 360buy based on service consistency framework

360buy widget application just realizes a service based on service consistency framework. User browses service on the website of 360buy, when he is willing to buy some new discount commodity. However, we have to wait an hour to buy for justice, while we will be offline that time. Then we can customize the service. After all user and service

information is submit, service consistency platform will push the user service data to mobile terminal at the due time. With the help of widget manager, widget application of 360buy successfully runs in user terminal. User can also follow the flow of community distribution. From now on, any user favorite things can be bought by this mobile widget application from 360buy.

To test the service consistency of 360buy widget application, we install it in some mobile terminals with different platforms, such as S60, Windows Mobile and OMS. All these terminals have a pre-install BAE runtime environment (a kind of widget engine).

The running success ratio of the application is more than 95%. The terminal adaptation of service is upstanding. The identity of service is close to 90% thank to the similar technique between web and widget. After the introduction of service consistency framework which resolves the consistency problem fundamentally, the service of continuity is nearly 100%.

TABLE II.   PERFORMANCE COMPARISON

Service consistency		360buy widget application	Others (http://m.360buy.com)
Adaptation		>=95%	≈100%
Identity	Data	100%	100%
	Process	>=90%	≈60%
	Display	>=80%	<=70%
Continuity	Data	≈100%	0
	Process	≈100%	0

V.   FUTURE WORK

Under the background of network and service convergence, Internet plays a more and more important role. In this case, it is of great importance to realize the Internet service consistency when traditional Internet service is migrated to other terminal [10].

Whether widget is supported by terminals is the key of popularize of Integration framework put forward. However, it is hard to realize that widget can be run int all terminals with different system structure, although more and more terminals are concerned about widget and have done some research or development, such as PDA, TV, sensor, and mobile phone of course and so on. A universal widget engine should be developed to run inter-terminal widget application.

Another problem is to determine the service granularity. It is difficult to decide how many parts service should be divided. And then we have no way to know that the widget should realize which services.

In current service consistency framework, widget manager is only considered as background software. In fact, widget manager is not a widget but a software. So we have to face the adaptation problem.

In future work, the service consistency platform should have the ability of distinguishing different terminals and communicating with each one. Apart from that, service consistency platform can also be regard as a SaaS platform providing widget applications. A widget manager with interface could provide more assistance, like widget searching, application association, service classification. All these are of great value to mobile user behavior analysis.

The purpose of service consistency framework is to make end-user apperceive "anytime, anywhere, anyway" service, with the consistency and continuity of experience.

References

[1] IResearch service. http://news.iresearch.cn/Zt/107684.shtml, 7-2010

[2] Chiu KKS, Lin RJ, Hsu MK, and Huang LH. "POWER OF BRANDING ON INTERNET SERVICE PROVIDERS". The Journal of Computer Information Systems. Thursday, April 1 2010

[3] Wang Jing-lin. Design of Internet TV Based on Intel CE3100 and Yahoo! Widget Channel. VIDEO ENGINEERING. 2009 33(12)

[4] Miaoqing Tan, Arjona Andres, and Ylä-Jääski Antti. "Real-time service migration for voice over IP services". 2008 The Second International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies. September 29-October 04.

[5] Liang Weihong. "Integrative Structure Mode Based on C/S and B/S". Computer Study, 06-2003

[6] Wikipedia. http://en.wikipedia.org/wiki/Client%E2%80%93server_model, July 16 2010.

[7] Anind K. Dey, Daniel Salber, Gregory D. Abowd, and Masayasu Futakawa. "An Architecture To Support Context-Aware Applications". Georgia Institute of Technology. 1999

[8] Ryu Eun-Seok, Hwang Jeong-Seop, and Yoo Chuck. "Widget integration framework for context-aware middleware". Lecture Notes in Computer Science. Volume 3744/2005

[9] Srbljic S, Skvorc D, and Skrobo D. "Widget-Oriented Consumer Programming". Journal for Control, Measurement, Electronics, Computing and Communications, Vol.50 No.3-4 December 2009.

[10] Sultan Florin, Bohra Aniruddha, Iftode, and Liviu. "Service continuations: An operating system mechanism for dynamic migration of Internet service sessions". 22nd International Symposium on Reliable Distributed Systems (SRDS'03)