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ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 10 (4): 779-788, 2011
ISSN 1812-5638 / DOI: 10.3923/itj.2011.779.788

A Framework-Based Content-Orientated Services Delivery Technology for 3G Network

Shuoping Wang and Liu Jun
Computer Science School, Zhejiang University City College, Hangzhou 310015, China

Abstract: Since, the 3G network is well-developed, the increasing business requirements motivate the need for content-orientated services delivery, which plays a critical role in supporting value-added services to user. The dynamic content-orientated services delivery has the ability to provide value-added services through push content-orientated services that some research effort has been made to promote it in both academia and industry. The technology requires mechanisms to ensure the available services can be correctly pushed, which should include services select, content recommend, data transmission and services display. In this study, an efficient and flexible solution based on Service Oriented Architecture (SOA) has been proposed to sending services to WebPhone by using Session Initial Protocol (SIP). A framework for service push is introduced by using Widget to implement web services composition and interaction. After that, it showed architecture and a prototype for content-orientated services delivery. At last, some functional design of WebPhone is discussed. In conclusion, our approach is an improvement method to enhance the performance of content-orientated services delivery in 3G Network.

Key words: Services delivery, web services, webphone, 3G network, web widget

INTRODUCTION

With the development of telecommunications network, some Services Provider (SP) have extended their services range to information integration and content recommendation by pushing content-orientated services for obtaining the maximum benefits. As dynamic content-orientated services delivery has the ability to provide value-added services through push content-orientated services, some research effort has been made to promote it in both academia and industry. It is also convenient for user to get available information (data or services) without necessitating any user interaction. Consequently, the user doesn't have to waste time and network traffic to get computational resource when it needs to interact with more than two services during one process. The important technology is content-orientated services push which is characterized by the ability to notify and support users of new services.

Dynamic content-orientated services delivery is the process of selecting some related services on user demand from a set of services warehouse at run-time without respond-request paragraph. The early idea behind content push architecture had been used to inform a user if new data is available without necessitating any user interaction (Carzaniga and Wolf, 2001). The study in present research has improved the approach to implements services push, which is major different from the previous works. Recent researches have been published for content-orientated services delivery. Location-based content delivery will be a premier feature in these systems (Dornan, 2001). Shah *et al.* (2005) have discussed the client assignment problem in a content distribution network for dynamic data. Thomas *et al.* (2009) describe a protocol enabling devices in vehicles to identify and exchange content of shared interest.

The basic idea of content delivery of 3G network is to integrate the affluent information and resources from different available networks. Figure 1 illustrates our ultimate goal of using both WWW network-based and telecommunication network-based services to provide users complex requirements and interactive communication. The instance shows that the traditional telephone services has been combined with the online shipping services and credited-card services, from which user get shipping services after dialing the shipping number, then the scream will display some Goods information. When user selects one item, the system will automatically show anther scream for waiting user to input username and password of credited-card. The process is no long to interact with the server any more. Potentially, the WebPhone is the new a concept of a telephone device. The notion of WebPhone states that, in 3G Networks, the Web page attached with multiple services can be displayed in telephone equipment for more convenience.

As the Internet is moving toward the service-centric model, more and more storages and computational

Corresponding Author: Liu Jun, Computer Science School, Zhejiang University City College, Hangzhou 310015, China

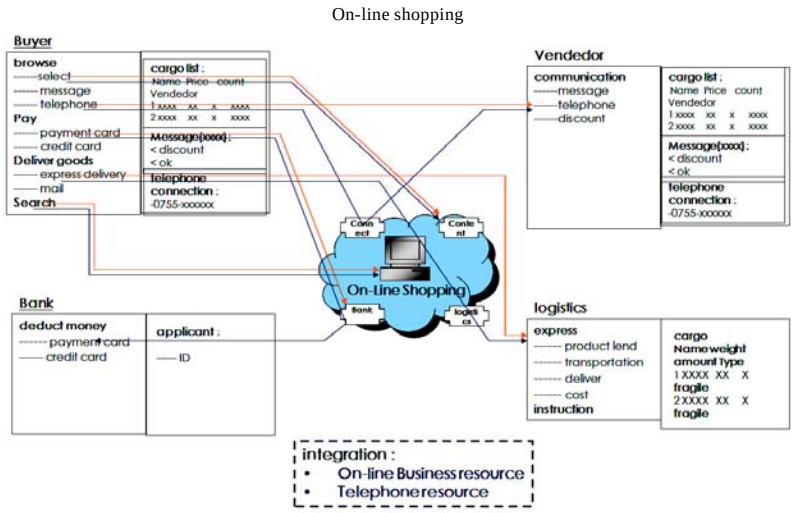

Fig. 1: An instance of services integration

resources are being put into the network infrastructure and provided as services to customers. The Web Services has been widely regarded as the potential software application which can across the different boundaries of enterprise implementing to properly work together. Web services use the standard communication interfaces and protocols based on XML, SOAP, UDDI and WSDL to overcome platform and language dependence. Generally, Web services have played an important role in content-oriented services delivery for the 3rd-generation networked computing framework.

Based on services delivery, it supports business agility, flexibility and availability which are the feature of critical importance in modern business world and e-business software systems. However, the problem of dynamic content-orientated services delivery is a highly complex task. One important issue must be considered is to select proper related services and guarantee them correctly work together, hence to support the related services at runtime. This study will explain how the delivery technologies are adapted to support content-orientated services push for 3G Networks.

MOTIVATION

Consider a scenario that the content-orientated services delivery is encountered when a user of WebPhone requests a travel services for a trip arrangement. Support Jeff has a plan to go abroad for traveling. When the WebPhone server received the requests, it dynamically selects related services, such as a flight booking service, a hotel reservation service, a car rent service and a credit-card payment service and then packages them to the terminal WebPhone for implementing the complex business interaction.

However, to accomplish the above process is highly complex task, which needs not only the well-designed architecture, but also an effective method for integrating suitable services together before sending them to the user. Firstly, the disturbed Web services were developed by different organizations, which requires the interactive process can make sure every interface of the Web services can cooperates well with others. For example, one hotel booking service can be selected from several candidates if and only if it can cooperate well with the credit-card payment service. Seconding, the sequence of execution should be guaranteed that the interaction can always be executed correctly. For instance, if the credit-card payment service must be invoked after the hotel booking service is accomplished. In this case, the WebPhone server should dynamically analysis the behavioral interaction. The above sources of complexity for content-orientated services delivery are attributed to one key issue, i.e., to ensure content-orientated services delivery is available for end users of WebPhone.

In order to help readers comprehend the behavioral interaction. An example of trip arrangement is given. The whole business process goes as follows (Fig. 2): After receiving a request of enter from a client, WebPhone will select the related services which include flight booking service, a hotel reservation service, a car rent service and a credit-card payment service. Two things can happen: If the request is rejected or canceled, the error message would be returned to the client,

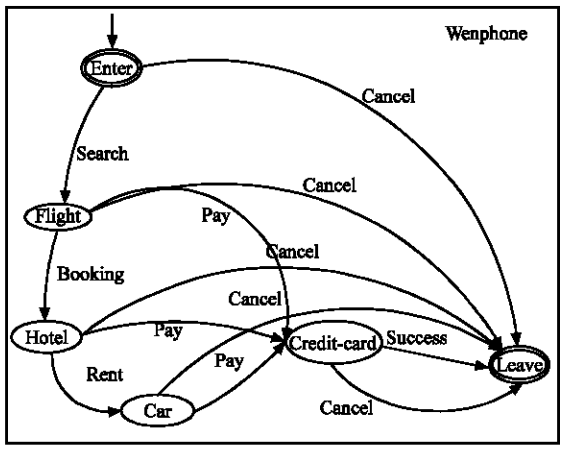

Fig. 2: An instance of webphone process

meanwhile the process halts. Otherwise, the successful message would be returned and the client can login to the fight searching scream. As the Fig. 3 shown, the flight information request the input his personal information and the travel information. After that user can also booking hotel and rent car. Moreover, user can pay the money by a credit-card payment service if he like. At every step of interaction, user can cancel the business. The final process shown in Fig. 4 is the push mail services which notify user some business information about the flight, hotel and car information. The bill is also send for confirming the credit card payment.

The push service model is different from the user-initiated pull model, where the content is actively pushed to subscribers without any request from user. The pushed services are selected by server according to the relation of the running service. Thus, when the travel services assemble a new service for the trip arrangement dynamically, it needs a mechanism to integrate and push the content-orientated services to the end user. Furthermore, when the content can be adapted according to network environment for universal access, we should have a well architecture or framework for implement this content-orientated services delivery technology.

SERVICES INTEGRATION BASED ON WIDGET

In order to push appropriate services to user across a wide area 3G network, a lot of related services need to be sent to user simultaneously. We also should ensure that the web services interact with other existing network elements collaboratively and seamlessly. A set of Content Dispatchers (CD) composes the service infrastructure and is responsible for managing channels and sending the content along channels (Carzaniga and Wolf, 2001). Web services can be executed on a remote system, which is designed to support interoperable machine-to-machine interaction over a network. For example, Misra *et al.* (2006) show how the Web Services technology can be used to develop functional interfaces of the various modules of a large-scale software project. But most of Web services are closure, stand-alone and signal execution body with exposing its interface description to developer. Therefore, the potential of web services as a means to develop dynamic content-orientated services delivery can only be achieved when application and business processes are able to integrate their complex interaction into a signal process. As above mentioned, the pushed content-oriented services based web services composition can be programmatically accessed through the web environment. So, CD should enable to connect to different web services and put them together to user.

To select proper related services and guarantee them correctly work together need to be supported at runtime. In out project, we introduce Widget to implement these works. Widget application have not to install any the third party software or operating environment to support running, which is generally divided into three types: Desktop Widget, WEB Widget and Mobile Widget. Desktop Widget is designed for desktop application and Mobile Widget is developed for mobile devices. Both of these methods are unsuitable for web services composition. We focus on Web Widget to achieve Web services integration.

Web Widget is a small software application widget for the web page, which can be installed and executed within a web page by an end user on a page where they have rights of authorship (e.g., a webpage, blog, or profile on a social media site). Web Widget allows users to turn personal content into dynamic web applications that can be shared on websites where the code can be installed. Web Widgets may be looked upon as downloadable applications which look and act like traditional applications but are implemented using web technologies including JavaScript, Flash, HTML and CSS. Web Widgets use and depend on web APIs exposed either by the browser or by a widget engine such as Akami, Clearspring, KickApps, MassPublisher, NewsGator, Plusmo, Widgetbox, Widsets, WebWag and many others. However, many of these Widgets platforms have been published by different companies, which raise some concerns in particular with regard to integrate the different platform and access to the different services. In Fig. 5, it shows that Widget API and Widget Engine are located between WebPhone devices and Web services. And theirs main function is to perform web services composition and integration. Web Widget API supports

Fig. 3: Flight information

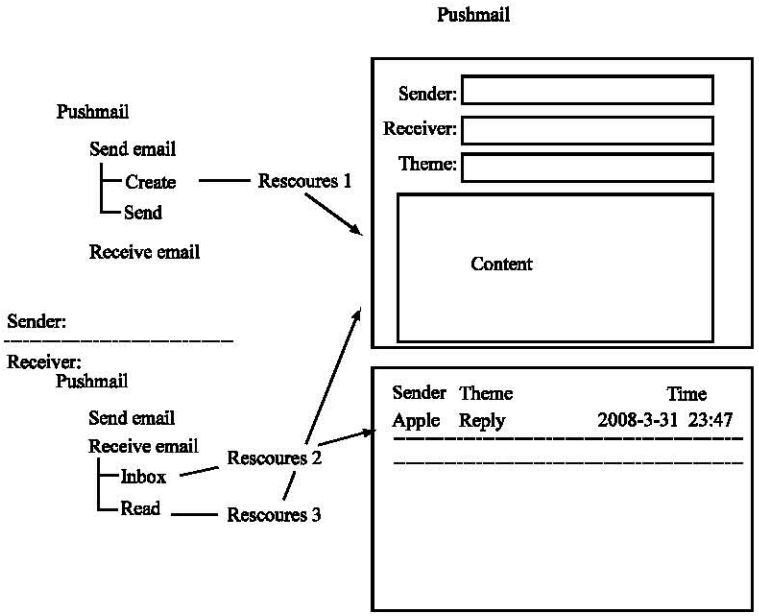

Fig. 4: Push mail

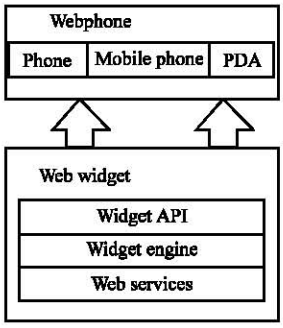

Fig. 5: Overview of widget

some functional interface for invoking target web services in different way. Web Widget Engine can obtain some the target web services' URL and dynamically compose them in runtime according to the BPEL requirements.

Web Widget application can embedded Web pages independent. When user requests a Web page thought Web Widget, the parser of Web Widget is executed and then converts the interface and data into a standard HTML page for end users. The web page browser is used as a Web Widget display tool. As Fig. 6 shows, it is the Widget request/response process. In the working mechanism, the interface description is displayed in form

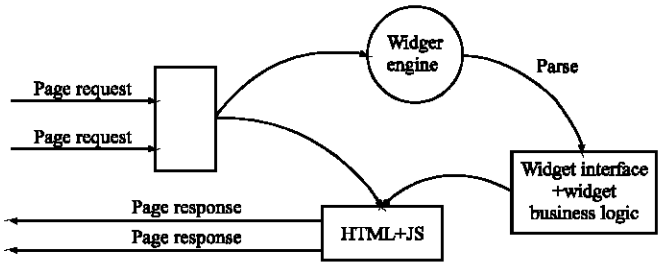

Fig. 6: The request/response process of web widget

of the extended HTML style. For example, we can add tag <Widget> and </Widget>to describe the business process logic. And the business logic can be achieved in extended JavaScript language by using the Web Widget API. The web Widget analysis interface and business logic to generate standard HTML pages and JavaScript code before sending to the client.

In order to solve the cross-platform problems, Netvibes Corporation has published a good solution, which is named as UWA (Universal Widget API). The application run in NetVibes Container (Starpage) can be widely executed on Vista Platform, MAC Platform, iPhone Platform, Windows Live Platform, Y!Widgets Platform, Opera Platform, iGoogle Platform and so on. Based on the solution, we build our Web Widget integrated platforms. (1) Firstly, it defines the standards of Widget, which includes Widget API and interface. (2) Secondly, it designs the Widget Engine which includes the standard browser engine and the supporting engine, with which Web Widget can compose some web services according to the requirements.

THE ARCHITECTURE

The main service task is the timely delivery of possibly large amounts of information to many subscribers. Additionally, wide acceptance will depend on the delivery of highly personalized and customized content. We build upon previous work in the Publish/Subscribe paradigm infrastructure (Hauswirth, 1999) from which the services interact asynchronously and need not be activated simultaneously to exchange messages.

The publishers who announce content and subscribers who have declared their interest in particular content types are shown in Fig. 7. The Publish/Subscribe approach is divided into two-phase roughly. In the first phase of advertising the publisher announcements to advertise content. If subscriber interesting in this content, delivery phase will be enable. In the second phase of delivery the functionality of delivery systems will start to send content-oriented services.

Figure 8 illustrates the architecture of our framework for content-orientated services delivery that includes four components that WebPhone, WSCF (WEB Services Control Function module), WE (Web Engine) and SD (Secondary Database). The four participants interact with each other for content delivery. WSCF and WE are assembled as Telecommunications Server (TS). The signal transmission denoted by dashed line between WebPhone and WSCF is transmitted by SIP protocol. The HTTP protocol is used to page transmission. The interaction between WSCF and SD is supported under SOAP protocol. Meanwhile, the XML data exchange denoted by solid line between WE and SD is also written in SOAP protocol. Moreover, the Web page based on HTTP protocol implements a complex service which is composed by Web services according to the BPEL description.

WSCF is the control center for sending and receiving signal. The web services-based process are controlled and implemented by BPEL, which is proposed by BEA, IBM and Microsoft is an emerging standard for specifying interactions and compositions between Web services. Service personalization is vital in this scenario because a user must be able to define his/her preferences according to the currently used end device. Thus, the BPEL is proper to model service behaviors and interactions accoridng the personal requirements. As the Fig. 9 shown, the content between tag <process> and tag <process> describes the interaction of Web services, where tag <sequence> indicates the process is the sequence. The tags <flow> means that the execution should be invoked after receiving some message denoted by tag <receive>.

WE has capacity of database query, web page synthesis and page transfer. WE receives the control signal from WSCF thought SOAP protocol, meanwhile, WE reports the status and events to WSCF. Moreover, Web page is sent to WebPhone which is look like HTTP server.

WEB Engine does not provide any information resource by itself. As the Fig 10 shown, it can integrate

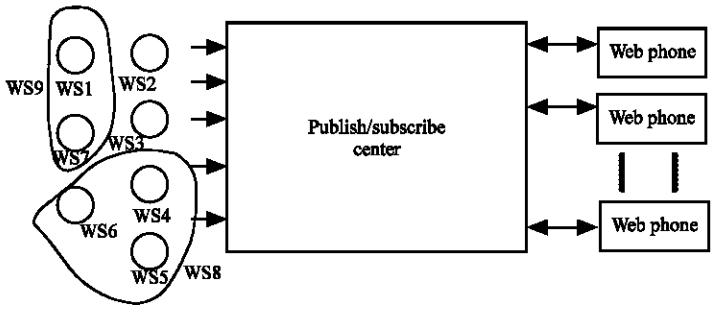

Fig. 7: The publish/subscribe paradigm

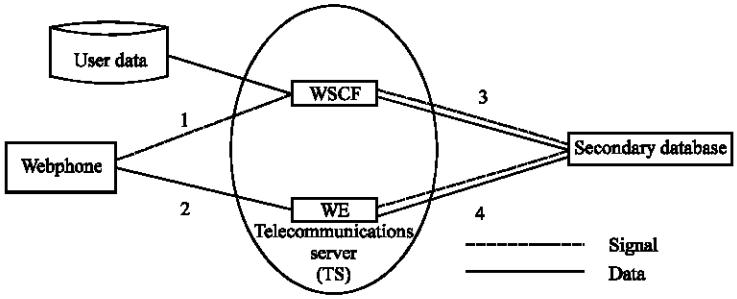

Fig. 8: Architecture of content-orientated services delivery

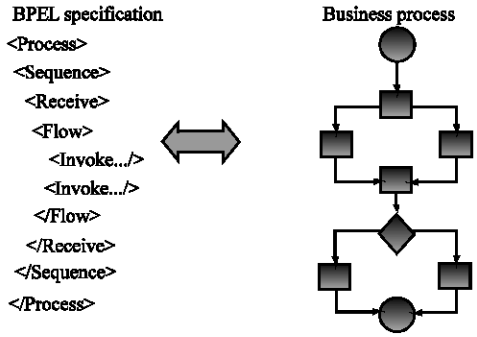

Fig. 9: A BPEL process

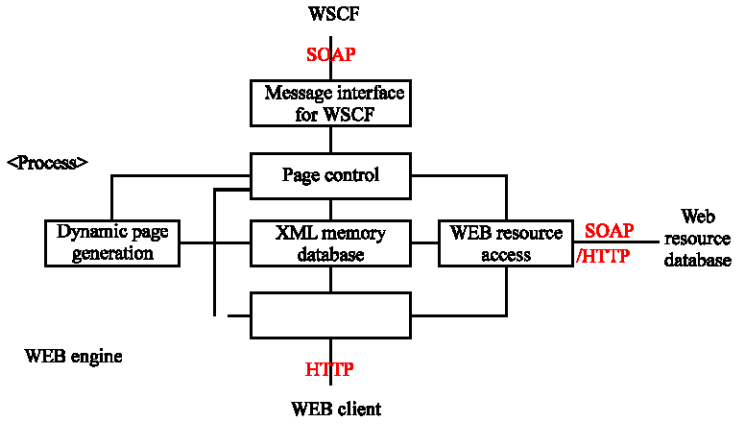

Fig. 10: The Web Engine workflow

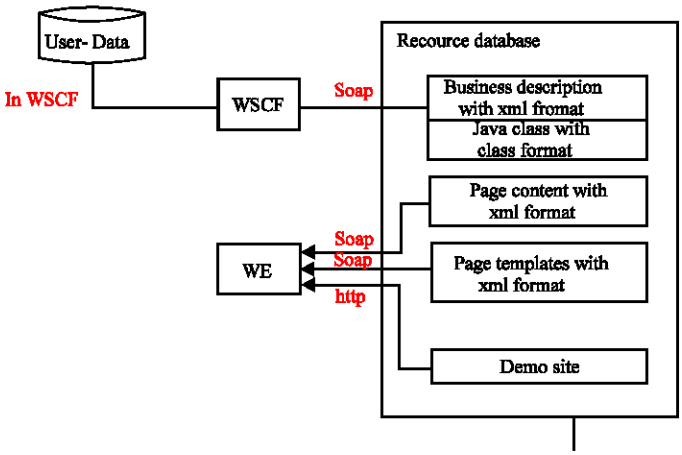

Fig. 11: The proxy for integrating web services

external web services resources by using SOAP or HTTP protocol. In WE, there exists six interfaces for interaction: Interface for WSCF, which is responsible for communication with the WSCF; Interface for web services resources access, which is used to connect web services and query the information (or semantic) in resource database; Interface for web page transfer, which sends web pages to WebPhone; Interface for dynamic web page module generation, which is used to generate web pages once there is a request to access resources.

SD has two functions. One is to provide WSCF the information of web services. The other is to provide WE the data of web page. Data are saved as two kinds. One is XML data in form of SOAP. And the other is web page in form of HTTP.

As Fig. 11 shown, to achieve dynamic content-orientated services delivery, the following protocols are used. SIP (Session Initial Protocol), which is an IETF-defined signaling protocol, widely used for controlling multimedia communication sessions such as voice and video calls over Internet Protocol (IP). WebPhone is a SIP-based terminal phone including mobile, handset, PDA and telephone. SOAP (Simple Object Access Protocol), which is a protocol specification for exchanging structured information in the implementation of Web.

For example, the first interaction is started from WebPhone to WSCF, which is denoted by WebPhone? WSCF. From the view of WebPhone, the interaction achieve login authentication, instant message sending, launch a call, download/update the operation tree and push web pages.

Table 1: Parameter table

Command-Type	Command-Parameter
GetOperatingTree	User, Password
DoAction	User, Password,Workflowid,Actionid, Push_page_url
Register	User, Password

Algorithm 1: The message specification format

```
MESSAGE sip: WSCF_URI SIP/2.0
From: Client_URI
To: WSCF_URI
Call-ID: ###
CSeq: # MESSAGE
Content-Type: text/xml
<Command_Request/Response      type="*****">
<parameter name="***" value="***"/>
<parameter name="*****" value="*****"/>
....
</Command_ Request/Response>
```

As the Algorithm 1 shown, it is a message specification format. The value of Command_ Request/Response can range over set {GetOperatingTree, DoAction and Register}. Parameter is command parameters, where different command is Identified by element Tags. The label Content-Type describes the type of signal, where the label text/xml is control signal and the label *text/txt* is message signal. If message signal is empty, message Content is equivalent to message body.

The more information is shown in Table 1. The label From is the user's ID, which is same to the Call-ID during call services. The command GetOperatingTree can download/update the operation tree, which is form of XML description. The command DoAction can operate the operation tree, which is controlled by WSCF. The parameters of DoAction consists of User, Password,workflowid,actionid and push_page_url. The command Register is the register process.

FUNCTIONAL DESIGN OF WEBPHONE

Along with the process of the content-orientated services delivery, the WebPhone Client, WSCF, WE, WE-Content and HSS are interacted for dynamically selecting and sending a number of web services based on estimated demand. Figure 12 shows the process which consists of three main parts:

Initialize the registration process: Due to the large volume of message exchange, efficient identification in the 3G network is of major importance. The upper layer is the registration process that the WebPhone client is registered to WSCF with a unique identifier ID. When user send request for starting, the WSCF dynamically select the BPEL for business logic. According to the user's URL, the WE generate the access port. Moreover, this information is recorded in WE-Context. HSS returns the user profile to the WE-Context after identifying the user.

Dynamic content-orientated services delivery: According to the BPEL logic, different Web pages will be shown during user interaction. The business logic may contain a variety of optional executions because user will make a different choose (decision) which is not like to the traditional single service model. To implement this model, web services should be updated and downloaded in the WebPhone client dynamically when user make a decision or input additional URL.

Costs display and process disconnection: When the interaction is terminated, the WCSF will output a notification about cost. Meanwhile, the access port of WE and the context in WE-Context are completely deleted.

The XML technology of Web Widget is used to create and manage web services. Operation tree management is core concepts in XML-based profile. The information of executable services described by XML is controlled by tree structure expression in WebPhone client, which is called operation tree. The operation tree is downloaded from WSCF, where the hierarchical relations and node description are context for web services interaction. Let us consider an example as shown in Fig. 13. It shows that it is the business logic of Fig. 1. If anybody access to this logic, he can call other people, handle business and go shopping; and the shopping process consists of four sub-process which denoted by tags <StartShopping>, <ConfirmShopping>, <SendGoods>, <EndShopping>.

When we invoke the web services according to the operation tree, the send control signal is also send for

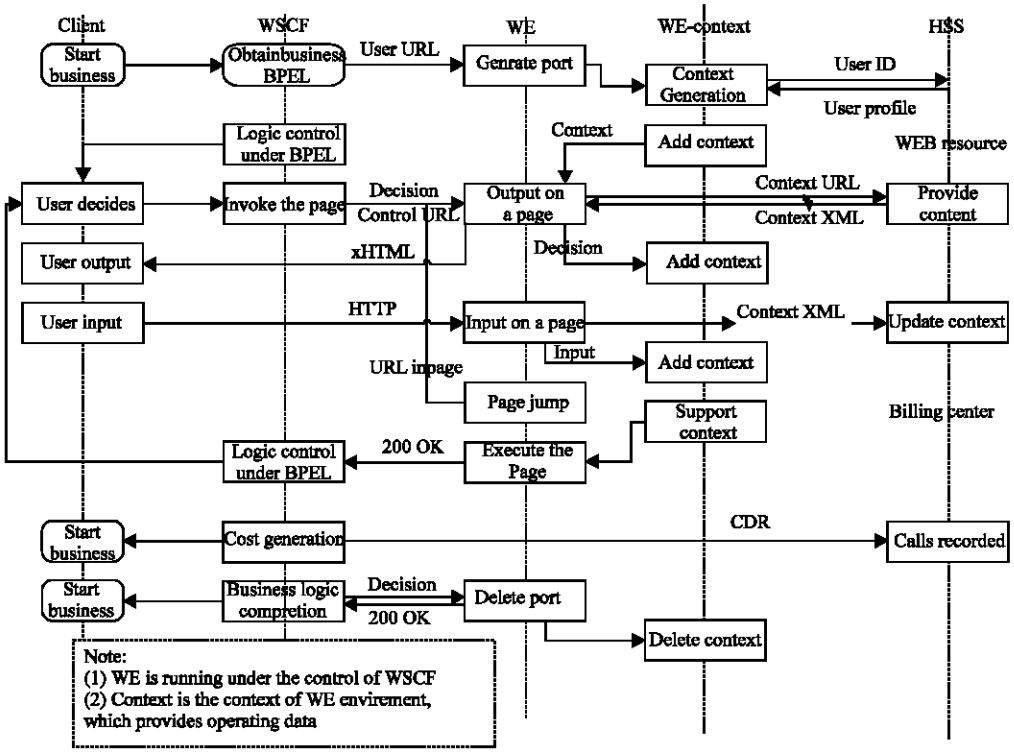

Fig. 12: UML diagram for interactive process

<Operators>
|--<Telephone>
|--<Handle business>
|-- <Go shopping>
|---<Start shopping>
|--<Confirm shopping>
|--<Confirm>
|--<Cancel>
|--<Send goods>
|--<End shopping>

Fig. 13: An instance of operation tree

Fig. 14: The interface of WebPhone

Table 2: Web service access strategy

State	Operation
Unrunning	Running / Cancel
Running	Termination /Suspension
Suspension	Restoration/ Cancel

recording the status of runtime. The service behavior refers to the dynamic properties of a service, which includes the actions the service can take and the states the service has. According to Table 2, we can config different web services access strategy.

To display services for user, WebPhone have an embedded WEB browser. It has fowolling basis function that: (1) display the address, content and the progress of pages received; (2) get web pages under URL; (3) display the received service (or notifcation) and (4) input URL.

Our prototype has been simulaed in Fig. 14, the browser can display web pages and recevice user imput. The browser will adopt the open source Apache project JDIC 2004), which can display XHTML-based pages.

RELATED WORKS

To our knowledge, the architecture or implementation of a dynamic content-orientated services delivery system supporting services integration and has not been published yet. The first research of content pushes architecture has been formulated for instance in the standards of the Open Mobile Alliance (2006). After that, content delivery to mobile users has recently attracted particular attention (Open Mobile Alliance, 2006; Jacobsen, 2001).

ELVIN (Sutton *et al*., 2001) is the only notification system that implements limited support for mobile users. The proposed solution puts a proxy server between the ELVIN server and a mobile device to queue messages for non-active users. The third generation partnership project (3GPP, 2001) is trying to solve the problem, that wireless networks offer limited possibilities for the design, implementation and deployment of services, by offering an API specification to enable third parties to design and deploy services using the network provider infrastructure. The service-enabled proxy is related to the IETF working groups on Open Pluggable Edge Services (OPES) (Hofmann and Beaumont, 2007) which is addressing the problem of extending the functionality of a caching proxy for providing additional services that mediate, modify and monitor object requests and responses.

Podnar *et al*. (2002) investigated the features of a mobile push system and based on previous work in the Minstrel push system (Hauswirth, 1999) propose an architecture for mobile content delivery systems. Gao *et al*. (2011) has designed and implemented a new experimental platform to verify theoretical results of Networked Control Systems, in which three types of data (control, video, ftp/web) and two classes of network are considered. Sayenko *et al*. (2010) proposed the composed concept of quality of service evaluation in conditions of continuous monitoring process. The aim of his study is to develop a method for evaluation of service quality estimations in continuous monitoring system for computer networks.

CONCLUSION AND FUTUREWORK

As the standards and tools for developing, testing and deploying content delivery evolve to maturity, a number of services providers adopt web services to design content-orientated services delivery system in a low-cost way to meet customer's requirements, especially in the telecommunications telephone, such as mobile, handset, PDA. As a result, the related services can be pushed to end user dynamically during execution. Compare with the general process of interaction in telecommunications network, it can only archive a signal task. Moreover, the more complex of services process needs the more money and time we should pay.

Dynamic content-orientated services delivery in 3G network plays a critical role in supporting value-added services to user and obtaining the maximum benefit for services provider. It is becoming well-admitted that the use of a web services-based content-orientated services delivery technology is worthy as an effective way to deal with this problems. This study has proposed a framework-based approach to push services by using Widget. After that, this study has also given an architecture for services delivery. At last, we showed some functional design of WebPhone. Our future work will focus on the trusted data delivery that some interaction will face security challenges regarding data transmission to and storage of the data on the end user equipment.

ACKNOWLEDGMENT

This work is Supported by the Special Funds for Key Program of the China No. 2009ZX01039-002-001-04, 2009ZX03001-016, 2009ZX03004-005.

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