WEB SERVICES IN HOTEL INDUSTRY

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Abstract: The hotel industry is in need of efficient, integrated, and economic supply chains and circulation processes. This paper introduces a project of integration of hotel management systems by web services technology. We discuss how web services will consent to the hotel industry by automating product distributions and providing better services to buyers, suppliers, and prospective partners. The project, Group Hotel Integration Reservation System (GHIRS), integrates many hotel industry systems such as Enterprise Information System (EIS), Enterprise Information Portal system (EIP), Customer Relationship Management system (CRM) and Supply Chain Management system (SCM) together. Evaluation of this project and comparison with other systems are discussed. We conclude that although web services technology faces some challenges, it is a potential tool that brings hotel industry increasing profits.

1 INTRODUCTION

Web services technology is a set of standards that work for the next generation business applications around the world. Many commercial software systems extend their capability and power by using web services technology. By web services technology, today's E-commerce is not merely using internet to transfer business data or supporting people to interact with dynamic web page, but are fundamentally changed.

Web services technology allows the business applications to exchange data easily. The World Wide Web Consortium's eXtensible Markup Language (XML) (W3C, 2003a) and the eXtensible Stylesheet Language (XSL) (W3C, 2003b) are standards defined in the interest of multi-purpose publishing and content reuse and are increasingly being deployed in the construction of web services. Since XML is looked as the canonical message format, it could tie together thousands of systems programmed by hundreds of programming languages. It provides applications with great integration and interoperability. Any program can be mapped into web service, while any web service can also be mapped into program (Newcomer, 2002).

In this paper, we discuss the issues of web services in hotel industry. We present a web services commercial system in hotel industry that is Group Hotel Integration Reservation System (GHIRS). It fully integrates the hotel Front Office system, Property Management System, Customer Relationship Management System, Quality Management system, Back Office system and Central Reservations System distributed in different locations. And we found that this system greatly improves both the hotel customer and hotel officer's experiences in the hotel business work flow. Currently in hotel industry there are few truly integrated systems used because there are so many heterogeneous systems already exist and scalability, maintenance, price, security issues then become huge to be overcome. From our study, there are still challenges to integrate different hotel industry business systems together, although our system is one of few integration solutions to add or expand hotel software system in any size of hotel chains environment.

The rest of this paper is organized as follows. Firstly we briefly introduce current web services technology, then describe a scenario of hotel reservation and discuss the interaction between GHIRS and human. After that we analyse details of the design and implementation of this system. The result and implications of the evaluation studies on the development of GHIRS are shown in the later part. Finally we discuss some problems still need to be improved and possible future directions of web services in hotel industry.

2 WEB SERVICES TECHNOLOGY

Currently there are many definitions of web services technology. Here we are not going to give a specific definition of it; however, we concentrate the applicable advantages of web services in hotel industry. That is it allows different systems exchange data easily by XML standard. It has several components, which include XML, (Simple Object Access Protocol) SOAP, (Web Services Description Language) WSDL, and (Universal Description, Discovery and Integration) UDDI.

The format for web services to exchange is XML, instead of HTML or other formats. They are transmitted by using SOAP, which in fact can use HTTP underneath the covers. UDDI is the term that refers to the equivalent of a search engine server, but instead of using it to find a web page, applications use it to find other applications. And much like web search engines that show a "snippet" or synopsis of the hits for a search request, WSDL is the description of the services provided by an application.

The most outstanding feature of web services is the promise of interoperability. The web services architecture is based on sending XML message in a specific SOAP format. XML message can be transferred from one system to another easily, no matter what kind of system it is and no matter where the message comes from or goes to. So web services technology can help hotel management system overcome the traditional boundaries of location, operating system, language, protocol, and so on.

3 A SCENARIO OF HOTEL RESERVATION

In the GHIRS project, we developed a Group Hotel Integration Reservation System (GHIRS). Our initial thinking to develop GHIRS is to minimize the human interaction with the system. Since GHIRS is flexible and automated, it offers clear benefits for both hotel customers and hotel staffs, especially for group hotel customers and group hotel companies. Group hotel companies usually have lots of hotels, restaurants, resorts, theme parks or casinos in different locations. For example, Shangri-La group has hundreds of hotels in different countries all over the world. These groups have certain customers who prefer to consume in hotels belong to the same group because they are membership of the group and have personal profiles.

We deployed GHIRS in many large hotel groups, which have many 4 to 5-star hotels locate in

different cities. This next generation hotel management system saves the hotel group running cost, provide their customers better services and make hotels more profits spontaneously. To customers, the system not only saves their time but also saves money.

Figure 1 shows a scenario of hotel reservation. The first step is that the consumer plans and looks for a hotel according the location, price or whatever his criteria and then decides the hotel. Then he makes a reservation by telephone, fax, internet, or mail to the hotel, or just through his travel agent. When hotel staffs received the request, they first look if they can provide available services. If there is enough resource in the hotel, they prepare the room, catering and transportation for the request and send back acknowledgement. At last the guest arrives and checks in. The business flow is quite simple; however, to accomplish all these tasks is burdensome for both the consumer side and the hotel side without an efficient and integrated hotel management system.

Figure 1: A scenario of hotel reservation

Guests can contact hotels by telephone or fax at any time and any place. However, it costs much when the hotel is far away from the city where the guest lives; especially the hotel locates in a different country. More over, if there is a group of four or five people to make reservation together, it would take a long time for hotel staff to record all the information they need. Making reservation by travel agent saves consumers' time and cost, but there is still millions of work for agent to do. They gather the requirements from consumers, then distribute to proper destination hotels. Because these hotels don't use the same system (these thousands of hotels may use hundreds of management systems), someone, agent or hotel staff, must face the problem how to handle information from different sources.

Web services technology becomes the tool to solve these problems. By our web service project that integrates the web server and hotel management system together, everyone gets benefit. Booking a room easily anywhere and anytime becomes possible by using GHIRS. Consumer browses the internet and finds hotel by his PC, PDA or mobile phone (WAP supported), after his identity is accepted, he can book a reservation. Two minutes later he can get the acknowledgement from the hotel by mobile phone text message or multimedia message, email sent to his email account or just acknowledgement on the dynamic web page, if he hasn't leave the website. The response time may takes a little longer because when the hotel receives the quest, in some circumstance, the staffs should check if there is clean and vacant room left. The web service is a standard interface that all travel agents can handle, gather and distribute the reservation information easily through internet. When the reservation request is acknowledged, hotel staffs prepare the room, catering, and transportation for guests. Since the information already stored in the database, every part in the hotel chains can share it and work together properly. For example, staffs in front office and housekeeping department can prepare room for guests according to the data, staffs in back office can stock material for catering purpose and hotel manager can check business report in Enterprise Information Portal integrated with GHIRS by his browser. In the later part of this paper, we will show how consumers, agents, and hotel staffs can efficiently work together by GHIRS. GHIRS is scalable for small-to-large hotel chains and management companies, especially good for hotel group. It truly soars with seamless connectivity to global distribution systems thereby offering worldwide reservation access. It also delivers real-time, on line reservations via the Internet.

4 INTEGRATION OF HOTEL MANAGEMENT SYSTEM

4.1 Existed System

The GHIRS system is developed on the base of an existed hotel management system, Foxhis[TM]. In China, Foxhis[TM] shares the largest part of software market in hotel industry. Foxhis[TM] version 5 has distributed Client/Server architecture that the server runs Sco-UNIX and client runs Microsoft Windows and it use Sybase database on UNIX. The system includes Front Office system, Property Management system, Quality Management system, Human Resource Management system, Enterprise Information Portal system (EIP), Customer Relationship Management system (CRM) and Supply Chain Management system (SCM) as it is shown in figure 2.
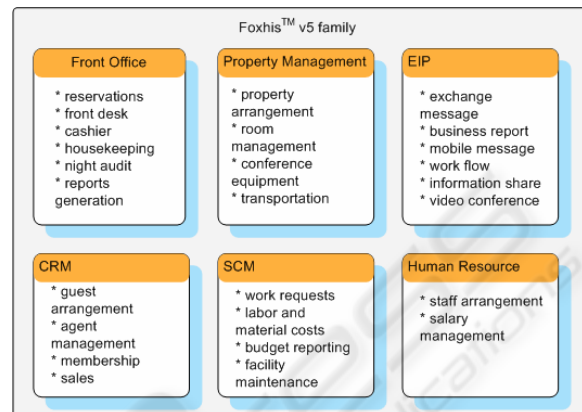

Figure 2: Foxhis[TM] family

Foxhis[TM] is largely based on intranet environment. Most of the work is done in a single hotel by the hotel staffs. It's no customer self-service. If a consumer wants to book a room, the hotel staff must help the guest to record his request, although Foxhis[TM] system already done lots of automatic job. When the systems are deployed in different hotels that are parts of a group, sharing the data becomes a problem. Just as an example, if the group has ten hotels, there would be at least ten local databases to store the consumers' data. Because hotels need real-time respond of the system, so these ten hotels can't deploy a central database that is not locate in the same network. Thus one guest may have different records in different hotels and the information can not be shared. By web service as an interface, these data can be exchanged easily.

4.2 Design

The consumers of hotel industry could be divided into two categories. One is membership of hotel group, who holds different classes of membership cards and gains benefits like discount or special offers. These consumers usually contribute a large part of the hotel's profit then are looked as VIP. The hotel keeps their profiles, preferences and membership account status. The other category is common guest. All these two kinds of guests and the travel agent who may trade with many other hotels face the interface that let them to make a reservation. For the common guest, the system just requires him to input his reservation information such as guest name, contact information, arrival and departure

date, room type, number of room, and preference etc. Then his request is submitted to the system. The central processing server then distributes the information to the appropriate hotel. Since web service is so good for submitting documents to long running business process flows, hotel staffs could easily handle this data in and out of database management system and application server. As the membership of hotel, user just input his member id and password, room information, arrival and departure date, then finish the request. Because hotels keep members' profile, and systems exchange profile across all hotels of the group by web service, hotel staffs in different hotels could know the guest's individual requirement and provide better services.

The agents work for consumers get benefits from GHIRS as well. They may also keep the consumers' profile and the web service interface is open to them, it is easy to bridge their system to hotel management system. Before GHIRS is deployed, the agents should separate and process the reservation data and distribute it to different hotels, which is an onerous job. But now the agents could just press one button and all the hotel reservation is sent to destination.

Hotel staffs receive all the requests from different sources. Some policies are applied to response the request. For example, some very important guest's request is passed automatically without confirmation, the guest could get acknowledgement in very short time. It triggers all the chains of the hotel business flow and all the preparation work is done before his arrival. But for the common customer, hotel staffs would check on the anticipate date if there is vacant and clean rooms available. Because all the Foxhis™ components are integrated together, staffs users needn't change computer interface to check the room status. If it is a valid request with enough guests' information and there is enough room left, a confirmation is sent back. If there is not enough vacant room available, hotel staffs will ask if guest would like to wait a time or transfer to other hotels in the hotel group or alliance hotels.

4.3 Implementation

There are many platforms that could provide capabilities to integrate different system and offer other features such as security and work load balancing. The two main commercial campaigns are Java 2 Enterprise Edition (J2EE) and Microsoft.NET. They offer pretty much the same laundry of list of features, albeit in different ways. J2EE works on any operating system while .NET core works on Windows only but theoretically

supports development in many languages (once sub-/supersets of these languages have been defined and IL compilers have been created for them). We choose .NET platform as our programming environment, however, here we don't advocate which platform is better or not. Our target is to integrate these decentralized and distributed systems together. In fact, both of these platforms support XML and SOAP to accomplish our task.

We use Microsoft Internet Information Services (IIS) as web server and Sybase database server. The firewalls separate the local networks from the public networks. This is very important from the security point of view. Each hotel of the group has a database server, an application server and a web server to deploy this multi-tier system that includes the user interface presentation tier, business presentation tier, business logical tier, and the data access tier. C# is adopted as the programming language for the core executable part. XML is the data exchange standard format. The following XML file shows an example of the reservation information of a guest. By using XML, the information can go freely through different system.

```xml
<?xml version="1.0" encoding="utf-8" ?>
<DataSet xmlns="http://tempuri.org/">
<xs:schema id="NewDataSet" xmlns=""
xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:msdata="urn:schemas-microsoft-com:xml-
msdata">
<xs:element name="NewDataSet"
msdata:IsDataSet="true" msdata:Locale="en-AU">
……
<rcReserveLog diffgr:id="rcReserveLog1"
msdata:rowOrder="0">
  <OrderNumber>0319843004</OrderNumber>
  <HotelCode>nbky</HotelCode>
  <OrderStatusCode>R</OrderStatusCode>
  <GuestID>W000032</GuestID>
  <GuestName>Wendy McCormick</GuestName>
  <IdentityCode>C01</IdentityCode>
<IdentityNumber>330227790607441</IdentityNumber>
  <CheckInTime>2003-07-
23T00:00:00.0000000+08:00</CheckInTime>
  <CheckOutTime>2003-07-
24T00:00:00.0000000+08:00</CheckOutTime>
  <AdultNumber>1</AdultNumber>
  <ChildNumber>0</ChildNumber>
  <CellPhone>0414256874</CellPhone>
  <Email>wendymcc@yahoo.com</Email>
  <NationCode>AUS</NationCode>
  <Sex>1</Sex>
  <Address>15 OAK STREET, SURREY HILLS</Address>
```

```
  <Telephone>87068888</Telephone>
  <Zip>5040</Zip>
<ArriveTime1>06:00</ArriveTime1>
  <ArriveTime2>18:00</ArriveTime2>
  <ConfirmCode>TEL</ConfirmCode>
  <RoomType>BSA</RoomType>
  <RoomNumber>1</RoomNumber>   <ModifiedTime>2003-
07-17T20:52:37.0000000+08:00</ModifiedTime>
  <Operator>RWJ</Operator>
  <GuestFlag>P</GuestFlag>
  <CreatedDate>2003-07-
17T20:51:50.4500000+08:00</CreatedDate>
  <FoxhisOrderID>0307170157</FoxhisOrderID>
  <ReserveChannel>Group</ReserveChannel>
  </rcReserveLog>
<rcReserveDetail diffgr:id="rcReserveDetail1"
msdata:rowOrder="0">
  <OrderNumber>0318200002</OrderNumber>
  <RoomType>DRA</RoomType>
  <RoomNumber>1</RoomNumber>
</rcReserveDetail>
</NewDataSet>
</diffgr:diffgram>
</DataSet>
```

5 EVALUATION OF GHIRS

Many 5-star hotel groups deployed this system. One of the hotel groups includes three 5-star hotels and seven 4-star hotels locate in different cities. Each hotel has about from 200 to 300 standard rooms and luxury rooms with other facilities such as restaurant, bar, swimming pool, recreation room and so on. Then we conducted an evaluation study focusing on the staff performance of hotel reservation and consumer experience. The first quarter after deployment the group make ten percent more profit than last year. We found that by using the system the time staffs spent in front of their computers reduced greatly. We observed 3 hotels in this group. The following figure shows the staff of one hotel in front office should spend about 2 minutes to finish a reservation process from paper information and almost 4 minutes from telephone information, according the observation of 69 general front office staffs in this hotel. If reservation is done by help of GHIRS, only 30 seconds are needed for staffs to confirm available room. If no confirmation needed, the system just does everything automatically. So our aim to reduce the human interaction with the system receives positive result.
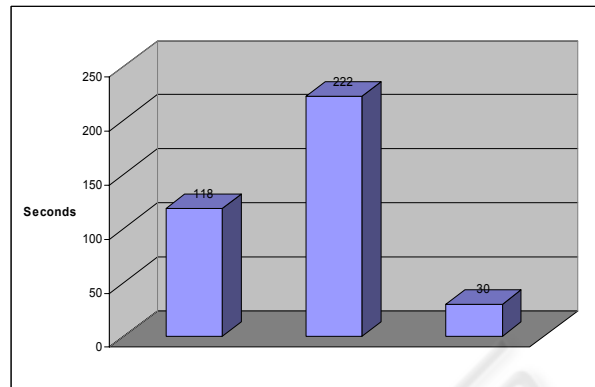

Figure 3: Reservation processing time by different methods

On the side of consumers, it also improves the hotel reservation experience well. Although nowadays computing technologies are still not "disappear", as described by Mark Weiser as "they weave themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser, 1991). With GHIRS, people needn't be stuck facing his PC or make an expensive long distance phone call to make a reservation. Instead, by only sending cheap mobile short text messages to certain number, it can be finished. Or he can browse his palm size device and submit his request. Although integrating wearable computing device such as IBM's Linux smart watch (Narayanaswami, 2002) outside the laboratory and into our system still faces significant challenges, our approach successfully offers various ways to make a hotel reservation.

The system is compared with other two hotel management systems. One is a US software company's product that dominates the largest market part in China's 5-star hotels. The other is also a popular system shares second largest market part in China's 3 to 5-star hotels. We choose each system's latest version. Compared with these current commercial hotel management systems, GHIRS has lots of advantages. The most strength of GHIRS is integration that seamlessly links different systems of hotel chains.

Table 1: Comparison with other systems

Features	System 1	System 2	GHIRS
Database	Sybase	SQL server	Any database
Integrated Reservation system	Yes	No	Yes
Integrated POS system	Yes	No	Yes
Integrated credit card authorization and settlement	Yes	Yes	Yes
Integrated Customer's profile in whole hotel group	No	No	Yes
Integrated Room Locking system	Yes	No	Yes
Integrated Enterprise Information System	No	No	Yes
Integrated Hotel Supply Chain System	No	No	Yes
Integrated Mobile Housekeep system	No	No	Yes

6 FUTRUE WORK OF WEB SERVICES IN HOTEL INDUSTRY

Web service technology is developed rapidly these years as a practical means to integrate heterogeneous systems and develop new applications. Our project of GHIRS successfully integrates systems in hotel business chains together. Although research has greatly advanced in this area, developing and maintaining integration system in hotel industry remains a lot of challenges.

First, web services provide us great freedom to exchange data and define data format, however, how to define the data standard format still relies on people who use it. Our experience implicated that in order to deploy a global, or to less scale, national wide hotel reservation system, there is a long road ahead for hotel industry to get standardization. Nowadays there are several hotel alliances existed, but these organizations do not touch data exchange standard between enterprises. So our work is limited in the range of certain hotels deployed Foxhis™ system previously. If some agreements on hotel industry standards would be settled, business to business (B2B) system and business to customer (B2C) system in hotel industry would provide both enterprises and consumers more benefits.

Second, web services technology is a quite high level technology, thus its security features are mainly dependent on the lower level technologies.

Web services security is one of the most important and complicated challenges related our work. There are lots of research papers on providing security solution of integration of heterogeneous computers and resources spread across multiple domains with the intent to provide users services. Current technologies such as firewalls, virtual private networks (VPN) are used to protect communication between user's host and server. On web-based application, Secure HTTP (HTTPS) implemented over Secure Sockets Layer (SSL) is widely used as well. XML-based security standards that are still evolving propose a series of standards for authentication, authorization, and public key management, for example, Security Assertions Markup Language (SAML), XML Key Management Specification (XLMS), WS-License and WS-Security by different organizations.

By all these means above we intend to obtain the following basic targets. One is to keep the contents confidentiality and integrity - that is to ensure nobody ever tempers or steals the data transferred through public networks. The other is to control access to web services. Before use web services, end users must pass the authorization procedure. Finally, but not least importantly, protecting the server from malicious attacks is practical and imperative problem because there always no enough security when services opened to the Internet. For example, currently the DDoS attacks draw many attentions of researchers to protect web applications from the attacks (Xiang, 2004).

Third, beside the technical issues, there are also social issues on security and privacy. The consumer might don't care a certain hotel or hotel group to keep his personal profile. For example, he is an acrophobe and always prefers the room on the ground floor. If his personal information is open for other organizations for instance, the travel agents, to access through web services, it is possible for them to abuse the information or be eavesdropped by some criminals. Then the problem becomes very serious. Some legislation still need be developed to solve this problem.

7 CONCLUSION

From the project we discussed above, we can see many key advantages of web services in hotel industry.

1. Web Services technology supports increased operational efficiencies and improved services by allowing multiple applications to interoperate.

2. XML, the language of web services, is simple, adaptable, extensible and supported by industry-developed standards.

3. Web Services and XML messaging standards help IT managers resolve technology decisions by devolving application issues from infrastructure, and the limits otherwise imposed by proprietary protocols and features.

4. It increased hotel customers' satisfaction; meanwhile, it decreased the cost of customer services and distribution process.

However, customers will never be satisfied by just making a relative easy reservation by several of substitutable devices. They push our project go ahead with requirements of easy to use features. Therefore, enterprises need an increasingly robust IT infrastructure to handle the unpredictability and rapid growth associated with e-business ventures (Foster, 2002). Some smart and intelligent systems with more integration would be developed. For example, when people make a decision to travel somewhere, the reservation system could provide the optimized schedule for him, book the cheap flight, reserve the table in his favourite restaurant and make a room reservation according his preference of hotels. All this work would be done automatically with little human interaction. So we should develop a generic web service system work with airline web service processor, restaurant web service processor and hotel web service processor. We have make some attempt on integrate airline services into GHIRS. Another integration application is to link the wireless restaurant order system and this hotel system together. Although now it makes some progress in the integration development, there is still much research and development work ahead.

ACKNOWLEDGEMENTS

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