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## Development for Rural E-government Saas Application

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**Abstract:** Based on the problems that technical personnel was in great shortage and funding was insufficient in rural areas, a software as a service (SaaS) application for rural e-government was built which used the database scheme of chunk folding to enhance both query efficiency and resource utilization. It reached the fourth level maturity of SaaS and could meet the great demand of villages (towns). Based on the platform of both Liferay Portal and My SQL, a prototype was implemented. Test and analysis is show that a distinctive e-government platform for each villages (towns) is quickly built and at a low cost to meet the low level of rural informational technicians and the demand for lack of funds.

**Key words:** Software as a service, rural e-government, liferay portal, chunk folding scheme

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### INTRODUCTION

China is an agricultural country, therefore to construct informational rural is an important part in constructing an informational country. Rural e-government has the features of wide range and business simple etc., In recent years, the construction of rural e-government platform is strengthened everywhere by Internet. However lacking of information technical personnel and funds, the aim of building and operating a single e-government platform in each village is impractical. Software as a service (SaaS) deploys software as the host service, through the Internet access (Chong and Carraro, 2006). It enjoys the characters of being configurable, hosting services, single instance multi-tenant, etc. Based on SaaS application, rural e-government platform is establish by nation or province, by which each rural e-government platform can quickly be constructed. Both deployment and maintenance of SaaS application is based on national or provincial level, so both the technical requirements for rural information personnel and rural economic burden are reduced. Thus SaaS application in rural e-government is one of the most effective ways to reach the rural information.

Scholars have put forward many application fields based on SaaS. Wang *et al.* (2010) put forward a kind of “two-way” SaaS model which supports resource integration of technical information sharing and comprehensive utilization and facilitates effectively to organization and management. But it did not reach four level maturity model of SaaS and it cannot fully play to the multi-tenancy features. Zhou (2011) designed a library management system based on SaaS, but its database

scheme existed a large number of idle because the traditional database scheme was adopted. Salih and Zang (2012) proposed a variable service process customization to implement the software flexibility which did not take into SaaS maturity.

For the above problem, taking rural e-government affairs as the research object, it is built the four level maturity SaaS application (Chong and Carraro, 2006) and using the chunk folding (Aulbach *et al.*, 2008) of database technology. A prototype of rural e-government SaaS application is accomplished based on Liferay portal and My SQL. This research has great significance for promoting and increasing rural information service.

### THE DESIGN OF RURAL E-GOVERNMENT SAAS APPLICATION

**Rural e-government Affairs:** According to Chinese e-government construction planning, web is the main model of the elementary e-government which includes all kinds of policies and rules etc. (Zhao, 2011). Villagers need to focus on their village's affairs and participate in discussion and management of state affairs, so rural e-government should include the columns about rural public affair and inform. As village's gateway on Internet, rural e-government must serve local economy and industry, using Internet to improve the popularity of their village's characteristic industry, so it should include the column of “One Village One Product”. As heavy component of the party affairs, rural is important. Because of the great flow of people, it is Strengthened the rural party by the Internet, so the party Building and conduct

public affairs should be included. For better control of population, improve its quality and stabilize lower birth level, the local village should adopt Planned Parenthood Public. In order to further improve the work style of cadres and work efficiency and make it convenient for farmers to timely understand the village office dynamic, an opened public service should be included. Financial disclosure should be adopted for the villagers to understand "real situation", thus promoting an appropriate and reasonable financial management. Policy guidance is very important to facilitate the farmers to keep abreast of the principles and policies in response to call of policy.

**Overall architecture design:** Accord to the demand to rural e-government, the construction of rural e-government should include the aspects like“ One Village One Product”, Party affairs public, Planned Parenthood Public, public service, financial disclosure and policy guidance. On this basis administrators are also provided with more permissions for convenient management and maintenance. In order to improve the experience level, users can also make some settings for theme and layout. Thus rural e-government platform mainly includes information management module, user management module, rights management module and customization module four parts, show as Fig. 1:

- **Information management module:** Mainly indicates the dynamic information of each village, including rural affair public, Party affairs public, Planned Parenthood Public, public service, financial disclosure and policy guidance. The administrator need to actually update news every day, showing latest news and displaying their own characteristics for each village agricultural products in One Village One Product section
- **User management module:** Includes user registration and login where you can log on the website to browse and make related operations after registration
- **Rights management module:** Permission settings, allocation and each user permissions takes effect after the super administrator’s distribution
- **Customization module:** Customize the theme and layout so that user can set the layout and change the theme according to their own style which make it more humanized

Module	Function	
Information management	Information management	One village one product
User management	User registration	User login
Rights management	Permission settings	Permission allocation
Customization	Customize theme	Customize layout

Fig. 1: Basic modules of multi-tenant village affairs

**Detailed design of database:** In order to reduce cost, operators use query transformation to map multiple single-tenant logic schemas in the application to one multi-tenant physical schema in database. However, the mapping is challenging. Assuming the work load is controlled within a certain range, the most fundamental limitation is that database can handle the number of Table based on the scalability (Aulbach *et al.*, 2008). Large chunk folding technology is new schema mapping and to extend the number of Table is to divide the logic Table vertically into blocks, fold together them and add to the different physical multi-tenant Table (Aulbach *et al.*, 2008). Since, the number of villages, even for a country, is very large. In order to guarantee rural e-government based on SaaS application has strong scalability, combining with large chunk folding technology is applied to the database design of the platform, make good integration between database Table, the database schema of the present study plan is based on large chunk folding technique.

According to the overall architecture design, using traditional database schema, the data Table of the present study mainly includes channel Table, article Table, user Table, shown as Table 1-3.

To support SaaS level 4 maturity, make the system with high scalability and improve the efficiency of query, we make the design of the database schema according to the chunk folding technology as shown in Table 4 to Table 5. Specific plans:

- **Find the intersection by column of each table:** Id, name, establish a common Table, such as Table 4

Table 1: The numbers for 1

Id	Pid	name	url
20110101	201101	Public Service	url1
20110102	201102	Party affairs public	url2

Table 2: The number for 2

Id	columnId	Name	Content
1291	20110105	Title1	content1
1292	20110101	Title2	content2

Table 3: The number for 3

Id	Name
10155	Liferay
10157	Zpinga

Table 4: The chunk

NumId	Row	Id	Name
1	0	20110101	Public Service
1	1	20110102	Party affairs
2	0	1291	Title1
2	1	1292	Title2
3	0	10155	Liferay
3	1	10157	Zping

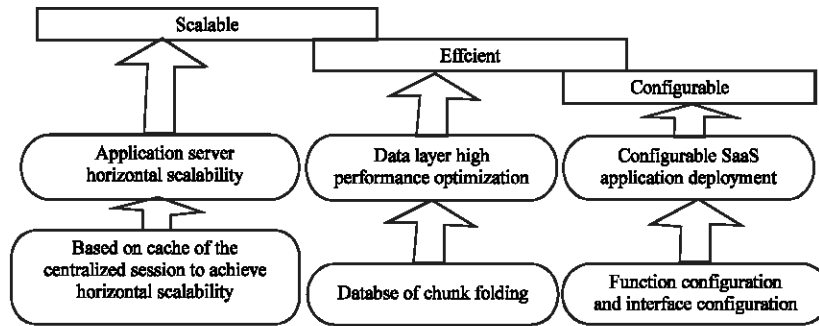


Fig. 2: Level 4 maturity of SaaS application

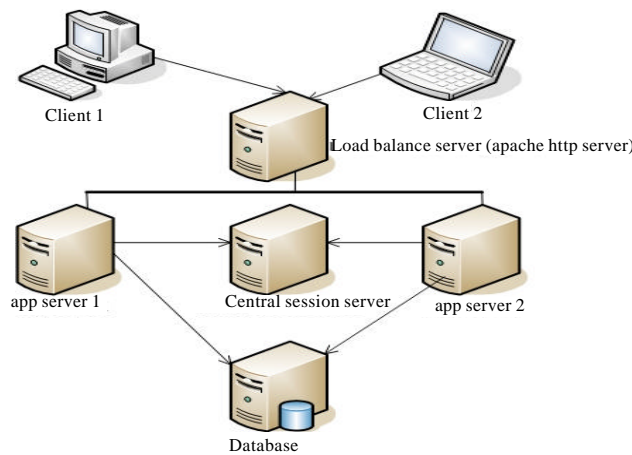


Fig. 3: Based on cache of the centralized session to implement deployment model of horizontal scalability of application server layer

Table 5: Chunk table

NumId	Tab	Chu	Row	Int1	Str1
1	0	0	0	201101	url 1
1	0	0	1	201102	url 2
2	1	0	0	20110105	content 1
2	1	0	1	20110101	content 2
3	2	0	0	-	-
3	2	0	1	-	-

- Calculate the union of column of each Table, minus the intersection parts
- Put column data type of getting the result of 2 step into chunk
- Divide all except what is not in common Table column in each Table according to the division of the chunk
- Get chunk Table, such as Table 5.

Compared with the above technical scheme, chunk folding scheme can reduce significantly the number of Table, saving memory space and improving the efficiency of query.

**Level 4 maturity saas application design:** The maturity model of SaaS is divided into 4 levels (Chong and Carraro, 2006). The rural e-government platform meet the 4 level. Firstly, it has met the first level of maturity because each customer has its customized instance, On the basis of Fig. 2, sequentially shows the four maturity of the implementation process from top to bottom, where highly configurable mainly achieves function configuration and interface configuration and function configuration mainly is online configuration when the system is running making different tenant uses different functions of the system online at the same time. The interface configuration are mainly system menu configuration and page content configuration. Highly efficient mainly through database using chunk folding for the optimization of database's layer. Scalability is mainly based on cache memory's centralized session (to keep the state of the client-side) to achieve horizontal scalability of application server layer, the scheme uses centralized cache replace local session, deployment model as shown in Fig. 3 (Ye, 2009).

In the above, the application server achieved full horizontal scalability which means the application server layer pressure can be shared completely by adding to server. When the number of session is so big and reaches a certain degree that cache server cannot bear, we only need to increase the number of corresponding cache server, the application of integral architecture will not change.

### **IMPLEMENTATION BASED ON LIFERAY PORTAL**

As an open source project, Liferay has implemented portal function that is proposed in JSR168 specification (Meng and Ma, 2008), with the use of Hibernate, Struts, Spring and other open source framework. Implementation of platform is based on Liferay Portal from the following aspects:

- **Information management module:** Information management module is mainly to implement article issue process management. And here we will specifically explain the transform. process by taking an example of picture upload/download function: Use the file upload to upload pictures in the Portlet, upload the acquired pictures to Liferay's document library and display file into the page by reading file's information
- **User management module:** On user rights management, we use Liferay Portal's associated way of the user-groups- role-portlet to implement user management. The users can exist alone, belong to groups, assign roles to groups or directly to users, while operating a Portlet needs to have the specified role (Liu *et al.*, 2008)
- **Privilege management module:** By assigning user privileges, support the e-government to customize the default page and at the same time open the ordinary registered user to customize their own personalized home page content. After logging in as an administrator, we can modify the relevant contents of public home page, while other users can only browse and use. After ordinary user register, they can customize their own personal home page, including selecting page style, planning page layout, custom channels, attributes and so on. The personal space is used only by the registered users, other users can't access
- **Personalized customization:** Relying on the Liferay Portal of template programming technology, the platform can control the page format output, implement portal of custom management and design the templates to provide direct use of rural e-government platform. Templates include page layout template and page style templates. During the customization, use Ajax technology to implement

mouse dragging channel layout, automatically generating the required layout of home page and various points, etc

Based on the above, according to Chinese specific characteristics of rural e-government, the design and development of SaaS application in rural e-government is completed by using Liferay Portal framework for development, thus building different sites in villages to accomplish the information announcement.

### **CONCLUSION**

We analyze the rural e-government business requirements and propose SaaS application in rural e-government. With the use of chunk folding technology for database schema, SaaS module reaches the level 4 maturity which is scalable, configurable and efficient multi-tenant. A test prototype is implemented in Liferay Portal+My SQL platform.

Test and analysis is shown that the application meets SaaS level 4 maturity, achieves the functions such as "One Village One Product". Compared with the traditional network platform, it enjoys the advantages like easier management and maintenance, easier updating and development, lower investment cost at initial and providing personalized service etc.

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### **REFERENCES**

- Aulbach, S., T. Grust, D. Jacobs, A. Kemper and J. Rittinger, 2008. Multi-tenant databases for software as a service schema-mapping techniques. Proceedings of the ACM SIGMOD international conference on Management of data, June 9-12, 2008, New York, NY, USA., pp: 1195-1206.
- Chong, F. and G. Carraro, 2006. Architecture strategies for catching the long tail. MSDN Library, Microsoft Corporation, pp: 9-10
- Liu, Yi., Y.J. Tang, R. Yang and C. Li, 2008. The design and implement of institution integration platform based on liferay portal. New Technol. Library Inf., 165: 72-77.

- Meng, X. and Z. Ma, 2008. Research and implementation of multi-dimensional portal system in digital library based on liferay. *New Technol. Library Inform.*, 17: 8-14.
- Salih, N. K. and T. Zang, 2012. Variable service process for SaaS Application. *Res. J. Appl. Sci. Eng. Technol.*, 4: 4787-4790.
- Wang, Z.H., Z.F. Zhao, J. Fang and X.C. Wang, 2010. A SaaS-Friendly Service Community Model and Its Application in the Nationwide Service Network for Sharing Science and Technology Information. *Chinese J. Comput.*, 33: 2033-2043.
- Ye, W., 2009. *Internet Era Software Revolution: SaaS Architecture Design*. Publishing House of Electronics Industry, Beijing, ISBN-13: 9787121077364, pp: 131-138.
- Zhao, Y., 2011. The problem research of rural information service in the process of urban and rural integration. *Econ. Res. Guide*, 12: 24-26.
- Zhou, Q., 2011. Study on library management system based on SaaS architecture. *Sci.Tech. Inform. Dev. Eco.*, 21: 142-144.