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The Cross-border Electricity Business Cloud Services Platform Based On A Combination Of Cloud Computing Services Composition

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ABSTRACT

Nowadays cloud computing industry has turned to the stage of small-scale application from the stage of import and preparation, so business model has become an integral part in cloud computing. According to the existing problem of commercial operation in cloud computing, by analyzing and forecasting the service composition effects, this paper proposes the theoretical thought of synthetic prediction of risk management for cloud computing services composition systems, gives a synthetic prediction model of services composition, namely multi-layer recurrent model, and analyzes it properties. Then based on multi-layer recurrent model, the construction and application prospect of the cloud service platform based on cloud computing service portfolio is discussed.

Keywords:Cloud computing, Services composition, Synthetic prediction, Cross-border electricity business.

INTRODUCTION

Information technology is recognized as one of the most important focuses of national competition. Cloud computing is the latest development trend in IT industry. In cloud, IT resources including software, hardware and platform, are provided as infrastructure to users in the form of service [9]. Most of the existing researches focus on cloud computing technology (e.g. virtualization, standardization, parallel computing and open source computing). Few literatures of cloud computing from the perspective of company or organizational management in business and management context exists [7]. Cloud computing, as a new utility computing model, is the development of grid computing, distributed computing and parallel computing. And it is the commercial implementation of these models. The success of cloud computing services systems largely depends on the development of the commercial operation mechanism. For a cloud computing service carrier, a market strategy in line with the business interests, is an essential point [14]. The biggest difference between cloud computing and previous computing paradigms is that its emerging business model, which creats remarkable commercial value [15]. In the study of Weinhardt et al. [12], they propose a cloud business model framework, which suggests that each of cloud service model should be based on a certain business model [8]. And Zhang, Cheng and Boutaba [13] presents that the business model in cloud computing is usually considered synonymous with the role of carrier. Fischer and Turner [3] suggests that cloud computing is a cooperation-oriented system composed by different stakeholders of cloud computing carriers and service providers as a service supply chain.

However, cloud computing services carriers in commercial operation is facing a key issue, i.e. in order to better address customer need and buck for the long-term development of enterprises, they need generate some strategies to coordinate the behavior of members in cloud computing services supply chain so that each member can consider the impact of its action on other members to make the optimal strategy in the whole supply chain system, to share market risk, to achieve a win-win situation, and to improve the competitiveness of the entire cloud computing service supply chain. Therefore, based on the former studies, the paper introduces the theory of services composition to solve the above problem.

By cloud computing services composition, we mean that the related services are assembled dynamically by the specific needs then published as a new service that accomplishes particular tasks. This is showed in Figure 1. Modern service enterprises can effectively utilize the shared IT resources of the whole society and the intelligent analysis of customer demand by services composition, and they can formulate and implement various innovative and targeted service measures so as to achieve ahead of the competition and sustainable development.

In fact, when consumers select service patterns or services composition patterns, they choose better services composition generally by analyzing and forecasting future effects of various service patterns. Here selection obviously contains the component of prediction. So we can establish the respective prediction models to all sorts of service patterns, and utilize the prediction results of all prediction models, by using the idea of combination forecasting [11] [1] [2] or synthetic prediction [6] [10] [5]. The services composition with ideal future prediction by appropriate combination can be called synthetic prediction model of services composition. Here there is no establishing that these are ideal or that there is an appropriate combination. In this paper, an idea of synthetic prediction of cloud computing services composition is given. And the construction and application prospect of the cloud service platform based on cloud computing service portfolio is discussed.

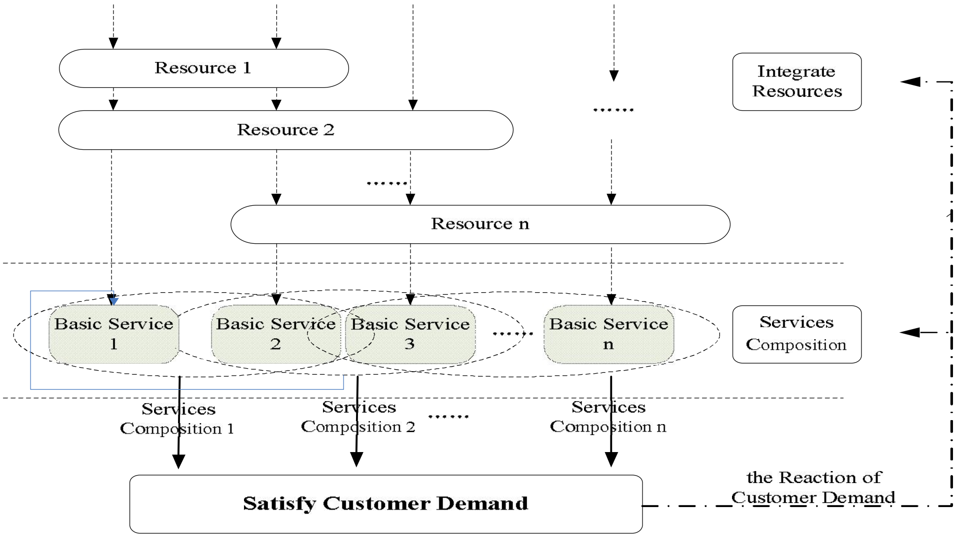

Figure 1: Cloud computing services composition systems

MULTI-LAYER RECURRENT PREDICTION MODEL OF CLOUD COMPUTING SERVICESCOMPOSITION

Basic Concept

Suppose S is a dynamic cloud computing service composition system, F is a model family that all models are corresponded to kinds of service composition modes, and M_i denotes the model in the model family. So the following expression is showed:

$$F = \{M_i, i \in I\} \text{ or } \{M\}, \tag{1}$$

where I represents the indicator set.

Only consider the case of discrete time system. k is a discrete timevariable (e.g. year, month, or day). $y(k)$ is the output of S, and $u(k)$ is the input. Without loss of generality, let the model $M \in F$, and it can also be written as one step forward prediction form:

$$M : y(k) = f_M[Y_{k-1}^{k-n}, U_{k-1}^{k-n}, \theta, v(k), k], \tag{2}$$

Where θ is a parameter, $v(k)$ is the random noiseof difficult to measure for the system, $Y_{k-1}^{k-n} = \{y(k-1), \ldots, y(k-n)\}$, and $U_{k-1}^{k-n} = \{u(k-1), \ldots, u(k-m)\}$ (n and m are both model order).

Multi-Layer Recurrent Prediction Model

Multi-layer recurrent model is an improved method on least squares composition model. The basic form of the prediction model is

$$y(k) = \sum_{l=1}^{h} \beta_l M_l(k \mid k-1). \tag{3}$$

When $\phi(k) = (M_1(k+1 \mid k), \ldots, M_h(k+1 \mid k))^\tau$ and $\beta = (\beta_1, \ldots, \beta_h)^\tau$, expression (3) can be written as

$$y(k) = \varphi(k)^\tau \beta \tag{4}$$

If these known observation data are

$$(y(k), \phi(k)), k = N_0 + 1, N_0 + 2, \ldots, N,$$

$\hat{\beta}(k)$, the estimation of β , is obtained by the following recursive algorithm:

$$\hat{\beta}(k)=\hat{\beta}(k-1)+\frac{\phi(k)}{\|\phi(k)\|^{2}}\{y(k)-\phi(k)^{\tau}\beta(k-1)\}. \tag{5}$$

When the matrix

$$H(h)=\begin{bmatrix} \varphi(N_0+1)^{\tau} \\ \varphi(N_0+2)^{\tau} \\ \Lambda \\ \varphi(N_0+h)^{\tau} \end{bmatrix}$$

is an invertible, the initial value $\hat{\beta}(N_0)$ in expression (5) is given by $H(h)^{-1}\hat{\beta}(N_0)=Y$, where

$$Y=[y(N_0+1),\mathrm{L}\ ,y(N_0+h)]^{\tau}.$$

Suppose the estimation sequence of β is $\hat{\beta}(N_0+1),\hat{\beta}(N_0+2),\mathrm{L}\ ,\hat{\beta}(N)$.

Therefore

(1)Accordingto the above estimation sequence, the model that the parameter $\beta(k)$ satisfies is determined by application ofappropriate identification.

(2) $\hat{\beta}(N)$ of one step forward predictive value is given by application of the model:

$$\hat{\beta}(N+1\,|\,N)=(\hat{\beta}_1(N+1\,|\,N),\mathrm{L}\ ,\hat{\beta}_h(N+1\,|\,N))^{\tau}.$$

Then the multi-layer recurrent prediction model is

$$\hat{y}_M(N+1\,|\,N)=\sum_{l=1}^{h}\hat{\beta}_l(N+1\,|\,N)M_l(N+1\,|\,N)=\phi(N+1)^{\tau}\hat{\beta}(N+1\,|\,N). \tag{6}$$

Previous research[4] elucidates that as long as the error between the parameter's predictive value $\hat{\beta}(N+1\,|\,N)$ and the parameter's estimation $\hat{\beta}(N+1)$ is sufficiently small, the prediction error of multi-layer recurrent prediction model is small enough, that is, with a multi-layer recurrent prediction model to solve the prediction problem of cloud computing services composition systems can reduce the prediction error.

The practical economic meaning of this composition mode (expressions (1)-(6))is that because of full consideration to the dynamic time-frequency features of the system, the prediction error is greatly reduced (by the theoretical proof of the literature [5]) and the effect of the future services composition becomes better because the prediction accuracy is improved.

THE THEORETICAL THOUGHT OF SYNTHETIC PREDICTION MODE

The Best Matching Criterion OfThe Model And Algorithm

The basic idea of synthetic prediction pattern [6] [10] is that based on the observation data, the most suitable prediction model, the most appropriate parameter estimation algorithm and parameters prediction algorithm are selected, in order to get the best match of the model and the algorithm separately from the existing model family and algorithm family, and as much as possible to obtain a better prediction results. Therefore, the key to solve the synthetic prediction problems is the search for the best matching criterion of the model and algorithm with data [5].

For the sake of convenience, it is assumed that by some appropriate steps, all models are written in the form of prediction model with unknown parameters: $M_1 : y(k) = M_1(\theta_1(k)) + e_1(k)$,

$$M_2 : y(k) = M_2(\theta_2(k)) + e_2(k),$$
$$\cdots \qquad \cdots \qquad \cdots$$
$$M_n : y(k) = M_n(\theta_n(k)) + e_n(k),$$

where n is the number of models, $y(k)$ is the predicted value, and $e_i(k)(i = 1, 2, \cdots, n)$ is the random noise. So the model family is $M = \{M_1, M_2, \cdots, M_n\}$.

The basic assumptions are as followed：

Suppose S is a dynamic cloud computing service composition system to be predicted; $e(k)$ represents the white noise with constant variance and it is not a zero mean in the system. It is typically around 10^{-9}. If the system S is described correctly by the model M_i, there exists $e_i(k) = e(k)$.

Due to the model with unknown parameters, primarily the unknown parameters need to be estimated for solving the prediction problem. Suppose l_1 parameter estimation algorithms can be applied. Based on the observation data and application of parameter estimation algorithm, a series of estimation of the parameters can be drawn in the last moment:

$$\hat{\theta}_i(1), \hat{\theta}_i(2), \hat{\theta}_i(3), \cdots, \hat{\theta}_i(M), i = 1, 2, \cdots, n.$$

Then, the parameter $\hat{\theta}_i(k)$'s predictive value $\hat{\theta}^*(M+h)(h \geq 1)$ can be determined by appropriate parameters prediction method. If there are l_2 kinds of prediction methods available, the number of matching modes between parameter estimation algorithms and parameters prediction algorithm is $l_1 l_2$, let $m = l_1 l_2$. So there will be an algorithm family $A = \{A_1, A_2, \cdots, A_m\}$,containing m kinds of matching modes.

The prediction results of the model M_i and the algorithms A_j for system S meet some optimal criterion, this is to say, the model M_i and the algorithm A_j with the system S is the best match under this criterion.

Suppose that the algorithm A_j is good enough to make the best matching among the model M_i and the algorithm A_j with the system S. Then the residual error is

$$\varepsilon_i^j(k) = y(k) - M_i(\hat{\theta}_i^j(k)), M < k \leq N. \tag{7}$$

which is the sample value of the white noise $e(k)$, and $\hat{\theta}_i^j$ represents the evaluation of the parameter in the model M_i by the algorithm A_j.

Prediction Accuracy Discriminate

If the model with the most specific match to the prediction system S at time k is M_{i_0}, and the algorithm is A_{j_0}, there is

$$\varepsilon_{i_0}^{j_0}(k)^2 = \min_{i,j} \varepsilon_i^j(k)^2, M < k \leq N. \tag{8}$$

Take into account that time-variation and diversity of the system prediction model. So instead of directly using a squared error value of this prediction as the criterion for determining the prediction system with the most specific match to the model and algorithm, the following weighted average is adopted:

$$\eta_i^j(k) = \alpha\eta_i^j(k-1) + (1-\alpha)\varepsilon_i^j(k)^2, M < k \le N \text{ ,and } \eta_i^j(M+1) = \varepsilon_i^j(M+1)^2. \tag{9}$$

Where α satisfies $0 < \alpha < 1$. So $\eta_i^j(k)$ is called the prediction accuracy when the system S is matching with the model M_i and the algorithm A_j. Then, the prediction accuracy discriminate is given by:

If the model M_{i_0} and the algorithm A_{j_0} satisfy

$$\eta_{i_0}^{j_0}(k)^2 = \min_{i,j} \eta_i^j(k), \tag{10}$$

the system S with the model M_{i_0} and the algorithm A_{j_0} are the best match(by the theoretical proof of the literature [10]).

SYNTHETIC PREDICTION METHOD OF CLOUD COMPUTING SERVICE COMPOSITION

Based on the foregoing research, the main steps of the synthetic prediction method of cloud computing services composition can be further drawn:

(1)According to the characteristics of the observation data, a subfamily u_0 is made up of some models from the model family, which are available for the observation data.

(2)Unknown parameters of each model in the subfamily u_0 should be dependent on the observation data, and estimated by the estimation algorithm. Suppose the estimation sequence obtained is

$$\hat{\theta}_i^{l_1}(1), \hat{\theta}_i^{l_1}(2), \cdots, \hat{\theta}_i^{l_1}(N_0),$$

Where i is the sequence number of the model in u_0, l_1 is the label of the estimation algorithm, $N_0 = N - h$ is the end time of the observation data, and h_0 is the length of the test predicted segment. The last parameter h_0 generally depends on the numberof the observational data, and the value can be 1～5, usually $h_0 = 3$ or $h_0 = 2$.

(3)Derive the parameter predictive value during the test predicted segment:

$$\hat{\theta}_i^{*l_1l_2}(N_0+1), \cdots, \hat{\theta}_i^{*l_1l_2}(N_0+h_0),$$

Where l_2 is the sequence number of the parameter prediction algorithm.

(4) Calculate

$$\hat{\varepsilon}_i^{*l_1l_2}(N_0+\gamma) = y(N_0+\gamma) - M_i(\hat{\theta}_i^{*l_1l_2}(N_0+\gamma)), \ \gamma = 1, 2, \cdots, h. \tag{11}$$

(5)The model and the algorithm with the most specific match to the system at N time is determined by the prediction accuracy discriminance, and suppose the model is M_{i_0} and the algorithm is A_{j_0}.

(6)Work out the parameter predictive value $\hat{\theta}_{i_0}^{j_0}(N+1)$.

(7)The one step forward predictive value can be got by the prediction formula:

$$\hat{y}(N+1 \mid N) = M_{i_0}(\hat{\theta}_{i_0}^{j_0}(N+1)). \tag{12}$$

Finally, with the obtained prediction results, changing N to N+1, and repeating step (2)~(7), the prediction results in h step forward can be determined.

CLOUD COMPUTING SERVICES PORTFOLIO SYSTEM APPLICATION---HARBIN “CHINA-RUSSIA” CROSS-BORDER ELECTRICITY BUSINESS CLOUD SERVICES PLATFORM

Harbin “China-Russia” Cross-Border Electricity Business Platform To Build Cloud Services

Harbin “China-Russian” cross-border cloud service platform construction goal is: put forward the model of cross-border e-commerce services and solutions, security technology R & D information based e-commerce cross-border trusted collaborative technology and other basic services, customs clearance, to demonstrate the application of network technology and transaction related business integration platform and significantly improve the cross-border network transaction based information credibility, efficiency and other aspects of customs clearance network, transaction related business integration, will create the following specific objectives:

(1) According to the particularity of the “China-Russian” border trade, focusing on cross-border e-commerce service platform, fully open to Russia bilateral trade new e-commerce business era, the new Russian e-commerce cloud service platform, in order to solve the problems of China foreign trade enterprises and businesses in the development of trade with Russia on the difficulties encountered;

(2) The use of one-stop high credible Russian e-commerce service system, including solving customs, operations, marketing, logistics, payment and other issues, so that China foreign trade enterprises and businesses easy to conduct trade with Russia, to promote the rapid development of economy and trade of the “China-Russian” benign operation;

(3) Vigorously develop cloud services platform for China's foreign trade enterprises and businesses to expand the Russian trade provides the best solution and ways to make “China-Russian” international trade to a new stage of development.

(4) The Harbin cross-border e-commerce pilot city and country attaches great importance to “China-Russian” economic and trade relations, focus on the development of more than 3 cross-border e-commerce service enterprises, the formation of 5 billion / years the size of the trade, promoting cross-border e-commerce full service.

Harbin “China-Russia” Cross-Border Electricity Suppliers Cloud Service Platform Construction Content

The platform construction includes: Research on innovative service mode of Sino Russian trade cross-border e-commerce based on cloud services platform, breakthrough business application platform, the whole network management, network promotion, information service and information sharing, transaction optimization and integration, flexible supply chain and the supply chain finance, mobile services, cloud service integration 8 the key technology research and application of the Sino Russian cross-border e-commerce services.

The core technology of big data era of cross-border e-commerce is in a comprehensive perception, reliable transmission based on cloud computing platform using intelligent processing technology, the vast amounts of data and information (or data) analysis and processing, so as to provide all-round services for the development of cross-border e-commerce.

The platform will design and implement a new cross-border e-commerce business model and service model based on cloud computing services, mainly through the “China-Russian” cross-border electronic commerce involves the logistics, warehousing, trading, payment, customs declaration, inspection and other cloud platform system, solve the “China-Russian”cross-border e-commerce bottleneck problem fundamentally, promote the rapid development of e-commerce industry.

In view of the current needs of the development of cross-border e-commerce in China and Russia, with the idea of cloud computing services to explore the service model, to form a "“China-Russian” cross-border e-commerce cloud services platform" as the core of the service model, focusing on the realization of:

(1) To achieve the platform of basic services and unified security services.

(2) The key process optimization of cross-border e-commerce, online inspection, customs clearance, tax rebates, foreign exchange, exchange of resources, content distribution and other business services.

(3) Docking government management business, customs inspection and Quarantine on the formation of resources, resources, logistics resources, resource tax, foreign exchange resources, effectively regulate the comprehensive use of resources.

(4) For “China-Russian” enterprise application, the realization of multi-language resources network, centralized reporting,

logistics visualization, commodity classification and merge, goods traceability query, statistical analysis and other services.

CONCLUSION: APPLICATION PROSPECT

This paper analyzes and forecasts the control from the perspective of the combination of the cloud computing services, discusses the coordination of such dynamic system prediction problem, some new results of system identification and control system and the comprehensive use of theory, put forward a comprehensive coordination model in theory; this theory seeks to establish Harbin China-Russian cross-border electricity supplier based on cloud platform, and carry out the actual application.

At present, the calculation of the composite service system based on cloud service platform - Harbin“China-Russian” cross-border trade through the dragon, has officially launched startup, specific verification and implementation under operation; and focus on the application of landing to the Longjiang silk road to bring things to the main trunk line (from Suifenhe via Harbin to Manchuria City on the key nodes), which as the center of Harbin City, including: East of Mudanjiang and Suifenhe, west of Daqing and Qigihar, extending to Inner Mongolia and Manchuria; and promote the province's border node city and important node city transit logistics; e-commerce will gradually guide the enterprise innovation project relies on cloud computing infrastructure and service platform, the formation of leading edge computing the service in the electronic commerce industry of cloud, cloud computing to the e-commerce industry chain integration and optimization, truly reflect the cloud computing service group The huge economic benefits and social benefits brought by the combination system.

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