On Application of SOA to Continuous Auditing

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Abstract: In today's fast paced business world, there is growing interest in the concept of continuous auditing. Although, current technology makes continuous auditing possible, it still faces some problems. The main problems consist of the accuracy of the data, the real-time and comprehensiveness of the audit, and the flexibility of the audit. In order to solve these problems, a SOA-based conceptual model for continuous auditing is proposed in this paper. The two main models of SOA (service registry model and enterprise service bus model) are all applied to this conceptual model. The model also requires the user interface to be separated from the client's management information system so that the auditing systems can monitor the process of the transactions between the client and the third parities. The model shows how the new technology using ESB, XBRL, The shadow subsystem , Just-In-Time database , and the Intelligent Agent can help effectively audit the transactions between the client and the third parities. Finally, a SOA-based conceptual model for continuous auditing is presented to provide the real-time, comprehensive, and flexible of the audit.

Key-Words: Continuous auditing; SOA; ESB; Real-time audit; Model

1 Introduction

In the fast developing Commercial world, electronic commence, electronic data interchange (EDI), and the internet are dramatically changing business practices and record keeping. Doing business on the Word Wide Web enables organization to connect into the online world and improve all aspects of their business. In this high-technological environment, real-time information systems facilitate real-time accounting systems and real-time communication between entities. The audit environment is changing to keep pace with the changing business environment. There is a growing interest in the concept of continuous audit. [1]

The continuous auditing technologies can ensure the audit is Real-time. In a continuous audit, data that flow through a client's system are continuously monitored and analyzed using devices integrated within the system. Exceptions to auditor-defined rules trigger alarms, proving communication to the auditor any potential deterioration or anomalies in the system.

The CA concept is over a decade old. Several classical continuous auditing models were proposed .However the current research of continuous auditing still faces some problems, such as, how to ensure the accuracy of collected data, how to ensure the real time and comprehensiveness in the auditing process and how to improve the flexibility of the auditing process.

In order to solve these problems, in this paper we propose a continuous auditing model based on SOA (Service Oriented Architecture). SOA is composed of three major modes that are service registry model and enterprise service bus model. The main advantages of SOA, as follows: [2]

●Alignment of IT with the business
●Maximal reuse of IT assets
●IT infrastructure flexibility

The aim of the paper is to make a conclusion about how a generic and comprehensive continuous auditing system could make use of SOA to provide real-time and comprehensive audit.

The remainder of this paper as follows: Section 2 describes continuous auditing and SOA. Section 3 provides A SOA-based conceptual model for continuous auditing, and Section 4 provides evaluation of the model. The last section is about the summary and conclusion.

2 Backgrounds

2.1 Continuous Auditing

According to the CICA/AICPA research report, CA is "a methodology that enables independent auditors to provide written assurance on a subject matter using a series of auditors' reports issued simultaneously with, or a short period of time after, the occurrence of events underlying on the subject matter". [3] The CA concept is over a decade old. Several continuous auditing models were proposed, but few have been implemented in real-time systems. The Continuous Process Auditing Systems (CPAS) is one of early classic models. CPAS was developed at AT&T Bell Laboratories. The main feature of CPAS is that it is a methodology for internal auditing of large "paperless" real-time systems. This model appears to have formed a basis for the latter models. [4]

Later, most development of the continuous auditing systems adopted a "CPAS-like" design. For example, Fig. 1 the intelligent agent is used in continuous auditing.

The kind of model is mainly based on a database of the client system; the continuous auditing agent technology uses the stand-alone system to continuously monitor the client's system. The system extracts data from the database of the client's system and then compares data with the standards. Once exceptions are found, it may trigger alarms. Then exception reports are sent to the audit staff, and relative measures are taken to achieve the audit goal.

Recently, Computer-based accounting systems have been widely used in firms. Many firms try to utilize electronic data interchange (EDI) .The business transact and communicate is changed Doing business on the Word Wide Web enables organization to connect into the online world and improve all aspects of their business. With the changing business environment, the audit environment is changing. It is necessary to build an advanced continuous audit. Simultaneity, current technology is making it possible for the continuous auditing. Theses technologies include embedded auditing modules (EMA), Extensible Business Reporting Language (XBRL), database technology, data warehouse and internet technology, and so on.Table1 shows technology and environment related to the continuous auditing.

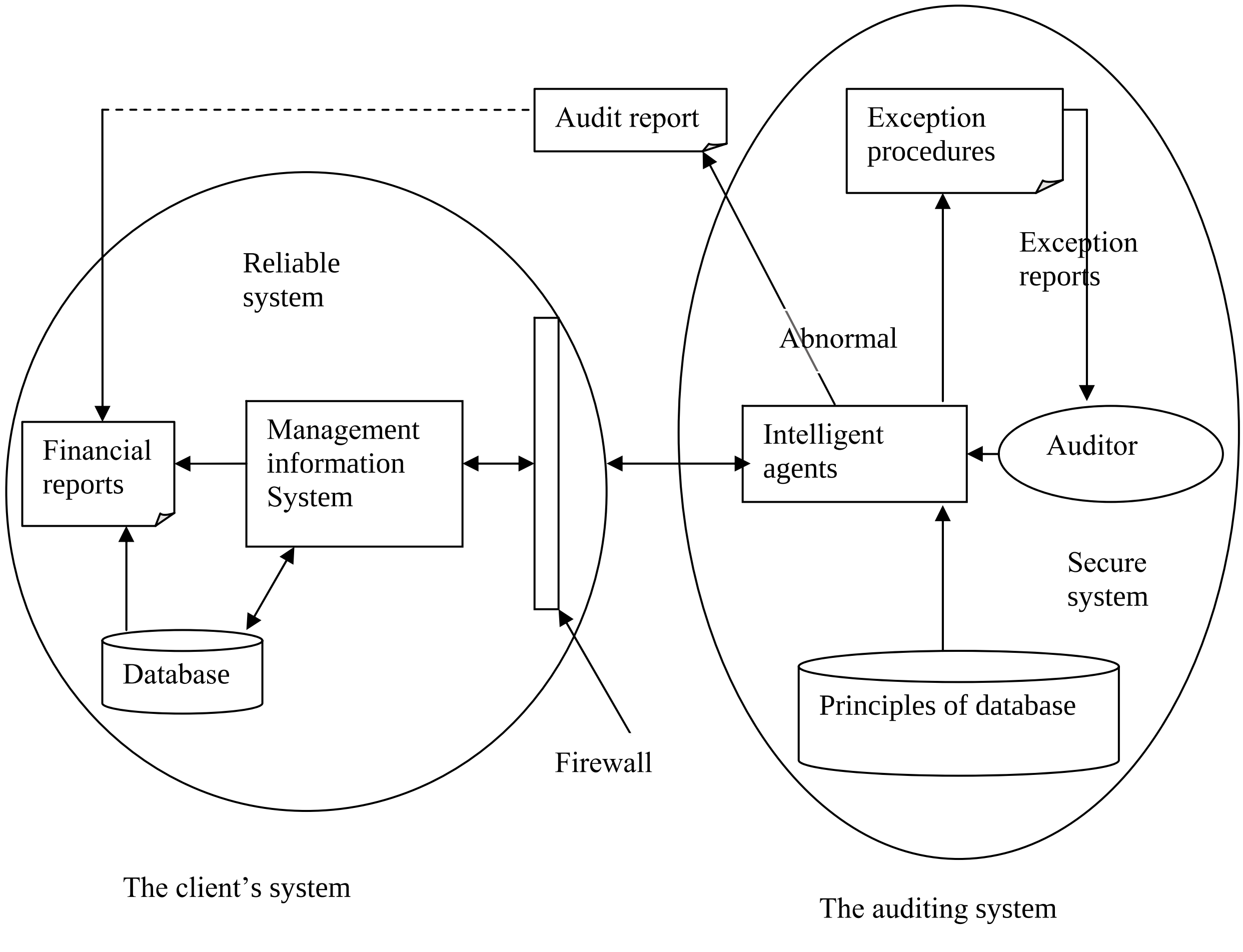

Fig. 1 the intelligent agent is used in continuous auditing

Table1. Summary of Related auditing Studies

Technology and Environment	Related Studies
Embedded Auditing Module (EAM)	Bodnar and Hopwood(2001), Orman(2001),kneer(2003), Bodnar(2004)
XBRL	Cohen and Hannon(2000), Weisel(2002), Zhao et al.(2004), Srinivas(2004)
Web Services , Internet Technology	Muthy and Groomer(2004)
Data mart ,Data Warehouse	Rezaee et al(2000)
XGAL	Onions (2003)

2.2 SOA

Service Oriented Architecture (hereafter referred to as SOA) is a methodology. Just as the concept of object is the core of the object-oriented architecture, SOA is based on the concept of service. SOA is an architectural pattern that describes a system that is composed of discrete services that interact with clients and each other accomplish various tasks. [5] The main advantage of SOA, as follows: Alignment of IT with the business, Maximal reuse of IT assets, and IT infrastructure flexibility. SOA provide many standard interfaces to enable the business mapping IT. This can improve alignment of IT with the business. SOA can utilize the exciting system to reuse IT assets. SOA which is built on the basis of some rules can also improve IT infrastructure flexibility.

SOA is composed of two major modes that are service registry model and enterprise service bus model.

2.2.1 Service Registry Model

This model consists of three roles: a service application (service requestor), a service provider (service provider), and a registration service (service registry), such as the role of relationship: Fig. 2 service registry model. [6]

A service provider: offers a service by defining its interface and implementing the service functionality

A service requestor: offers a request of the service and invoke the service.

A service registry: describes the service, broadcast it, and binds that service into its application.

2.2.2 Enterprise Service Bus Model

ESB is a new technology to integrate applications, coordinate resources, and manipulate information. ESB can provides common communication, integration, services interaction and autonomic management.ESB also uses industry standards (such as XBRL) for the services that the clients and third parties provide. It facilitates cross-platform interoperability .

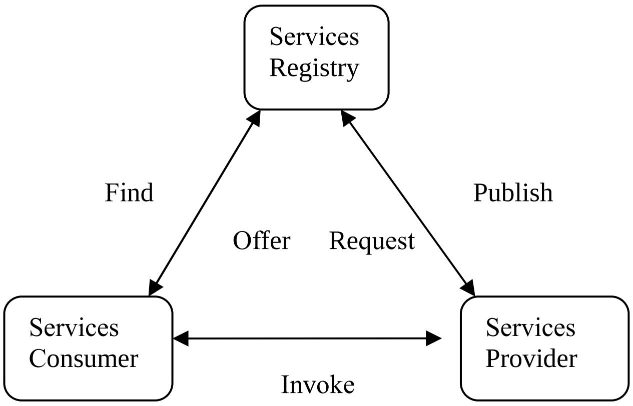

Fig. 2 service registry model

This model mainly consists of HUB, Namespace, Adapter and Service Orchestration Engine. The main function of HUB is to shape and magnify the signal received, which renews the attenuated signal to the state of being sent.Service orchestration engine which bases on standards like Extensible Business Reporting Language (XBRL) hosts long running business processes. Adapters, typically built to the Java Connector Architecture (JCA) specification, enable integration with a wide variety of enterprise applications. Namespace store a lot of standard name, is used to map the business with service.

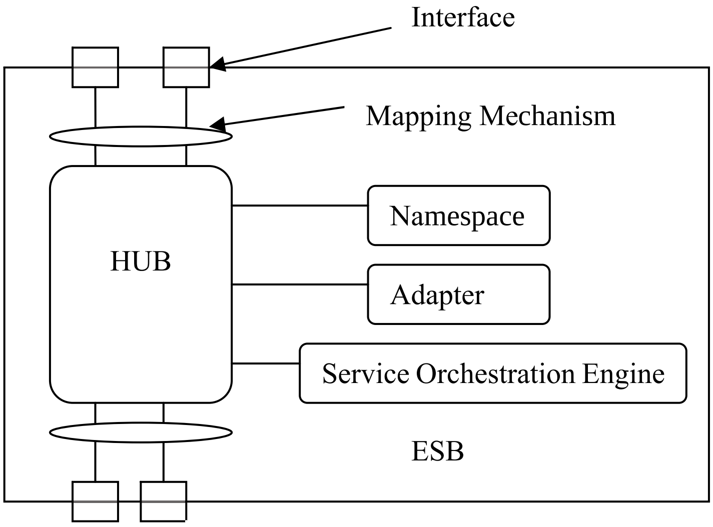

Figure3. ESB architecture

3 A SOA-based conceptual model for continuous auditing

Traditionally, the most prominent continuous auditing models are based on a database of transactions in the client's system, which have a web interface (in the client's system) for the auditor to use. [1]Due to the changing audit environment, we need a model that would be capable of running on a distributed client/server network and is based on a process of transactions in the client's system. [7]

In this model, the user interface will be abstracted form the information system. All data-flow will go through a standard interface, and then enter the management information system. Data is extracted from ESB, not from the data that has been changed in the database of the client's system.

3.1. The Continuous Auditing Components with This Model

Fig.3 depicts A SOA-based conceptual model for continuous auditing. According to Fig.3, the chief components of the continuous auditing model are follows: the various interconnected Web servers — the client's system, the auditing system, and third parties: (1) Tthe Client's System: User Interface, Management Information System, EBS and WSDL Interface ;(2) The Auditing System: Registry, The Shadow Subsystem, Auditing Module, Just-In-Time Database, Intelligent Agent and Audit Report ;(3) Third parties: Banks, Dealers, Suppliers and so on. The following paragraphs develop each of these components.

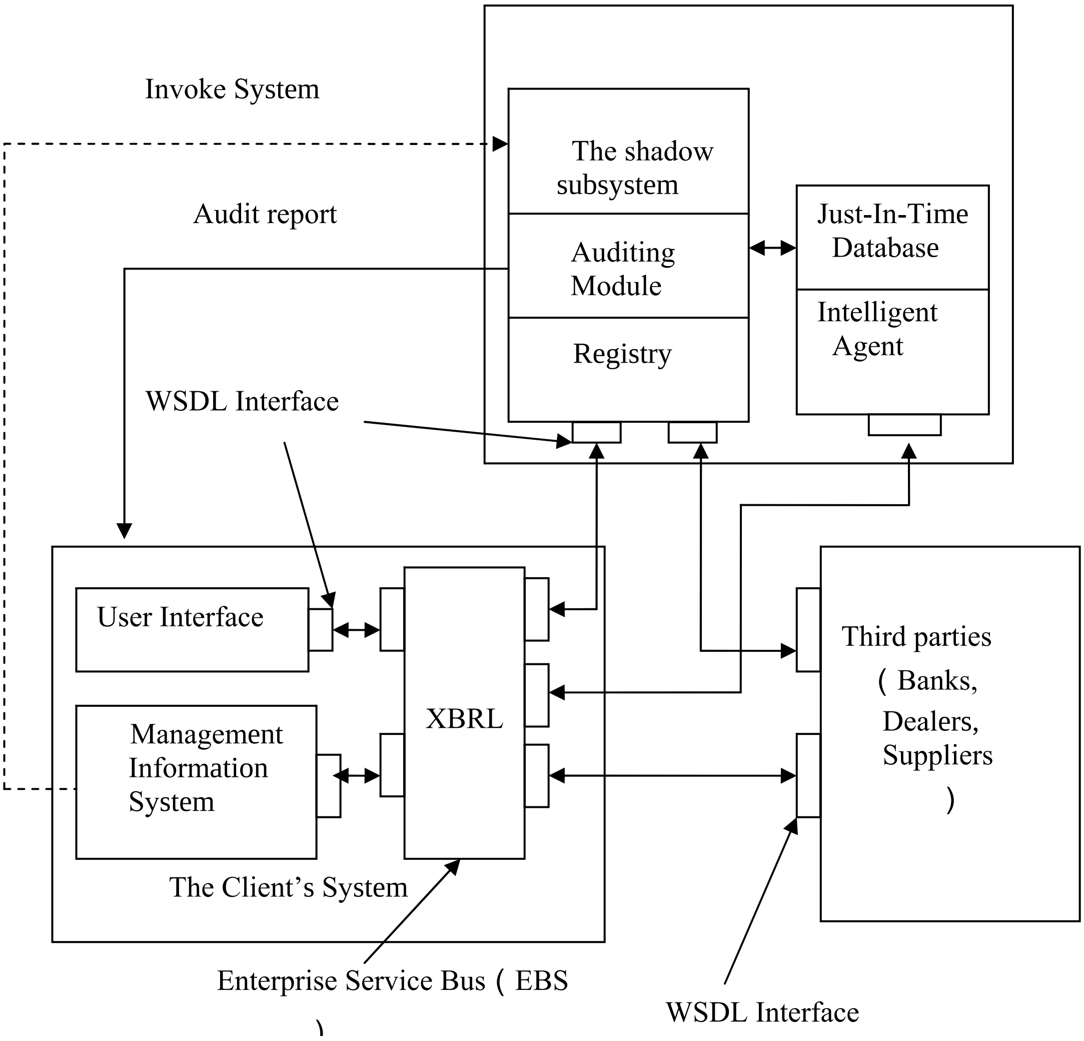

Fig. 3 A SOA-based conceptual model for continuous auditing

3.1.1. The Client's System

In the model, the client’s system can be seen as a service provider or a service consumer. As a service provider, the client’s system offers a service to define its interface and implement the service functionality. For example, the client’s system provides an audit business, and the business audit can be abstract as a service, so that any authorized user can use it.

In the client’s system, the user interface and the management information system are separated. They are linked indirectly. When the clients want to use their own system, the client’s system will be seen as a service consumer. Before the clients use their own systems, they must send a request to the auditing system. Only after obtaining the authorization from the auditing system, the user will be allowed to enter the management information system.

Enterprise service bus（EBS）embed in the client’s system . EBS is a place to provide interactive services. [6] In the enterprise service bus（EBS）, the interactive service use XBRL (eXtensible Business Reporting Language) which was created to describe business reporting information. XBRL is useful for preparing, publishing, exchanging, acquiring and analyzing accounting and business data, and it provides a standard for on-line reporting of financial information between different software applications. [4] One of the main features of XBRL is that it allows organization to by placing financial information in a format which is not proprietary to any specific software application.

WSDL is an XML document that is used to describe Web service interface: methods, parameters and service location. [8] Web service client developer needs information about the Web service to implement Web service invocation code: service location, methods, and parameters. And this information is captured in the WSDL file. [4]

In the model, each entry is connected to ESB by the WSDL interfaces. ESB is a place to provide interactive services. When the transactions between the client system and third parties happened, all data-flow about the transactions through the ESB.In the ESB, the financial information between the client system and third parties is translated into XBRL which provides a standard for on-line reporting of financial information between different software applications.

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3.1.2. The Auditing System

In the model, there is a server central registry which is embedded in the auditing system. The server central registry describes the services and broadcasts them.

The auditing system also consists of the shadow subsystem, the auditing module and audit report. The shadow subsystem invokes the management information system. The variety of the management information system will be stored in the shadow subsystem. At the same time, the relative system can check the reliability of the system compared with the rules in the shadow subsystem (possibly using continuous SYSTRUST). A reliable system has four SysTrust principles of integrity, security, availability and maintainability. [9]

·Integrity: The capability of the system to capture, store, aggregate, and report information is complete, accurate, and real-time.

·Security: The data and processes have been not compromised by unauthorized access. When violations happened, alarm must be triggered to the auditor.

·Availability: Availability is the degree to which the continuous audit report is available. Control must be implemented to insure a high degree of availability.

· Maintainability: When the system will be unavailable, the scheduled maintenance can be performed.

The auditing module is also connected to the EBS by WSDL interface. The rules based on the criteria would be employed in the auditing module. When the transactions between the client’s system and third parties happen, the auditing module will monitor the Data-flow in real time through the WSDL interfaces and extracts the data. [10] At the same time, according to the information, the auditing module invokes the relative management information system to test the transactions and generate a report which is temporary.

Just-In-Time Database is being managed in real-time and is connected to the intelligent agent. [11] Just-In-Time Database has the values of some financial information which be acquired by the intelligent agent. The values of some financial information include corporate balances sheets, cash flows, inventory and so on.

Intelligent agent is also connected to the EBS .Intelligent agent continuously monitor the database of the client system and the internet site of third parties and seek for values of some financial information. The financial information is stored in the Just-In-Time Database.

Audit Reports are available whenever a user accesses the management information system. And they are dynamically dated according to the timestamp created when the user accesses the management information system. The audit reports include three levels of assurance. Level 1 assurance relates to the reliability of the management information system. Without Level 1, no further analysis is performed. Level 2 offers an opinion on the fairness of real-time financial statements. Level 3 assurance is concerned with the covenant and agreement. [12]

3.1.3 Third Parties

Third parties consist of banks, dealers, suppliers and so on. In the model, third parties can be also seen as server provider or server user. The third parties represent the various suppliers or customers who have agreed to participate in a continuous auditing relationship with the auditor and the client. These third parties could represent vendors (suppliers of merchandise) and financial institutions (suppliers of capital), as well as customers; thus, confirmation of account balances (accounts payable, cash and accounts receivable) could be done electronically and automatically.

3.2. The Continuous Auditing Process

The conceptual model of continuous auditing makes use of SOA. It draws attentions to the need for a real-time, compressive and flexibly system. The model is not only based on a database of transactions on the client’s system, but based on a process of transactions between the client and third parties.Fig.4 shows the continuous auditing process.

The auditing module, user interface of the client’s system, intelligent agent and third parties are all connected to the Enterprise Service Bus of the auditing system through standard WSDL interface.

This model is implemented in five stages:

3.2.1 The third parties and the client register in the auditing system .Then the shadow subsystem are established.

In the first stage of the model, the third parties and the client must register in the auditing system. When the third parties and the client register, they must fill out their detailed information. Then the auditing system needs to check the authenticity of the information.

Then the auditing module will use the "mirror" method to copy information of the client’s system into the database of the shadow subsystem. It is a “pull” audit idea .In order to ensure the reliability of the client’s management information system, SysTrust is used to continuously evaluate the control risk. A reliable system has four SysTrust principles of integrity, security, availability and maintainability.

After the copied management information systems was recognized to be reliable, they will be stored up to the shadow system. These management information systems are classified according to industry and are managed by different auditor. The auditors should spend some time in being familiar with the management information system’s operate flow under the corresponding client’s assistance.

3.2.2 Before the transaction happens, the third parties and the client should submit an application to the auditing system.

In the second stage, it must be noticed that, in the client’s system, user interface and management information system are separated. They connect indirectly through ESB.

When a transaction happens, both of the clients and the third parties must submit an application to the registration center of auditing system firstly. The auditing module will audit this application information. If the application was authorized, registration center will bind the clients and the third parties together according to interrelated protocols and deliver the binding information to ESB. Then the audit module takes out the information about the client and the third parties from registration center, in order to take out the corresponding management information system from the shadow system to carry on the audit.

When the transaction happens, the clients certainly will use their own management information system. But in the client’s system, user interface and management information system are separated, so the clients can’t use their own management information system directly. They also must submit an application to the auditing system. Only after obtaining the authorization, they can enter their own management information system to carry out the related work (update and modify). At the same time, the intelligent agent module in auditing system starts to monitor the management information system, especially the database.

3.2.3 When the transaction happens, the auditing module extracts the information from the ESB. The information is checked for the contract.

The third stage of the implementation model is the heart of the continuous audit environment.

When the transaction is taking place, the transaction data is transformed into XBRL in the ESB. There are two reasons for transaction data need to be transformed into XBRL. On the one hand ,now many systems are heterogeneous ，this creates communication barriers. On the other hand, the commercial language used by both sides in a deal are various. Due to no uniform standard, this would also create obstacles to the communication of the two sides. In order to solve this problem, ESB is integrated into the client’s system. XRBL is used for mutual interaction in the ESB. After the transaction data was transformed into unified XRBL, it will be stored into the namespace of the ESB.

In the data transmission process, the auditing module comprehensively gets real-time data from the ESB, not like most of the continuous auditing just monitors the essential data, which can’t ensure the comprehensiveness of audit. Sometimes, the non-essential data also will cause serious results. If only monitors the essential data, some slight mistakes may be difficult to be detected, which will result in disastrous consequences.

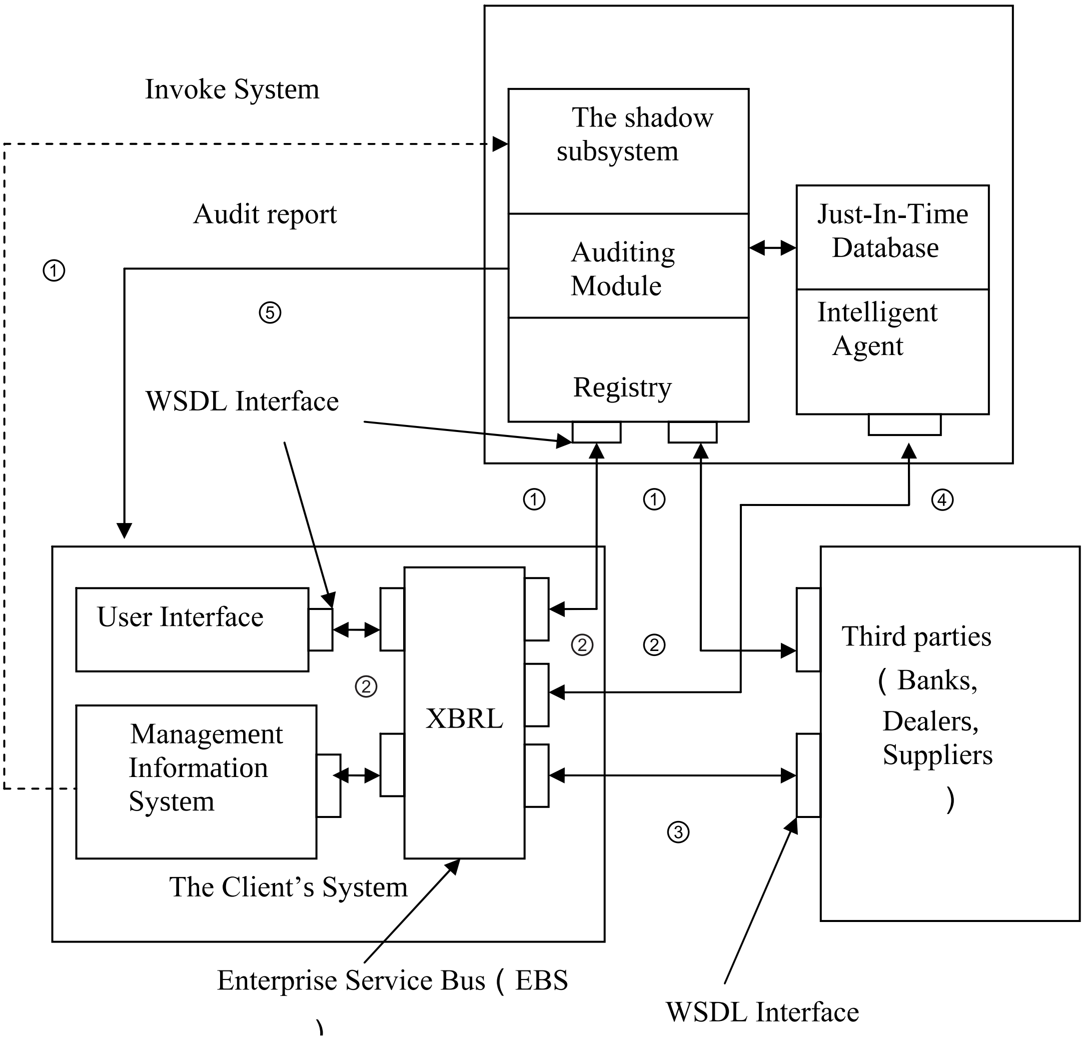

Fig. 4 The Continuous Auditing Process

Then, according to the transaction which is carrying on, the auditing module invoke the corresponding management information system in the shadow system database to simulate the client’s management information system. Finally, the auditing module combines corresponding accounting standards and produce a temporary audit report.

3.2.4 The intelligent agent continuously monitors the database of the client’s system and the internet site of third parties.

In the forth stage of the implementation model, the intelligent agent continuously monitors the database of the client's system and the internet site of third parties.

The Intelligent agent of the auditing system retrive and display the client's real-time accounting balances. The intelligent agent can directly access the database of the client's management information system and extracts the information relevant to the transaction. The information will be stored in the Just-In-Time Database.

At the same time, the intelligent agent is linking the auditing system to various internet sites of third parties. It seeks for values of some financial information. The financial information which is relevant to the transaction between the client and the third parities includes accounts payable, corporate balance sheets, cash and accounts receivable. The financial information which is continuously updated to market is stored in the Just-In-Time Database. When the temporary report was generated in the third stage of the implementation model, the audit module can acquire the values of some financial information from Just-In-Time Database and check the report.

3.2.5 An Exceptive report is generated and displayed to the client.

In the final stage of the implementation model, an audit report is automatically generated and display to the client.

When exceptional case happened, the audit module can make the response rapidly. The audit module will produce an audit report in the first time and send it to the auditing system.

As mentioned earlier, there are three levels of assurance in the audit report: [12]

·level 1: An assurance relevant to the reliability of the client's system;

·level 2: An assurance regarding the fairness of real-time financial statements;

· level 3: An assurance is concerned with the covenant and agreement.

If there are no exceptions at any of the levels, an unqualified report is given. The auditors provided an audit, their goals is to find exceptions.

A level 2 report assumes level 1 assurance, and A level 3 report assumes assurance at both level 1and 2 Without Level 1, no further analysis is performed. If the reliability of the client's system is in question, the information which is generated from the system should be viewed as unreliable. The further analysis will become no sense. Once notified the exception, the auditor should determine the cause of the exception and take steps to remedy the problem.

The Intelligent agent tigger level 2 exceptions as it contiuously monitor the client's transactions and processes.The causes of the exceptions mainly are that the client's transactions and processes don't meet the auditing standards. Once notified the exception, the auditor should send the exception to the client via email.

Level 3 assurance is concerned with the covenant and agreement. The covenant and agreement must be agreed upon by the client, the audit firm and relevant third parties. Level 3 exception reports are generated to notify the auditor and the third parties of a technical violation.

4 Evaluation of the Model

4.1. Benefits

The continuous auditing model based on SOA has several notable characteristics: 1) the user interface is separated from the system. 2) It provides a standard WSDL interface with enterprise service bus. In the ESB, using eXtensible Markup Language (XBRL) completes the interaction between the data. 3) The client systems will be saved in the shadow subsystems by using a "mirror" method. Then we can detect the real-time data roundly and audit the data by invoking the relative systems. So the model can help to solve some problems which Current continuous auditing study faces.

4.1.2. Accuracy

There is an assumption to all researches of continuous auditing. The assumption is that, the clients can use their own accounting systems actively and input accurate data without optional modification. But the fact is different. Some illegal data would be not entered into the system (Some clients are doing a secret accounts for themselves), or after the transaction their data is revised again. Once the clients to do so, we will not ensure the accuracy of the information and the result will be meaningless. In this model, the user interface is separated from the system, and the clients need to register and apply before using their own systems. Only after obtaining the authorization of the auditing system, they can use their systems. Thus, users can not modify data casually, so that we can ensure the accuracy of the original data. In addition, there is a Just-In-Time Database which is being managed in real-time. The values of some financial information are stored in the Just-In-Time Database. This can enhances the accuracy of the audit report.

4.1.2. Real time and Comprehensiveness

Some continuous auditing systems adopt a "CPAS-like" design which is prevalent. But there is a problem of this design that the synchronization is not very good. It monitors some key data and compares extracted data with standard data, but it only works roundly when there will be some exceptions. That means we can’t monitor and analyze real-time information roundly. In the model, there is an ESB in the client system. When the transactions between the client’s system and third parties happened, all data-flow of the transactions through the ESB.The auditing module is also connected to the EBS by WSDL interface. The auditing module can continuously monitors the business data-flow in real-time .It can get real-time data through ESB, not the data that has been changed in the database of the client system. This can ensure the auditing process is Real-time and comprehensive.

4.1.3. Flexibility

Nowadays most continuous auditing systems can just be applied to one industry or some large-scale enterprises, so the flexibility is poor. In this model, the WSDL interfaces connect each entry to ESB. The financial information between the client system and third parties is translated into XBRL which provides a standard for on-line reporting of financial information between different software applications. One of the main features of XBRL is that it allows organization to prepare one set of financial information in a format which is not proprietary to any specific software application. In the future any continuous auditing system which uses XBRL can access to data on any software platform and run any software in any country. This can improve the flexibility of the auditing process.

4.2. Drawbacks

Although the model offers some benefits for the research of continuous auditing, it also has some drawbacks.

In the model, the proposed shadow subsystem will bring two problems: 1) when the auditing system audits a client systems, it needs to invoke the client’s management information systems. The performance of the auditing system must be high. The shadow subsystem needs much large storage space.2) in the model, the auditor must require very high levels of trust and commitment. The auditing system can not only directly access to the client system, but also invokes management information systems of the client system and tests it.

Another hurdle is the cost. It will cost more money to establish the Shadow subsystem, ESB and uniform standards. How share the cost between the auditor and the clients, which is a problem. Especially, ESB must be installed in every client system ,it need to pay more money .The cost will be high for the clients.

The continuous auditing model based on SOA is for online information systems and the application scope is rather narrow. We will face new risks on Internet,such as secure transmission,reliable system.We don’t disscuss much detail in the paper.We will discuss it in the future research and we also hope others have good issues about it.

5. Summary and Conclusion

This study proposes a continuous auditing model that introduces SOA. The main advantage of SOA, as follows: IT provide better and faster business value, rapid response capabilities, and reuse. We discuss SOA model can be introduced to facilitate continuous auditing for the next generation of accounting systems. The components of the model, including EBS, WSDL Interface, and the shadow subsystem, are described, and XBRL is then discussed. After that, a continuous auditing model based on SOA is proposed, which resides in the auditor’s accounting system.

The whole work flow of the SOA-based continuous auditing system as follows: The audit module、user interface of client system and the third parties are all connected to the Enterprise Service Bus of the auditing system through standard WSDL interface. First, the third party and client must register in the auditing system. Then the audit module will use the "mirror" method to copy information of client system into the database of the shadow subsystem. In order to ensure the reliability of the client’s management information system, SysTrust is used to continuously evaluate the control risk. Before clients enter their own information management system or make transaction with the third party on-line, both of them must hand in the application to the auditing system. Then the auditing system public the description of the service and bind them according to the protocol. When a transaction happened, the business data are transformed into XBRL in the EBS. At the same time, the audit module continuously monitors the business data-flow and gets the data in real-time. [13] Then the audit module assigns out the corresponding management information system from the database of shadow system to carry on the audit. When exceptional case happened, the audit module can make the response rapidly. The audit module will produce an audit report in the first time and send it to the auditing system.

The continuing audit model can solve a series of problems, such as the accuracy of collected data, real time, comprehension and flexibility.

In the model, there are several hurdles that need to be overcome. One hurdles is controlled Access. In the continuous auditing model, the users must obtain auditing system's authorization, then they can access to their own management information system. The clients are uneasy to enter their system. But the auditor can acquire very high levels of trust and commitment. The auditing system can not only directly access to the client system, but also invokes management information systems of the client system and tests it. This will cause their dissatisfaction. Another hurdle is cost. It will cost more money to establish the Shadow subsystem, ESB and uniform standards. How share the cost between the audit system and the client system that is a problem. [14]

However, with the increasing popularity of the network and the development of information technology, the accounting information system in the future will be designed in XML format. We can predict that if we use the theory of SOA in the field of continuous audit, we will gain great value from it.

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