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Service Recovery Technology

P.L.Ramesh

HOD, Dept of Computer Sci., KBN College,Vijayawada, A.P, India

Abstract— Service recovery technology is an important constituent part of the emergency response technologies. The service recovery goal is to build a technology system of service recovery focusing on the survival of information system services. By analyzing the relationship between service and data, we present a service recovery mechanism by recovering service's data. We introduce a third party service monitor to monitor the state changes of the service, design the data recovery model, and give an example of quick data recovery. At Last we present a prototype system of service recovery; the experimental results toward the prototype system show that the mechanism which designed by us can greatly improve the service recovery efficiency and it can meet the timeliness requirements of the information service.

Keywords--Service recovery, third party service monitor, data recovery model, Prototype system

I. INTRODUCTION

Service recovery technology is an important constituent part of the emergency response technologies. Since 1988, the U.S. Computer Incident Response Coordination Center (CERTTCC) and Computer Incident Advisory Group set up many emergency response groups had been set up, and they had played an important role in the procedure of handling the network security events. These researches institutions regard the emergency response as an important part of the PDR security model. The emergency response technologies mainly include intrusion tracing, traps, collaboration processing, trusted recovery, disaster control, adaptive response, etc. And the CERT ICC also does much research on the technology of network survivability, which mainly includes attack identification, attack tolerance, attack response and system recovery from failure.

The service recovery goal is to build a technology system of service recovery focusing on the survival of information system services. Based on Service Oriented Architecture (SOA) [1], the technology system considers the commonness and characteristics of the service recovery processing, and modularizes the processing procedure. Then, it selects optimized recovery strategies in accordance with the properties of security incidents and the composition of the service. Through effective service coordination mechanism, it can achieve the objective that the minimum resource cost and the shortest response time during service recovery.

Data recovery is the basis and prerequisite for service recovery, and the traditional data backup and recovery technology has been used to solve some problems in the service recovery. In this paper, we intend to design a service recovery mechanism by recovering service's data.

II. RESEARCH BACKGROUND AND RELATED WORKS

As the organization of the different services in the service-oriented architecture is loose, while the deployment of them is flexibility, the service recovery mechanism built on the Service Oriented Architecture (SOA) will be beneficial to the integration and use of various technologies. Below figure shows the basic composition and calling relationship for the information system recovery

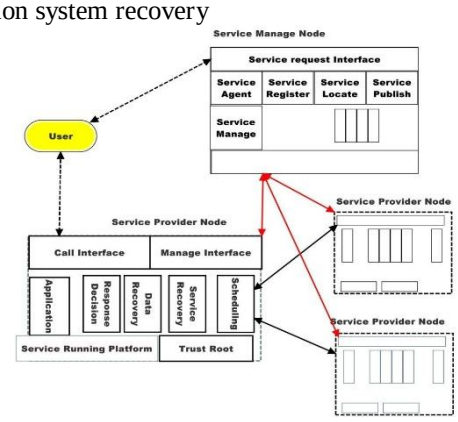

Figure: The basic structure of system recovery

The existing service recovery technologies generally concern the traditional service concepts, for example, the specific network service or application service. As in the context of network environment, many technologies have been proposed to enhance the survivability and dependability of the service, such as the load balancing and connection switching, IP redirection technology, dynamic DNS technology, TCP transfer technology and backup system switchover technology. And the researchers have proposed the system service switch protection method based on threshold cryptogram/secret sharing, and the method can be

used on the CA, certification services, key exchange services, file services, DNS services, data services and routing services. Meanwhile, the researchers also built some forms of service recovery application systems by means of monitoring, acceptance testing and redundancy, such as the web server systems and database systems.

About the reactively service recover systems; some researchers have studied many technologies to recover the systems fast and efficiently. These works do not consider by zonetime faults or security-compromised components and also do not rely on redundancy to ensure that the system stays available during recoveries, the main problems addressed in the present work. Huang et all advocates the execution of some kind of recovery action after a fault is detected. And the recovery oriented computing project proposed a set of methods to improve the recovery and reduce the time cost and other related techniques to detect the service failures, restart the minimum set of system components, undo some operator configuration errors and put the entire system state back to the modification operation. Joshi et al do some works to diagnose system faults through several monitors and evaluate which is the best set of recovery actions that must be taken in order to recover the system as fast as possible.

III. THE RELATIONSHIP BETWEEN SERVICE AND DATA

The service is mainly made up of the service body and the business information supporting service running; and the service body mainly consists of the service application and the function modules, also, the business information mainly consists of the static information and dynamic information. Moreover, in the sight of the data organization, the service body and the business information can all be regarded as data.

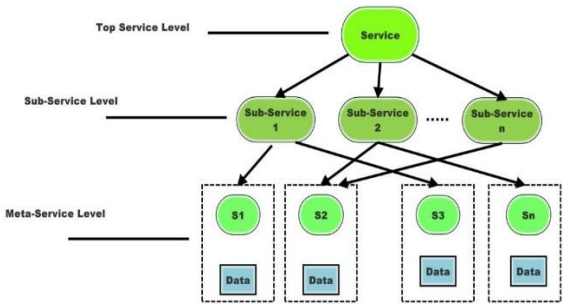

Figure: The hierarchical relationship between service and data

As is shown in Figure, the service is made up of a series of sub-service. The hierarchical levels include top service level, sub-service level and meta-service level. And the Sl, S2,...,Sn denotes a series of meta services. The so-called meta-service is the smallest unit of service that cannot be divided, and it can independently perform the functions.

IV. ARCHITECTURE AND DETAILS

Architecture Design

The main idea of architecture design is that once the service is complete failure, the system can achieve the object of efficient and quickly reconstructing the entire service. Based on recovering the service's data, we can recover the service bodies and the corresponding data. So we propose a service recovery mechanism that recovering the service's data and restarting the service. In other words, we divide the service recovery process into two phases; firstly, we recovery the service's data through quick data recovery technology; secondly, we restart the service to achieve the purpose of rerunning the service.

In this architecture, we introduce a third party service monitor to monitor the state changes of the service, delivery service recovery orders and control the service rerunning process. The monitor is completely independent from the application service. The communication and information transferring between the monitor and service is handled by specific interface. The architecture is shown in below figure,

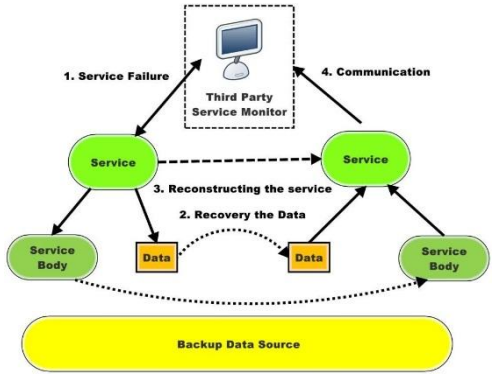

Figure: The Architecture of Service Recovery by Data Recovery

Data Recovery Design

We can divide the recovery operations into two types, that is, the accurate data recovery and selective data recovery, according to the user's participation. The so-called accurate data recovery means that recovering all data modification operations in a certain period. Usually after a certain data backup version; and the selective data recovery means that the users query and browse the data modification operation sets, and they choose some specific modification operations to recovery the data.

In order to record the data modification operations, the system must save the data modification logs and backup the logs to handling the accurate data recovery. The data recovery design model is shown in the figure. Once you need do accurate data recovery and selective data recovery, there are some steps needed to do.

The users determine the data operations sets by the data inquiry and browsing tools;

According to the corresponding record logs, the system generates data recovery request;

send the recovery request to the agent application of the data server;

The kernel recovery module receives the recovery request;

The kernel recovery module processes the corresponding data backup blocks;

Upon the supporting by the file system, the kernel recovery module completes the "replay" operation to recovery, the data state to the time of the specific modification operations.

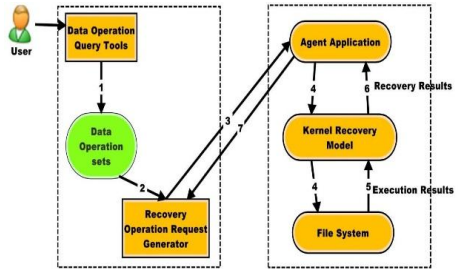

Figure: The Data Recovery Design Model

V. SYSTEM IMPLEMENTATION AND EXPRIMENT RESULTS

System Implementation

We have implemented a prototype service recovery system on the FAT32 file system under the Windows XP platform. The basic architecture of prototype system is designed by the following steps:

Real-time monitoring the file modification operation while the service is running and the monitoring process is implemented by the file system filter driver;

Backup the data according the current file modification operation;

Record the last modified time of the data backup blocks;

record the disk storage space information of the data backup blocks, also the disk storage space information is referred as the disk formatting partition information, which include the start cluster number of the blocks, the end cluster number of the blocks and the block size;

The system generates many data backup blocks according to the each file modification operation made by the operating system processes and user processes:

The data backup blocks together form the sets of file backup pieces;

When the information system service is out of order, the users need recovery the file state to a certain time, which is referred as the time Tt;

The users select some certain data backup blocks in the data sets according to the Tt;

Recovering the file by reconstructing the selected data blocks;

The system implementation architecture is shown in below figure,

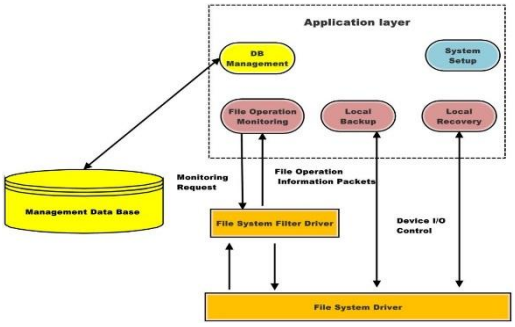

Figure: The System Implementation Architecture

Text Platform Configuration

The main hardware and software configurations of computer for testing are listed following:

Platform: Personal computer

CPU: Intel(R) Pentium(R) 4 CPU 2.8GHz

RAM:2.0G

Hard disk: 320G

Operating system: Microsoft windows XP(5. 1 .2600) Service Pack 2

File System: FAT32

Data Recovery Performance Results

Compared to the traditional data recovery technology, the method designed by us can greatly improve the data recovery efficiency. We select a 300MB data file, a 500MB data file and a directory with 600 files for the comparison test. The method is that we compare the recovery time between the traditional way of directory disk copy and the way designed in this paper, and the test results are shown below table.

Test Objects	Data Recovery Methods	
	Direct Disk Copy (s)	Method Designed
400 MB Data File	7	0.5
500 MB Data File	10	0.6
A Directory	25	6

We can see that data recovery mechanism designed in this paper can greatly improve the data recovery efficiency. Also, the service recovery efficiency has been improved greatly. Generally speaking, the time of the data recovery can be limited on the second level, and the service restarting time is merely several seconds. So, the entire service recovery process can be complemented in several seconds, which can greatly enhance the dependability and survivability of the information service.

VI. REFERENCES

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