Service Behavior Trustworthiness Management

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Abstract. As we move to a world where our information assets reside on the Web, the issue of service trust adds a new set of dimensions to the age-old problem of belief and trust in content. The ability to measure and evaluate service behavior trustworthiness becomes increasingly important. This paper presents a service behavior trustworthiness management system. This system could help third parties to develop and implement a framework for monitoring and managing the trustworthiness of service behavior. An overview, relate concepts and methods of the system are proposed in this paper. We also discuss a case study of this system and potential practical value of the proposed system in e-bank applications.

1   Introduction

For more than one hundred thousand years, if a user wanted to get a service, he should find a service provider. How can he trust this service provider? If he didn't know him directly, he had to know him through the social network. This social network is formed by lots of persons or organizations; we call them entities. If the user trusts this channel, he can trust the service provider, and the service provider provides service to the user.

Now we are in the information technology age. Users also need to find trustworthy service providers. It is the same as for one hundred thousand years ago. But there is the difference that in the information technology based applications every possible entity has an agent. In the trust channel lots of agents attend. A user not only needs to evaluate the entity channel, he also needs to evaluate the agent channel. His job is complicated and huge. But fortunately, he can use information technology to measure, evaluate and certify the service provider's behavior.

2   Related Concept

There are two definitions of **Trust**.
    Trust is the behavior X exhibits if he or she believes that Y will behave in X's best interest and not harm X. [1]

In this definition the trust is a behavior, which is the behavior X exhibits. The condition is: X believes that Y will behave in X's best interest and not harm X. But here is a problem. How could X confirm that Y will behave in X's best interest or not harm X. We think X should know Y over time or get information about Y from some way. This means that X should know Y's trustworthiness value.

Trust can be defined as user's thoughts, feelings, emotions, or behaviors that occur when they feel that an agent can be relied upon to act in their best interest when they give up direct control. [1]

This definition tells us that trust behavior happens when a trustor gives up direct control. If a trustor can control, the trustor doesn't need the trustee. But if trustor gives up direct control, he should know the trustworthiness value.

Trust is always the basis of a society. We trust a pilot, and we can take an airplane. IT service becomes an important means to provide service. IT service has evolved from closed and centralized environments to open and distributed environments.

Users enjoy an IT service without ownership of the system, so control of an IT service has moved from users to software service providers. Customers give up direct control of an IT service, so they need know the service providers trustworthiness.

IT service behavior trustworthiness adds new dimensions to the old age problem of trustworthiness in traditional services. The need for IT service behavior trustworthiness management has emerged.

What is IT Service behavior trustworthiness management? Now we give an explanation word by word.

IT Service means a service based on the use of information technology.

Behavior is the way in which an IT service functions or operates. We can also think that behavior is a service providers use software and systems to provide a special act or operates; the purpose is to complement a service.

Trustworthiness of IT service is the demonstrated ability of the service provider to deliver a correct service while adhering to a set of stated (and commonly agreed) principles.

Management includes specification, monitoring, measurement and evaluation of the IT service behavior trustworthiness.

Why do we need behavior? What is the relationship between service and behavior? We can get some elicitation from Fractals. Fractals are typically self-similar patterns. Fractal things can be split into parts, each of which is a reduced-size copy of the whole. Service also can be seen as a recursion of subservices and behavior. Our goal is to find the patterns of service that can be monitored, measured, and evaluated. Trustworthiness can be measured or be evaluated on the pattern of service behavior rather than on the attributes in the quality model. For example, Mail system is system. Mail service is service. Service Behavior is sending mails, receive mails, deleting mails and so on. Service providers are Google Company, yahoo, Hotmail and so on. Mail systems have different service behaviors. Service behavior depends on time. Some Service provider read your mails or deleted your mails. Some service providers do not respond. So customers enjoy service behavior, he cares for service behavior

trustworthiness. The mail system has a send function and responds quickly. But the service provider didn't operate; that means service behavior has low trustworthiness. The mail system can delete mails and read mails. But the service provider did this. This means service behavior has low trustworthiness.

3   Related Work

There is some similar concepts; we will show they are different. They are dependability, reliability, safety, security, privacy, and quality.

Dependability to describe the availability performance and its influencing factors: reliability performance, maintainability performance and maintainability support performance. [2]

IEC 61907 defines dependability as availability performance and it influencing factors.

Reliability: a degree to which a system, product or component performs specified functions under specified conditions for a specified period of time. [3]

Security: degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization. [3]

Safety: Freedom from unacceptable risk. [4]

From the definitions of dependability, reliability, security and safety, we know these terms are system properties whereas trustworthiness involves properties of the service provider. Trustworthiness is also related to moral values. These terms are only related to technical issues.

Privacy: The right of individuals to control or influence what information related to them may be collected and stored and by whom and to whom that information may be disclosed. [5]

The definition of privacy is from ISO 7498. Privacy is also important for trustworthiness. Privacy does not cover trustworthiness, but it is included in the trustworthiness concept.

Quality: Degree to which a set of inherent characteristics (3.5.1) fulfills requirements (3.1.2). [6]

Finally we can compare trustworthiness with quality. We look at the definition of quality from ISO 9000. The definition of quality is concerned with quality in general. Quality is related to the current version of software and system, so it is static. Trustworthiness is related to accumulate historical records, so it is dynamic.

It is clear that trustworthiness of IT service behavior is a dynamic property. It changes over time. Trustworthiness is about the ability of the IT service provider to deliver a specified service. Each time the service is delivered the trustworthiness may change. But trustworthiness is also about not lying, cheating, stealing, and so on. This is related to moral values. Therefore trustworthiness is completely different from the other terms.

4   Monitor

There are two kinds of monitoring methods to collect the trustworthiness data. If an IT service wants to prove it is trustworthy, it needs to give a standard interface to be monitored. This is like interior monitoring methods. The other way is exterior on time. Testers like customers to collect the trustworthiness data while using the IT service. In this a monitoring method; there are three roles: IT services provider, monitor, and trusted third party.

For the interior monitoring method, we have three ways to implement the monitor. The first one uses trusted computing techniques to construct a trusted execution environment. Any untrusted behavior is detected and reported to a trusted third party. It is up to the trusted third party to evaluate and verify the trustworthiness of the IT service. The second way is to analyze and audit the service log. In this approach, the internal implementation of the IT service is a black box. And through analyzing and auditing the service behavior recorded on the log, the trustworthiness of the IT service can be calculated. The third way is to hook the service behavior in which some specified API of the service should be open to an external monitoring entity. When the above APIs are invoked by the service provider, they are also bypassed and recorded to the trusted third party.

Here further analysis, e.g. finite state machine based behavior logical analysis, are done.

5   Measure

When we get trustworthiness data, the next job is to measure service behavior trustworthiness value. We need to complete three steps to measure service behavior trustworthiness values. Firstly, we should build a standard service behavior database. Secondly, we should formalize service behavior. Thirdly, we should compare standard behavior and real behavior obtained from the monitoring process. A standard service behavior database is the core of measuring service behavior trustworthiness. The database will be very huge, but it should be a simple Pattern. This pattern is decided by the formal language to describe service behavior. For the third step, comparing standard behavior and real behavior, our doctoral student Qiang Han have a public paper, "A Data Mining Based Measurement Method for Software Trustworthiness" [7]. In this paper presents a method that applies a software trustworthiness measure to the dynamic behavior feature datasets generated at software running time compared with the static attribute feature datasets generated at software testing time in order to make recommendations for users at service selection time under the environment of SaaS.

Trustworthy behavior will have some characteristics. If we want to find its nature pattern, we should abstract it from some example real trustworthy behavior. Below are the ten kinds of trustworthy behavior; their relationships are as shown in the Figure 1.

1) **Real/Reality:** Service provider realizes **real-name** system
2) **Claims:** Service provider **claims** the behavior of the service offered
3) **Feedback:** Each request has a **response**, even if it is unreasonable demand
4) **Compensation:** If evidence is enough, the service provider would **pay for its fault**
5) **Complaints:** Users have the opportunity to express their **views**
6) **Privacy:** Sensitive information is well **protected**
7) **Traceable:** Each behavior is recorded and can be **traced**
8) **Evaluate:** Service provider has basic ability to **evaluate** the trustworthiness of **partners**
9) **Consistence:** Service provider is able to prove the **consistence** between the actual service and the claimed service behavior
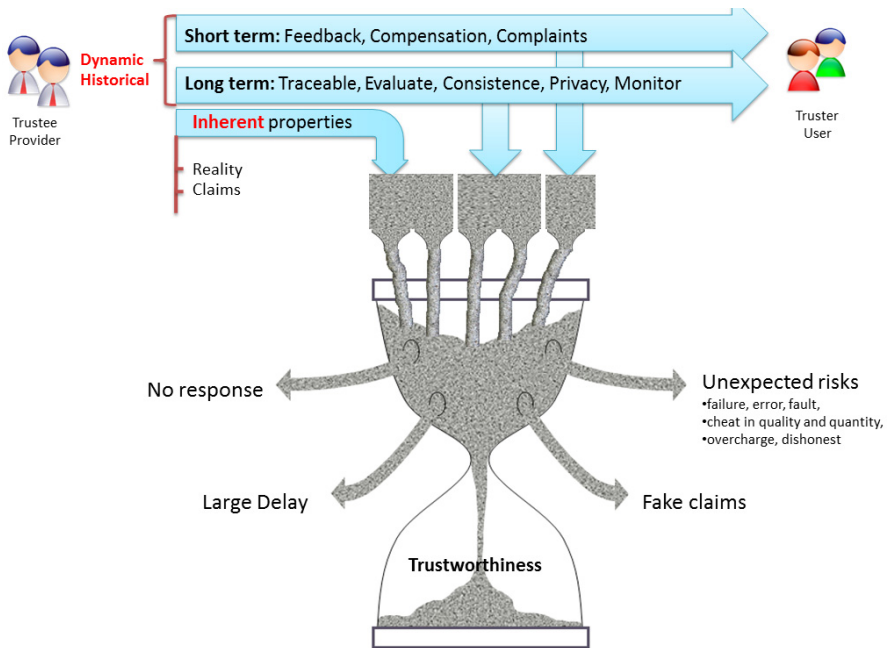10) **Monitor:** Service provider does indeed design **monitoring** interfaces

Fig. 1. The relationship of ten kinds of trustworthy behavior

6   Evaluate

IT service behavior trustworthiness evaluation is the practice part of SBTM. Different persons have different risk acceptance level. We can give an evaluation process for different persons. That means the same trustworthiness value will cause different trust degree. We will public another paper about this topic.

7 Scenario: e-Bank

Now we will describe a scenario of a Service Behavior Trustworthiness Management application. Bob want to find an e-bank to management his money. There are lots of e-banks, not only one. Bob should choose one e-bank to manage his money. Which e-bank can he trust? Somebody or some organization should tell him. This organization should have the ability to measure all the e-banks by using information technology. This organization should have a monitor system, which can collect trustworthy interior or exterior data from of service system. The e-bank trustworthiness value will change over time. The custom is depending on the value to choose the e-bank. The customers chose the e-bank with highest trustworthiness value. This trend forces other e-banks to get trustworthiness values. If they want to get this trustworthy value, they need to open the required interface to the monitor organization. This system running fee will be paid by customers and service provider. SBTM make the peoples life easy and simple.

8 Conclusion

Trust is the basis of society. IT service becomes an important means to provide service. This paper presents a system, which is service behavior trustworthiness management. This system could help third parties to develop and implement a framework for monitoring and managing the trustworthiness of service behavior. The overview, related concepts and methods of the system are proposed in this paper. We also discuss a case study of this system and the potential practical value of the proposed system in e-bank applications.

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