ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 2, February 2013

The Sliding Window Method: An Environment To Evaluate User Behavior Trust In Cloud Technology

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***Abstract: -*Trust is one of the most concerned obstacles for the adoption and growth of cloud computing. Although several solutions have been proposed recently in managing trust feedbacks in cloud enviornemts, how to determine the credibility of trust feedback in a cloud environments is difficult problem due to unpredictable numbers of cloud services consumers and highly dynamic nature of cloud environments. In the cloud computing, due to users directly use and operate the software and OS, and even the basic programming environment and network infrastructure which provided by the cloud service providers, so the impact and destruction of the software and hardware cloud resources in cloud computing are worse than the current Internet users who use it to share resources. Therefore, that whether user behavior is trusted, how to evaluate user behavior trust is an important research content in cloud computing. In this paper we mainly discusses evaluation importance of user behavior trust and evaluation strategy, in the cloud computing, including trust object analysis, principle in evaluating user behavior trust, the basic idea of evaluating user behavior trust, evaluation strategy of behavior trust for each access, and long acsess. In trust evaluation, behavior evidence is the fundamental basis of behavior evaluation. But at present, researchers almost directly use node behavior results or use a third party's evaluation results to synthesize it, not study the original evidence of node behavior and ignore an analysis of node behavior history, which limit the reliability, rationality and sharing of trust. Drawing on the characteristics of social trust and trust requirement, we first put forward basic criteria about evaluating node behavior trust, and then bring forward a kind of evaluation mechanism on node behavior trust based on sliding window model.**

***Keyword: - Node Behavior Trust, Trust Evaluation, Evaluation Principles, Sliding Window*.**

I. INTRODUCTION

1. Basic Criteria On Evaluating Node Behavior Trust

A. Basic Criteria on the Function of the Expiration Behavior in Evaluating can be Approximated as a Strange Node.

The record of trust was logged before a long time, meanwhile the record has scaled out the time period which is certain and effective. So this value of the trust evaluation has been natural attenuation in the process of evaluation. This attenuation is not the result of the abehavior of nodes, but the natural attenuation over time. Summary, this value can be approximated as a trust value which has been never affiliated with a strange node.

B. Basic Criteria on that the Function of the EffectiveBehavior in Evaluating is in Direct Proportion to Time and Abnormal Behavior

There is an important interaction between the time of node communication and the evaluative result of the behavioral trust. The more recent behaviors will play a more important role in trust evaluation, and as the attenuation, the more long-term behavior has the smaller influence on the trust evaluation. Meanwhile, the evaluative result of the behavioral trust also has

an important relationship with each behavior. The more conventional behavior has the smaller influence on trust evaluation, and the more abnormal behavior will play a more important role in trust evaluation.

C. Basic Criteria on that the Credibility of Trust Evaluation is in Proportion to the Size of the Node Behavior

The behavior trust evaluation is constantly accumulating formed, that is based on the historical behavior

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performance of a large number of nodes. So its results are stable and representative of the "personality characteristics". However, if the number of intercourse is not enough large, then the result is unstable and not representative. Therefore, the trust evaluation of node behavior should be based on behavior intercourse of a large number of nodes. As such, we need to determine the minimum number of contacts that based on the actual evaluation requirements and the granularity size of evaluation, to ensure trust in the stability and the representation.

D. The Prevention of Fraud Risk-- Basic Criteria on "Slow Rise"

Trust and risk is a pair of contradictory unity, on the basis of trust, need to guard against the risk, namely, in trust evaluation, the trust fraud will been prevented "Slow rise" is a strategy that is to prevent the nodes with a small number of intercourses, immediate access to a high trust value, only through a large number of the intercourse, slowly to achieve high trust in the trust evaluation. This is an evaluation strategy to prevent cheating beforehand.

E. The Punishment of Risk Cheating-- Basic Criteria on "Rapid Decline"

The punishment of non-trust is a very important indicator to trust evaluation. "Rapid decline" is a punishment strategy of non-trust, is a kind of evaluation measure on afterwards to punish non-trust behavior. The overall trust value of node that was rated mistrustful in any time will be quickly reduced. The intensity of the reduced trust value is far greater than that gradually increased; by the way, it can prompt the node to reduce fraud.

II. SLIDING WINDOW-BASED TRUST EVALUATION MODEL FOR NODE BEHAVIOR TRUST

A. The Main Idea

Based on the basic criteria of the evaluation, we decide the sliding window to carry out the evaluation of node behavior trust. In that, the trust value not only with the timerelated, but also with *m* the number of actual contacts about nodes in the window, and the window's size which control evaluation scale. And also the enough (sliding window size) original evidences were retained, in order to share the trust information or reevaluate the trust for different needs. The movement of window is involved with two factors: the time *t* and the new node intercourse. As time goes by, the window moves forward, and then some overdue trust records gradually out of the window. In this way, we can ensure that the overall trust value of the node will be decreased when the node doesn't exchange information with others in a long time. When a new intercourse comes, and the window size is fixed, so the record which has the farthest time from the current and wasn't overdue was "squeezed out" thought the window's movement. In this way, we can achieve the goal by selecting the model factors: the trust effective time period, the window size etc. and updating the window content, it not only effectively control the nodes of deception and punish fraud.

B. Node Behavior Trust Evaluation Model

1)Node Behavior Trust Evaluation Based on Sliding Window

The long-term node behavior evaluation model based on sliding window is a quintuple.:- *(Valid _ Tim* , min *N* , max *N, i tim ,m)*

They are:

1)Trust effective time span *Valid_Tim*: When the time difference between current time and the trust record's corresponding time exceeds *Valid_Tim* , this trust record is a overdue record.

2)In effective time period, the minimum number of effective intercourse *Nmin* . This parameter is mainly to prevent the trust deception, when the number of node intercourse below *Nmin* , calculating the trust value in practice, we use the slow rise method to accumulate it, namely, calculate the trust as *Nmin* .

3)In effective time period, the maximum number of retained intercourse *Nmax* . This parameter is mainly to show scalability of the mechanism on behavior trust evaluation. When the number of intercourse exceeds the value, the farthest-time trust record was squeezed out by the new trust record. In this way, we can ensure the scalability of the trust evaluation.

4)In the effective time period, the actual time of intercourse *timi* . It is used to record the time of the ith intercourse. It shows that different time behavior plays a different role in the trust evaluation.

5)In the effective time period, the actual number of intercourse *m* .This parameter can be used to evaluate the actual behavior trust of node in the window. Due to that the final trust evaluation of the node behavior dynamically updated, based on the evaluative result of longterm intercourse. So we can take the process of trust evaluation on node behavior for the sliding window model that is continuous slip, as shown in Figure 1. The two windows share a trailing edge, the left window is used to control the trust-building, and the right window is used to control the

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scalability of the sliding window. They are respectively referred to as the trust-building window *Wset* (small window) and the scalable window *Wext* (large window). The records left the two windows are the overdue records which were squeezed out, or the farthest time records. The record in the small window is trustaccumulation record, and the large window is mainly to control the scalability. When the number of the trust record exceeds the size of the large window, the farthest time record will be squeezed out.

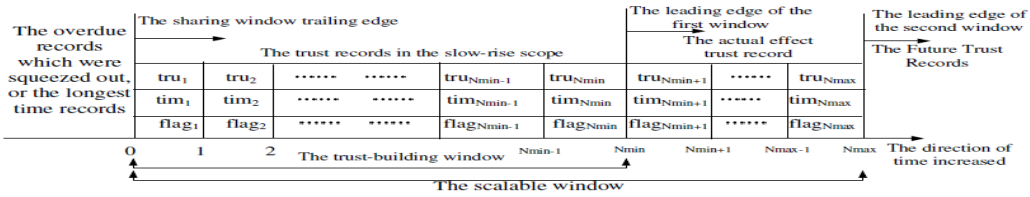

Fig:- ***TUBTCC***

2) Size of Window

The size of the small window is *Nmin* . When the cheating nodes attempt to obtain the final high value of trust evaluation via the fewer high trust intercourse, and owing to the overall trust value was calculated as *Nmin* , so even if each intercourse can obtain the very high trust value, but due to the number of actual intercourse is far less than *Nmin* , the other records which less than *Nmin* were calculated as strange nodes with lower trust value, it is impossible that quickly obtain the high trust value. In this way, it can incarnate the characteristic of trust: Time tries all. The size

of the large window is *Nmax* . When the number of node intercourse is very big, only keep *Nmax* (the size of the large window) trust records of intercourse. This will ensure the scalability of trust evaluation. The *Nmin* and *Nmax* are configurable. They are used to compromise between the scalability and the trust evaluation reliability

3) Initializes the Window

The trust values of nodes in the two windows are initialized with uncertainty trust of strange nodes *uncer_tru (For instance: 0.5)*, the trust value of strange node is low, it only enjoy fundamental rights. The mark of trust value *flag* is set to *stranger*. The time is the current system time, namely, *tim1 = tim2 =... = timN = tim_curr*. The overall trust value is still *uncer_tru.* With the node intercourse, the initialization value gradually left out from the left side of window, and the actual node behavioral records gradually moved into from the right.

4) The Type of Trust Record in the Window

There are three kinds of the trust record: the first, the type of trust record on strange node, it is used to initialize the trust record and reset the overdue trust; the second, the type of trust record on actual node behavior in the effective time period, and it is used to signal the trust record of node's actual behavior; the third, the type of trust record of punishment, it is used to signal the trust record of punished in the window. The three kinds of type on trust record are shown by *flagi*. The signs of initialized trust or overdue trust record are *stranger*. The sign of the trust record on node's actual behavior is *norm*. The punitive trust record in the window is *punish*.

Definition 1 effective trust record

The trust record that sign is *norm* or *punish* is referred to as an effective trust record, and the trust value have a direct causal relationship with behavior, the result is driven by the node's normal or fraud behavior. The effective trust record plays an important role in calculating the effective rate of trust, evaluating trust and counting the number of effective intercourse among the nodes.

Definition 2 effective rate of trust is that in the total trust record, the rate of effective trust records. In the trust evaluation, the total records except the effective records also include the initialized strange records, and the overdue records. The rate is higher; the credibility of evaluation trust is higher.

C. The Movement of Wndow and the Udate of the Tust Record

The updates of content in the sliding window include three cases: the reason of overdue, the arrival of new trust and the punishment for non-trust.

1) The Update of Window's Trust Record Based on New Trust Trigger

The basic idea of the windows updates that based on new trust: when the new trust record of the nodes' intercourse arrivals, through the window move to the right, the farthest time record that in the leftmost of the window is moved out, and the new record is moved into the rightmost of the window.

2) The Update of Window's Trust Record Based on Overdue

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When the sensor node has no dealing with others in a long time, namely, *timnew – timi Valid_tim* . Some records farther and farther away from the current time, and then became overdue records. The value of overdue records are no longer retain the original value, but replaced the lower alues of stranger. In this way, with the passage of the time, if the node doesn't have intercourse in a long time, the trust will gradually become the trust value of stranger. The trust records in the window were sorted by time, so we can use the bisection method to search the overdue record which in the last time, the record and its left side overdue records are moved out the window and their location will be filled with the trust values of stranger. The key is that how replace the records which were moved out from the window with the trust values of strangers, there are three kinds of basic strategies, and different strategies have different effects on the final trust evaluation.

1)Replacement trust record of stranger in the left-most window, namely, the farthest time record replacement strategy. These records have the farthest time, so they also have minimal impact on the trust evaluation, the time are the shortest
2) Replacement trust record of stranger in the right-most window, namely, the nearest time replacement strategy. They have the nearest time, and also have greatest impact on the trust evaluation, the time are the farthest.
3) Arithmetic average time replacement strategy, namely, the replacement record was inserted into the location which the average time in the window. In this paper, we use the first method the farthest time replacement strategy, the process is that the value of vacated record is replaced with the trust value of strange node, and its time is identical to the left-most, effective record, the sign is *stranger*, and then these trust records will be ordered, namely the replacement records put into the leftmost of window. Through the back proof, we know that in the three strategies, the farthest time strategy is the best on improving the effective rate of trust.

3) The Update of Trust Records in the Window Based on the Non-trust

The basic idea of the update based on the non-trust is that: if once the behavior of the node as non-trust, then the values of the evaluation which have been trusted in the *k* time will be reduced to the non-trust *under_tru*, the overall value of the trust will rapid decline, achieve the goal which punish the non-trust behavior. In the following paragraphs, we will discuss that how to determine the *k* and to choose what records are reduced. The factors of the trust punishment include three parts: the first is that the intensity of the current fraud on the node, the fraud intensity is larger the punitive intensity is larger, suppose the newly acquired trust value is *Tnew*, namely, the trust value is lower the punitive intensity is larger; The second is that the previous trust value *Told*, the value is larger the punitive intensity is larger. Because of that the previous overall trust value is larger, the trust of the evaluating node in evaluated node is larger and the authority of the node is higher, the losses caused by fraud of nodes are larger, thus the punitive intensity is larger; the last is that the necessary of real security and the background of application, we use the punitive factor αp show that. Through the above analysis, the value of *k* can be calculated by the formula 1:

$$k = \min\left[\left\lceil \alpha_p * \frac{T^{old}}{T^{new}} \right\rceil, S_w\right] \qquad (1)$$

In this formula, *Sw* is the number which the trust value is greater than *under_tru* and its sign is *norm*. Of course, it also shows that the punitive objects are confined to the actual behavior trust records for nodes, the overdue, strange, has been set up to punish and the records which below the lowest trust value will not be punished. For instance, given: *p*=10, *Told* =0.8, *Tnew* =0.4, *Sw*=50, then the punishment of trust is that the 20 records will be reduced to non-trust. In order to extend the impact of punishment on the node, in all records that fulfils the conditions for punishment, we choose *k* records which are nearest time (in the right-most of the window) to reduce to non-trust, at the same time the signs of the records will be changed to *punish*. By the way, the trust value of the *k* records which the value is greater than *under_tru* and the sign is normal behavior were reduced to non-trust, thus we achieve the goal which the value of the trust rapid declined

D. Node Long-term Behavior Trust Evaluation Based on Sliding Window

1) Calculation of Comprehensive Behavior Trust Which Sign is Effective in the Large Window At first, the comprehensive behavior trust of the *k* records which in the large window and its sign is effective is calculated. The punitive record is the trust record which was reduced by the non-trust behavior of the node, so it was calculated in the number *m* which is the effective intercourse of the node. The basic idea of calculation is that the more recently, the more abnormal behavior has the greater proportion of comprehensive evaluation, the degree of abnormal behavior is shown by the standard variance of history trust *di*, the proportion which each trust for overall trust varies with the time of this record, we have the formula 2, in this formula, α is a scale factor which between the behavior time with the behavior abnormal.

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$$m\_tru = \sum_{flag_j = \frac{norm}{punish}}^{m} \left[\frac{(tim_j - tim_1)}{\sum_{j=1}^{m}(tim_j - tim_1)} \alpha + \frac{d_j}{\sum_{j=1}^{m} d_j}(1-\alpha) \right] tru_j \quad (2)$$

2) Calculation of Behavior Trust for all Records in the Two Windows

First, we can calculate the trust value of the *Nmin* records in the small window, the basic idea is same to formula 2, and we have the formula 3:

$$N_{\min}\_tru = \sum_{i=1}^{N\min} \left[\frac{(tim_i - tim_1)}{\sum_{i}^{N\min}(tim_i - tim_1)} \alpha + \frac{d_i}{\sum_{i}^{N\min} d_i}(1-\alpha) \right] tru_i \quad (3)$$

Second, we also need to calculate the trust value *Nmax_tru* of the *Nmax* records in the large window, the idea is same to formula 2, and we need to replace *Nmin* with *Nmax* in the formula 3.

1) Calculation of Behavior Trust on Node in the Windows

The basic idea is that use the conservative strategy, namely, choose the smaller one between the two values. By the way, not only can prevent the fraud behaviors which result from the vicious nodes use a few intercourses to get the high value, but also can show the real trust value of the non-trust node. There are three cases:

1) When *m*<*Nmin*, compared *Nmin_tru* and *m_tru*. If *m_tru* *Nmin_tru*, then the final calculation of the trust according to *Nmin_tru*, the reason is that we use the method to prevent the vicious nodes using a few intercourse to get the high trust value, it also show the criterion of trust gradually accumulate, "time tries all". If *m_tru* < *Nmin_tru*, then the final calculation of the trust according to *m_tru*, in this way, it also show the real value of the non-trust node. All in all, we have the formula 4.

$$\begin{cases} N_{\min}\_tru_i & m\_tru > N_{\min}\_tru \\ m\_tru & m\_tru \le N_{\min}\_tru \end{cases} \quad \textbf{(4)}$$

2)When *Nmin*<*m*<*Nmax* , the final calculation of the trust according to the number of actual intercourse, so the overall trust result is *m_tru* .

3) When *m Nmax*, the final calculation of the trust according to the size of the expansive window, *Nmax*, so the result is *Nmax_tru*. The number of node intercourse maybe very large and the every node maybe has many evaluated nodes, so in order to ensure scalability of the trust evaluation, the farthest time trust record will be truncated and the tiny trust evaluation will be sacrificed, these measures are used to improve the scalability of the trust evaluation.

III. CONCLUSION

Paper mainly discusses evaluation importance of user behavior trust and evaluation strategy in the cloud computing, including trust object analysis, principle on evaluating user behavior trust, basic idea of evaluating user behavior trust, evaluation strategy of behavior trust for each access, and long access, which laid the theoretical foundation of trust for the practical cloud computing application.

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