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BFTDT: Byzantine Fault Tolerance tryout for Dependable Transactions in Cloud

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ABSTRACT

Cloud Web Services (CWS) is the technology used for business collaboration and integration among the web users. The Web Services Atomic Transactions (WS-AT) have been used for the trusted distributed transaction processing over the web. The WS-AT in the distributed sense has byzantine faults to overcome that Byzantine Faults Techniques (BFT) is used. The reliable coordinator provides the services that are Coordination services, Activation services, Registration Services and Completion services which make the transaction effective and reliable. In the trusted environment, to evade congestion of the resources, fair share bandwidth allocation scheme is used to allocate separate bandwidth for each web users and the transaction is processed Coordinator server and the Transaction Processing Monitor (TPM). The WS-AT for business applications analysis shows the high degree of dependability, security, trust, fault tolerance and fairness of the resources in the trusted environment.

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1. INTRODUCTION

Cloud computing is the service based on the subscription model to compute the wide range of network resources over the web. Cloud computing is the emerging technology among the web users. Cloud computing as the name implies, the users can access the data anywhere at any time. The major requirement needed to access the cloud service is the internet connection. The internet connection may be of wireless or wired or any mobile broadband connections. The advantage is that users can access that similar document from where on earth with any apparatus that has right to use the internet. These apparatus could be a desktop, laptop, tablet or phone. This can help cloud business to function more smoothly because anyone who can connect to the web and cloud users can work on documents, access software, and store data.

1.1 Types of clouds:

Based on the subscriber, the cloud can be classified into four types:

1. Public Cloud - A public cloud can be accessed by any subscriber with an internet connection and access to the cloud network resources.
2. Private Cloud - A private cloud is set up for the particular group or business and the users can access the resources within that group.
3. Community Cloud - A community cloud is shared among two or more business that have akin cloud requirements.

4. Hybrid Cloud - A hybrid cloud is essentially a concoction of at least two clouds, where the Clouds comprise of a concoction of public, private, or community.

Cloud Web Services is one of the important and upcoming technology used for the business transactions process. In the distributed sense, Transaction Processing (TP) is the driven based architecture for an organization to meet its high production. Different organization has different requirements to meet its business transaction and collaboration. To proffer interoperability among the transactional process, Web Services Atomic Transactions (WS-AT). The WS-AT specification requirements are the Coordinator and the participant of the transaction. The coordinator provides the set of services to the Initiator and the participants are the activation services, registration service, completion service and the coordination service. The transaction processes are reliable and honorable even in the non trusted environment over the internet and our coordinator should tolerate the Byzantine fault.

In order to overcome Byzantine fault (i.e. is an arbitrary fault that occurs during the execution of an algorithm by a distributed system) we can replicate the WS-AT specification services and ensuring a Byzantine Agreement (BA) among the replicas on each operation using a Practical Byzantine Fault Tolerance (PBFT) algorithm. Additionally , our BFT open source framework uses an effective protocol as a substitute of running a Byzantine agreement for registration of every Participant so that using of Byzantine agreement can be reduced since it is very expensive to accomplish ,if a non-faulty Participants have registered with the Coordinator, they can be included in the Backup two-phase commit protocol. For ease here we have chosen a PBFT algorithm as a substitute of Byzantine agreement during the execution of our BFT framework. The WS-AT standard which specifies two protocols are Backup two phase commit protocols and the Completion protocol and a set of services. The B2PC protocol [34] is permitted to run between the Participants and the Coordinator, and the Completion protocol is permitted to run between the Coordinator and the Initiator. Our objectives in this paper are not only to overcome the reliable coordination problem but also to share an equal bandwidth among the cloud users and cloud service provider to achieve fairness.

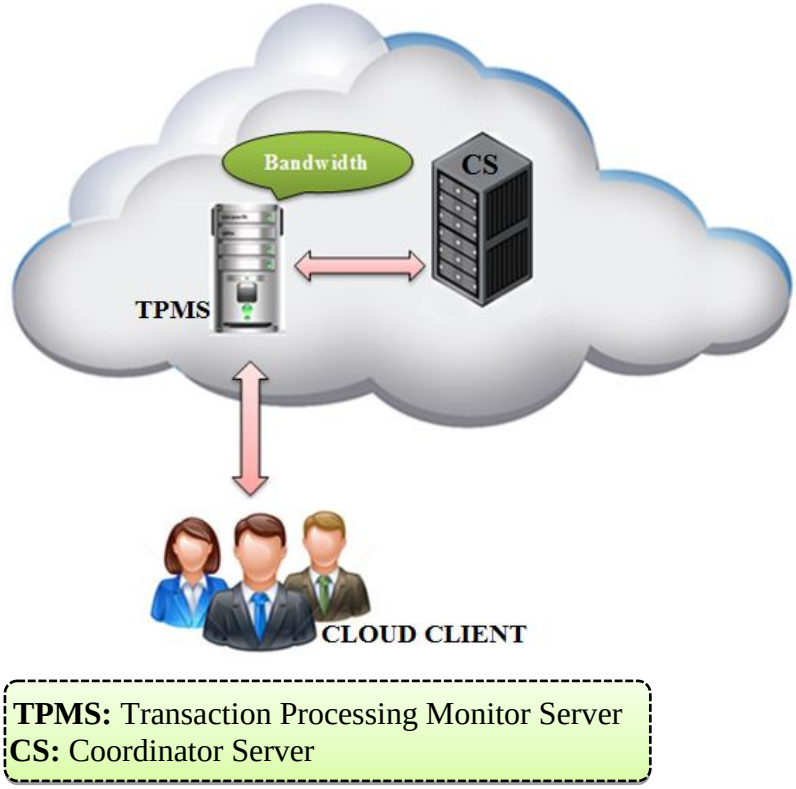

Figure1. Architecture of Cloud Web Services

2. OPERATIONS OF B2PC

2.1 First phase:

Coordinator: At first, the coordinator will convey the Initiate_commit message to all participants.
Participant: After receiving the request message, if the participant wish to commit the transaction means it reply with the Vote_commit message, or else it reply with the Vote_abort message to coordinator.
Coordinator: After receives the reply message from participant it commences the 2nd phase.

2.2 Second phase:

Coordinator: After receiving the Vote_commit message, it records the Decisive_commit message to its related backup site, else the coordinator send the global abort message to all its participants.
Backup site: After receiving Decisive_commit message from the coordinator, the backup site will reply withthe Recorded_commit message to the corresponding coordinator.

2.3 Third phase:

Coordinator: After receiving Recorded_commit message from the respective backup site, the coordinator will broadcast the global commit message, else it broadcast the global abort message to all participants.
Participants: Finally, the Participant follows the coordinator's command and it acknowledges with the coordinator.

3. ALGORITHM OF WS-AT

3.1. PRACTICAL BFT ALGORITHM

Practical Byzantine Fault Tolerance (PBFT) Algorithm can be used as a Byzantine agreement which overcome the Byzantine Fault by replicating the server and ensuring this agreement among all replica servers. Usually this algorithm is executed by the set of 3f+1 replica among them one is treated as primary and the rest are treated as back -up replica. This algorithm involves three phases of operation are;

First phase (Pre-Prepare phase)

Initially, the primary replica which broadcast its Pre-Prepare message to other backup and the message includes information such as client request, sequence number and view number and the backup accept the message by checking the digital signature of above attributes and it starts second phase.

Second phase (Prepare phase)

In this phase the back-up replica will further broadcast the Prepare message to other replica and the message contains the ordering message and digest of the message are ordered, all the replicas should wait until it receives matching message from above replicas and it starts the third phase.

Third phase (Commit phase)

In this phase the replicas will further broadcast commit message to other back-up replica, this phase ends when all the back-up replicas received same matching message from 2f replica, where the message is ordered and delivered.

3.2. FAIR SHARE ALGORITHM

The bandwidth used in the cloud environment is the network bandwidth. Fair-share is the method used for the maintenance of the network bandwidth allocation schemes.

```
1   UpdateFairShare()
2     Once every Δ units of time do
3       if T > 0.7C
4         v ← 0.9v + 0.1(C − T)
5       else
6         v ← 0.9v + 0.1(C)
7     enddo

8   PacketArrival()
9     if R < (t_i − v)/v
10        DropPacket
```

The fair share "v" of the transaction flow can be defined as the maximum flow of the resources without collision in a specified time. Consider two parameters aggregate throughput T and a network weight C. The fair share value is adjusted for the given time interval Δ. The fair share value is updated when the aggregate throughput T and network weight is equivalent and the transaction is done. The transaction process is dropped when the difference between throughput and fair share v divided by the fair share value lies between the random number 0 and 1 .Thus fairness is achieved among the transaction flows. Randomness ensures the maximum probability of the transaction process.

4. CORE SERVICES

According to WS_AT specification, the coordinator of transaction should provide some services to other attributes involved in distributed transaction. If we harden these services the coordinator can be a reliable entity even in non tenant environment over the internet and the coordinator should be tolerant towards Byzantine Fault. The core services are Activation, Registration service, Completion service and coordination service.

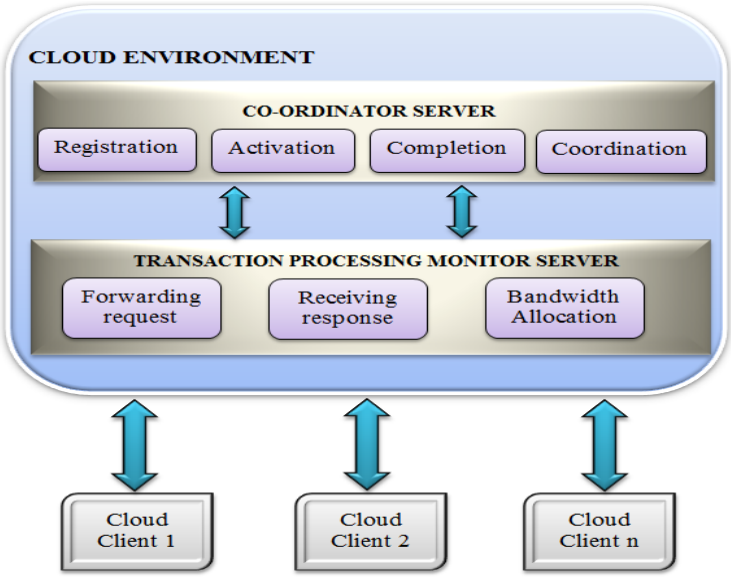

Figure 2. Detailed Design of the WS-AT

Registration Service

Registration service is the service provided by the coordinator which allows the non faulty participants to get register over with the respective endpoints references. Both the Initiator and Participants are needed to register. Only for the registered candidates the operation can be activated. In the beginning the Initiator broadcast its request message to participant to get register with it and the participant broadcast its registration request to coordinator replica and waits to obtain acknowledgement. If the participants gets registered successfully it broadcast completion message else exception message.

Activation service

Activation service is the service provided by the coordinator which can activate the operations and services required by the registered users. It creates a unique transaction id and coordinator object, whereas transaction id is the part of coordination object. The transaction id can be chosen from a random number so that no one can predict it. The Activation service which allows the replicas intercommunication can leads to exchange of transaction id among the replicas.

Initially the participant broadcast its request message to all Initiator replicas, if all replicas receives same message it broadcast its activation request message to Activation service replicas. The replicas are allowed to have intercommunication in order to exchange their unique transaction id and leads to the initiation of next phase of Byzantine Agreement phase, where we run a Practical Byzantine Fault Tolerance algorithm. At the end of this phase the activation response are broadcast to all replicas of Initiator and the Initiator forward the message only if the entire replica receives same matching results.

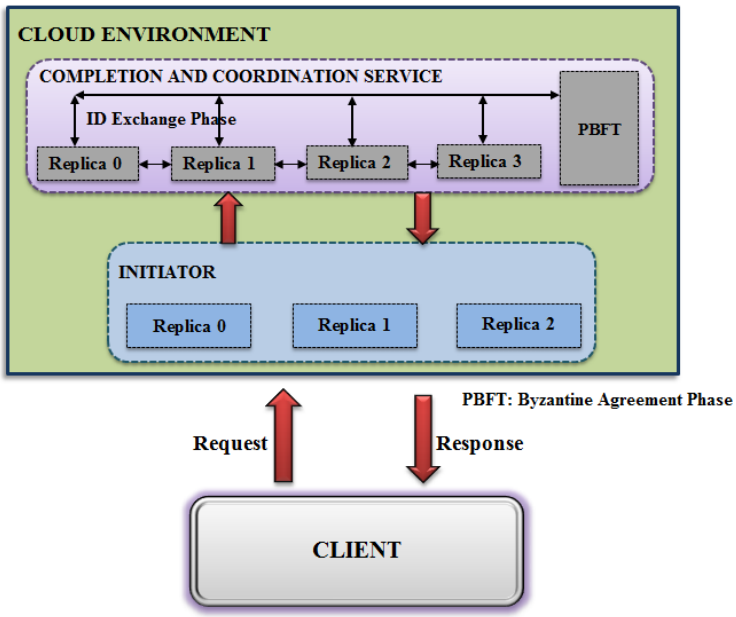

Figure 3. Activation service

Completion and Coordination Service

The completion services always denoted the successful completion of distributed transactions. The Coordination service is the service provided by coordinator which allows redirecting server if any server replica gets failed. At the beginning Initiator broadcast the commit request message to all coordinator replicas, and the coordinator replica accept this request message only if all the replicas receives same message and the replicas of coordinator are allowed to have intercommunication between replicas for the purpose of registration update phase.

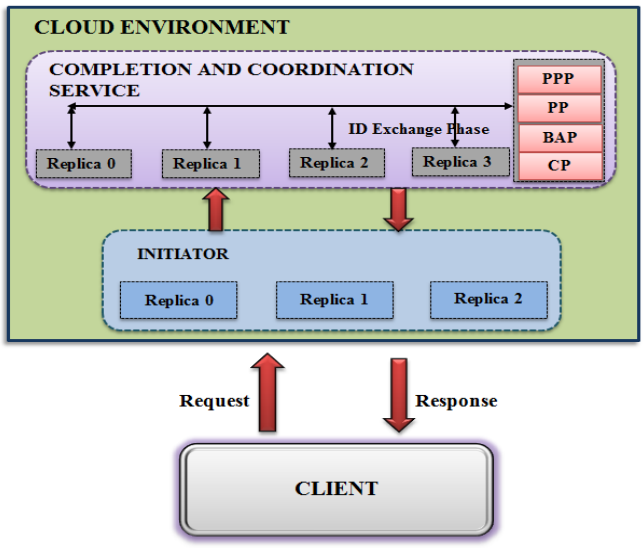

Figure 4.Coordination and Completion service

This phase is used to check whether all the participants are registered successfully or not. After the completion of the above phase it initiates the Backup two phase commit protocol and Byzantine Agreement phase. Finally it transmits the response message to all Initiator replicas and initiator further broadcast its response to client.

5. CONCLUSION

The network management is an important task in the cloud web services for web users in the trusted distributed environment. In this paper, we addressed the problem of byzantine faults in the Web Services-Atomic Transactions in the trusted environment. We deployed Byzantine Fault Techniques (BFT) and fair share bandwidth allocation scheme used to allocate the separate bandwidth for each web user and the transaction has been processed in the trusted environment. To process more number of requests in the given time, we allocate individual bandwidth and maintaining the stable handling of the resources both in the Coordinator Server (CS) and Transaction Processing Monitor (TPM). Thus we achieve high degree of dependability, security, trust, fault tolerance and fairness of the resources in the trusted environment.

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