

Trust Model: Cloud's Provider and Cloud's User

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Abstract

Most of the organization is not moving to cloud computing due to lack of trust on service provider. Although different advantages are suggested by many researchers, but they still have some reservations. In this paper, argued advantages and disadvantages are evaluated for satisfaction of users. A new trust model has been proposed between cloud provider and cloud users in three turns. At first turn user must be satisfied with previous experience of cloud provider, at second turn user must have knowledge about Cloud Computing, SLA (Service Level Agreement), Cloud Advantages, Cloud Disadvantages Issues related to advantages & disadvantages and securities at different levels. With the satisfaction of implementation of different securities at second turn, cloud provider can be a reliable provider. Now at third turn organization owner/ user can trust on reliable cloud provider. With proposed model any organization can easily make a trust on cloud provider and can use third parties service.

Key Words: *Cloud Computing, Cloud Providers, Cloud Users, Securities, SLA, Trust Model*

1. Introduction

The world is rapidly changing to a global village and everybody wants everything accessed through single medium. Now a day it is explored that through single medium i.e. Internet companies can access the costly computing resources distributed across the globe. Due to such strong communication medium, everyone is depending on Internet and trying to use such medium for all their computing needs. Using such flexible medium, Cloud Computing concept has been developed. Cloud is a big concept for replacing manual desktop application to cloud based applications. For such replacement, organizations can use storage spaces from cloud providers and can save their personal applications (Personal applications can be developed by themselves or from any cloud provider). It is generally observed that due to many reservations organizations are still hesitant to utilize the cloud environment. But when they will have complete knowledge about all clouds parameters i.e. SLA, type's services, services accessed interfaces and types of clouds, then they can trust on cloud service provider.

In different industries such as Telecommunication [11], where size of incoming data is very huge, some data is analyzed frequently but some sets of data in rest hence DW 2.0 organizes the data on different storage locations. By using such DW 2.0 there will be no pain of maintenance of data, because small portion of data will be stored locally and major bulk of data will be stored on cloud. Due to cloud computing reliability & scalability Microsoft has launched HealthVault in 2007 [14], where record of health data can be created by any end user and data can be imported through monitoring medical devices. Similarly Dell's MSite,

Flexiant's Extility and GE Healthcare's Centricity provide specific healthcare information system platforms using private clouds and a full range of technical services including disaster recovery. For hospitals and physicians, dell also launches new secure cloud-based services [14]. Many customers who are familiar with all benefits of cloud computing are make a turn to cloud computing for reducing their expenditure. Due to scalability of cloud computing, a company (WTB Group) which supplies building materials has decided to move its IT infrastructure to the cloud. For getting advantages of flexibility of cloud computing, GMS (Guardian Media Group) has moved its IT to cloud [15].

From above research it is observed that there is an odd between researchers and business organizations that they are suggesting different techniques and tools for cloud computing relevant to their domains, while most of the organizations are still standing on zero point of cloud computing. Yet they have not much knowledge about cloud computing frame work, then how they can use relevant services. Hence in trust model a fine structure has been explored for motivation of organization from conventional to cloud computing environment.

In addition a trust model is developed which is used to focus knowledge about cloud users. By applying the proposed trust model, it will be easy for any organization to adopt cloud environment to get the said benefits.

By surveying various organizations, it has been observed that most of the organizations have a little bit knowledge about cloud computing. Out of these, 55% have average knowledge about cloud computing, but 33% and 11% have surface and no knowledge respectively. In addition most of the organizations have limited information i.e. 33% about the benefits of cloud computing. Since cloud computing reduces maintenance cost, 22% of organization want to use the cloud on regular basis and 44% are willing to use it occasionally. This is due to lack of knowledge and exposures. Due to the following reasons, most of the organizations do not want to use the cloud computing services:

- Lack of knowledge regarding its attributes i.e. SLA, PaaS, SaaS, IaaS etc. (i.e. 40%)
- Security Concerns (i.e. 20%)
- Unawareness regarding the Entire services provided by the Cloud Provider (i.e. 40%)
- Untrusted Service Providers (i.e. 40%)
- Not interested to adopt cloud environment (i.e. 20%)
- Don't want to migrate (i.e. 20%)

By elaborating the said benefits of cloud computing, 29% fully agreed and 66% organizations partially agreed to utilize the cloud computing environment. Now it is necessary to provide a platform which could help organizations to make decision about the utilization and update their knowledge about cloud computing from all aspects.

Before examining the trust model, users must be familiar with cloud computing, how to access cloud services and why it is necessary to access these services. To understand the cloud environment, information about cloud computing components is necessary.

2. Cloud Computing Components

Cloud computing paradigm makes great changes in depth of IT center of different organizations. It is very important for each organization to understand the environment of cloud computing. Simply cloud providers provide different services to cloud's users of organizations with an agreement known SLA as shown in Figure 1.

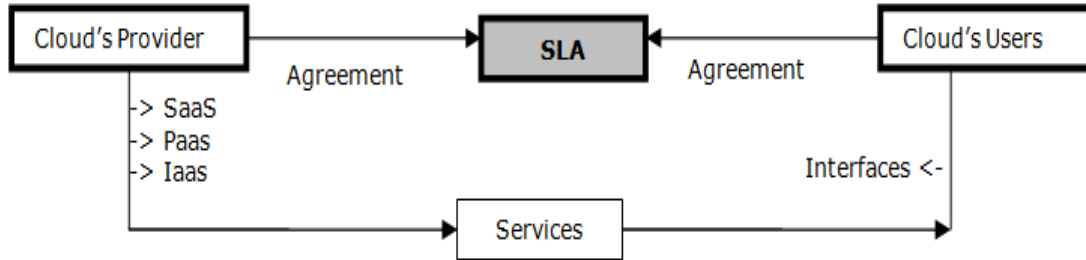


Figure 1. Cloud Computing Environment

2.1. Services

Services in cloud computing are reusable and fine-grained components over network of vendor. These services should be available to small businesses and large scale. Those services should be used by many users on any device all over [1].

2.2. Cloud Computing

Cloud computing deliver to organizations on-demand service wherever they need. It is a set of hardware, storages, interfaces that allow delivery of computing as a service. These deliveries are software, infrastructure and storage over the internet. Service provider will be the responsible for maintenance [2]. Cloud computing can be used with respect to many factors i.e. cost/ benefit ratio, speed, using how much capacity, data is regulated or not etc. In cloud computing, another company can host organization application and manage the software updates. This procedure depends upon agreement or contract between them.

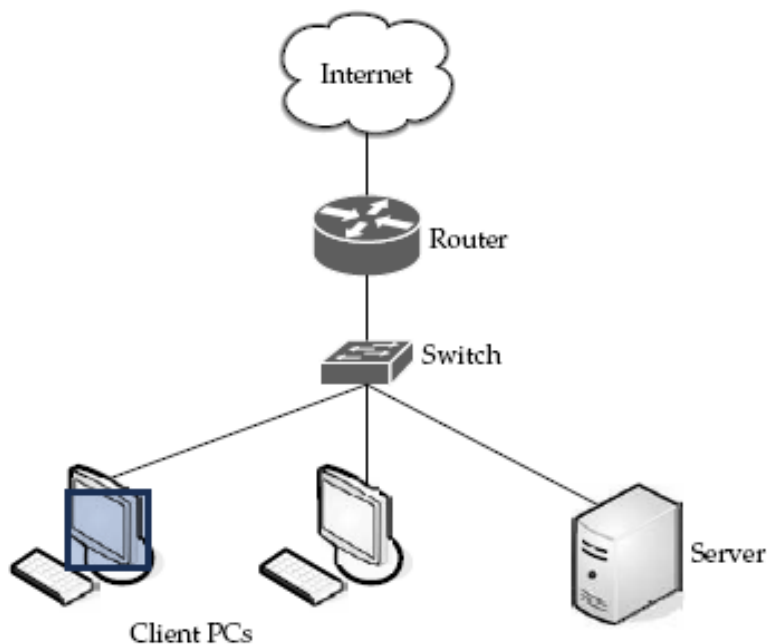


Figure 2. A Cloud is used in Network Diagrams to Depict the Internet. Adopted by [1]

Different models [1] [13] available for cloud computing such as

-Software as a Service (SaaS): Here applications are provided to end users as a service. Vender hosted software applications, and then end user can utilized those services.

-Platform as a Service (PaaS): This model provides all resources for development of applications without installation of software. Here custom based web application can be developed more quickly and easily.

-Infrastructure as a Service (IaaS): It is computer hardware delivery as service i.e. operating system (Virtual environment as service)

-Communication-as-a-Service (CaaS): It outsourced communication key. They provide VoIP (voice over IP) services, IM (Instant Message) and video conference services to consumers. CaaS venders manage hardware and software for such delivery of services.

-Monitoring-as-a-Service (MaaS): It provides security as services, it handles protection of different clients from cyber threats. A team plays a vital role in maintaining and securing the confidentiality, integrity, and availability of IT assets.

2.3. Service Level Agreement (SLA)

SLA is actually a service contract between customer and service provider where service's level is formally defined. It accounts a general perceptible about services, priorities, responsibilities, guarantees, and warranties [3]. SLA can also define at different levels.

Customer-based SLA: It is the agreement with entity personal group which covers all services use by them.

Service-based SLA: It is a contract between service provider and all customers using the service.

Multilevel SLA: Such SLA consist of different levels, each level shows the situations of different customers for same service.

Customer level SLA: It contains all SLA (Service Level Management) issues relevant to group of particular customer.

Service level SLA: It contains all SLA (Service Level Management) issues relevant to specific service, in relation with customer group.

As consumer demands are very complex, so measure and trigger process may not work for SLA enforcement. Most of the cloud provider puts burden of proving SLA violations on the consumer, so set up of enforcement process to be computerized [4].

Since SAL is a contract between parties at distance, consumer enforce on service based agreement rather than customer based agreement which must include that monitoring, reporting and performance of cloud that should be based on end user experience or ability of end user consuming resources.

3. Trust Model

We have proposed a Trust Model between cloud providers and users. Here it is proposed that trust can be done in three turns. When cloud users are satisfied at first two turns then at third turn they can rely on cloud provider. Sequence of Trust turns has been shown in following in Figure 1. Following are the major terms of proposed trust model.

3.1. Knowledge for Cloud Users

For using cloud computing cloud user must have knowledge about Cloud Computing, SLA, Cloud Advantages, Cloud Disadvantages, and Issues. Cloud computing and SLA details has been already explored. Now it is very necessary for each organization to understand advantages and disadvantages about cloud computing.

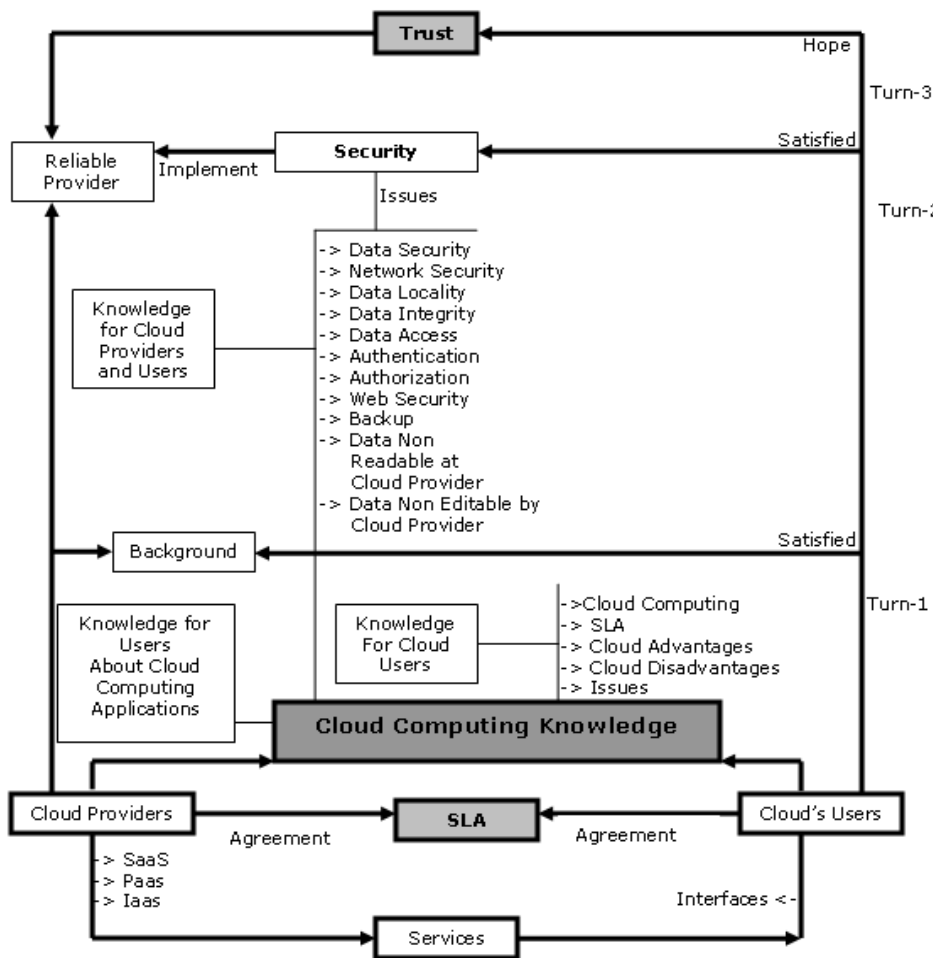


Figure 3. Trust Model between Cloud Providers and Users

Table 1 is representing the advantages [6, 7] and some issues about then for cloud computing. But here some satisfaction is provided for cloud users' issues on advantages. Table 2 is representing Cloud Disadvantages [8, 9] and proposed suggestions for satisfaction of users.

Table 1. Cloud Advantages their Issues and Proposed Suggestions

Cloud Advantages	Issues	Suggestions
<p>By using cloud facility, there will be no need of software installation and storage issues.</p>	<p>When business organization uses clouds software & storage assets then hiring software service may be beneficial but without storage other application can be run on client side?</p>	<p>Organization computers should be dedicated only for their own work, no irrelevant work should be done over here just like, then organization does not require storage for irrelevant application and storage for relevant application will be provided by cloud.</p>
<p>Due to cloud computing, with just only internet connections, application can be accessed all over the world.</p>	<p>Is it necessary to access application outside the organization? If yes then a member can done his work at home without attending office. In record he will be absent but in working, his work has been done? There is some odd for smooth running.</p>	<p>Private cloud can handle such situation. A member can access the application on particular circumstances, which will be known by all high-ups.</p>
<p>Business people can share their data or documents on internet and at one place People of Business can distribute data or document to all other business peoples.</p>	<p>It is not necessary to share data to all peoples. Suppose in any office an account officer makes an accounts sheet, then it should not be under the access of all peoples. Account's sheet holder will keep this sheet in his own custody not will leave it for all people.</p>	<p>Business data will be placed only at one location, so there will be no disperse thinking for hiding data from all peoples. No redundancy and consistency will be occurred. In manual system each member will kept hard copy of his data in his own custody and in computerized system all data will be stored in single server with privileges while in cloud environment no need to worry about personal server. In cloud based automation, security policies will also be maintained on sensitive data that sensitive data cannot be accessed to unauthorized person. However some data is require to be shared with other users such as diary dispatched transaction between different users, so such type of sharing will be more synchronized.</p>
<p>On cloud, resources can be hired more quickly.</p>	<p>This is good but in personal computerization, when any resource is required, then it can be easily purchased and resource will be physically in the hand of organization.</p>	<p>Some organizations have not many expenses for purchasing a resource then, cloud service can be utilized. Also in some busy days an organization can require a resource for that particular time then resource can be hired from cloud for that time. But with physical purchasing, organization will be responsible to keep the purchased resource in such a way that resource cannot be damaged forever even if it is not in working.</p>

Table 2. Cloud Disadvantages and Proposed Suggestions

Disadvantages	Suggestion
Users will be dependent on cloud provider.	This is not a big issue. If a user has an email on particular domain, then he will dependent on that domain and their policies. This is mature matter that cloud dependency is in only on wording not on practical effects.
Users have no knowledge about physically where is software hosted. And also If a problem can occur in software then user can not access the software to fix the error.	This is valid up to user satisfaction. But each user is already using different third party services such as email, website of organization etc. In email, we have also no knowledge that where our data is located. Almost users have no complaints about emails because they are most familiar with those things. While cloud is a new technology, so that's why people think about unaware place of data storage. When they will familiar with cloud so they will have no issue about such option. Secondly, users are worried about fixing the error: error fixing is necessary thing but also exceptionally. Although fixing error of in house software is accessible. And if at organization there is no technical person for such problem then error fixing can be critical but in cloud environment they are responsible for smooth running of software nothing else, so they will have number of technical person. And with just your complaint about problem, error can be fixed more accurately and efficiently.
Clouds resources runs through internet and if connection of network is slow then work can be effected.	World is now making as Global Village: why? Due to internet this slogan is gaining reality. Lot amount of data transactions are made daily through internet, already successful attempts are done through internet then why anyone think about slow network connections? Although due to some reason a net speed can be slow, but it is exceptional cases, this recovery can be done easily.
Legal rights can be set by host of server or owner of the system. Data sharing can create security issues.	If an organization has an in house application, each user can use application according to his rights. When application will run on cloud environment, then user will also use application according to his privileges. No think about who can set the permission. Due to SLA host of system and owner of the system will be transparent. Many users send their private data to other users with email, almost no people have complaint about security of sharing such data, and then why this is thinking that through cloud application data sharing can create security issues.
After cloud crash, where does our data will go?	After in-house server crash, where does our data will go? Although alternate of such options is backup and recovery. Cloud provider will maintain backup procedures and will recover hosted data. This is not a critical issue.

Some advantages of cloud computing without issues suggested by [10, 11, 12]:

- On demand service providing
- In cloud, data processing services required lowest cost with intensive applications for smaller organizations.
- Hardware and software can be accessed immediately.
- Activities of a business can be mobilized and portable. Employee of an organization can work any where with number of devices i.e. desktop computer, lap top or mobile.
- Overtime work can be done at home.
- Easier to change the requirements of services
- Easier to developing and delivering new classes of applications.
- In house deployment requires devices for backup i.e. compact disk, external storage devices, flash sticks etc. Cloud computing requires no backup devices at client side.
- In house data requires efforts on backup and recovery, means synchronization of electricity and then such devices should be kept in safe places no unauthorized person can thief such devices, while data on cloud requires no efforts on backup and recovery devices.
- When a system at organization is crashed, then system will require complete installation of relevant software while in cloud computing only system will require installation of operating system and internet connection. A new system can be easily replaced with crashed system because operating system is installed on each computer.
- In house application can require LAN, so LAN can also require some physical security i.e. cables should be on those places where they can not be affected by whether or cut off situations, while cloud application will be run only with provision of internet by any means.

3.2. Knowledge for Cloud Users and Providers

Necessary thing for cloud computing is the implementation of security. Providers are responsible for implementing security and users must have knowledge about security, so that users and providers can be transparent. There are some security issues suggested by [5]. Users must have knowledge about such securities, which are:

- Security on Data Level: It means data should be strongly encrypted. So data can not be accessed by any malicious users.
- Security on Network Level: Since in cloud computing data is flowed on network, so cloud provider should confirm that there will no leakages of sensitive information. Different significant protection policies are available such as SSL encrypted endpoints.
- Data Locality: In cloud environment users have no knowledge about where data is stored. Users must confirm what will be the physical location of storage.

- Data Integrity: Due to database constraints and transaction, integrity of data is an important issue. These options can be done at API level. And also different standards such as WS Transaction & WS Reliability are available for integrity of data, not yet mature.

- Data Access: Although on cloud computing data cannot be accessed by unauthorized person but there is some scenario in which authorized user of an organization have some restriction to access data. Such type of security policy should be implemented by provider and used by users.

- Authentication & Authorization: There are different policies for creating different users, if users of an organization are created in AD (Active Directory) of cloud provider, then owner of organization should have option for deletion of such registered employee.

- Web Security: Hacking is the critical issue for web security threats. Web applications is facing different security risks such as broken authentication & session management, insecure direct object references, cross-site request forgery, security missed configuration, insecure cryptographic storage and failure to restrict URL, so users must have knowledge for such risks and provider must be careful about them.

- Availability: Applications for users should be available all the time.

- Backup: Data should be regularly updated on cloud side. In case of failure quick recovery should be implemented by provider.

- Data Non Editable by Cloud Provider: It is confirmed that data of an organization can not be deleted or edited by any means.

- Data Non Readable at Cloud Provider: Cloud provider confirm such policy through which data can not be readable for cloud providers.

3.3. Knowledge for Users about Cloud Computing Applications/Providers

Different cloud applications are available on cloud computing [1]:

-Google App Engine: It is used for creating web applications, here different tasks can be done such as Write code once and deploy, Absorb spikes in traffic, Easily integrate with other Google services. After few months user may pay

\$0.10–\$0.12 per CPU core-hour

\$0.15–\$0.18 per GB-month of storage

\$0.11–\$0.13 per GB of outgoing bandwidth

\$0.09–\$0.11 per GB of incoming bandwidth

More information can be get from <http://code.google.com/appengine/>



Figure 4. GoogleAppEngineLauncher, Adopted [1]

-Google Web Toolkit: It consists of JAVA 5, JAVA-5 developers can utilize such toolkit with all capabilities of JAVA-5 i.e. debugging web application then deploying optimized java script. Further features can be read on <http://code.google.com/webtoolkit/>

-EMC: This corporation is leader of products, management and information storage. It launches V-Max in April 2009, which supports virtual datacenters. This system allows customers to easily manage and expanding storage systems. Their other expertises are backup & recovery, intelligent information management, IT management, replication and security.

-NetApp: It was 1st company that creates storage and data management solutions for their customers.

-Amazon: It widely known cloud provider, which offers different fronts from storage to platform to database.

-Salesforce.com: It is use for automating applications. Its major three areas which are

- The Sales Cloud: use for computing sales application
- The Service Cloud: The platform for customer service
- Your Cloud it is use for developing custom applications on its cloud

-IBM: It provides cloud computing services to all size of business. It offers different services such as industry specific business consulting services for cloud computing, Technology consulting, design, and implementation services and Cloud security.

3.4. Trust Development Turns

After understanding all issues related to cloud computing, user can trust on cloud provider in three turns which is concluded from Figure 3 and showed in following flow chart Figure 5.

It is very necessary for each cloud user to satisfy with cloud disadvantages and objectionable advantages. Here complete discussion on cloud advantages & disadvantages has been provided in Table 1 & Table 2 and also detail about SLA, cloud computing applications, all security parameters and dimensions of different researchers works about cloud computing to depict the importance of cloud computing.

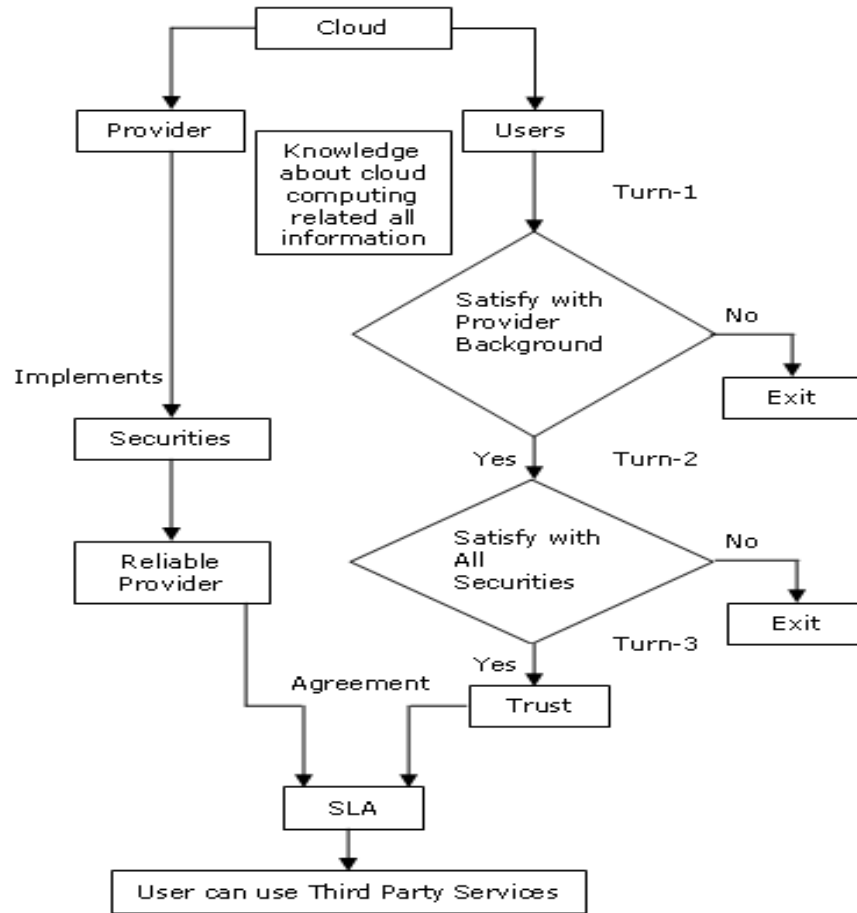


Figure 5. Flow Chart for Trust Model between Cloud Providers and Users

In first turn user must be satisfied with background of cloud provider i.e. users must be familiar to already registered organization as cloud provider, their complaint, securities issues etc. Users also have knowledge about cloud computing their merits & demerits and different security issues. In second turn, users must be satisfied with securities at different angles as mentioned above i.e. all securities policies should be implemented by provider. Now at third turn user can trust on reliable cloud providers and can use their applications without any hesitation.

4. Conclusion

Cloud computing can control and manage the organizations in best way, so different researchers explore cloud computing from different dimensions. Tinny application concept [10] is very fruitful for all those organizations having their customized application. With this application, organization can take a turn to cloud computing for saving the cost and getting considerable advantages of cloud computing.

Besides all importance of cloud computing, organizations are not making a trend of cloud computing due to lack of Trust. Securities and many other issues may be the reasons of un-trust. This is also due to lack of knowledge and understanding about cloud computing. This paper presented a trust model consisting of different packs such as Knowledge for

organizations in three turns. It also demonstrated that after going through such turns both cloud providers and users can be transparent to each others. Such transparency can develop a trust on cloud providers and their environments. Hence proposed trust model can provide a solid ground of motivation to organizations for utilizing all benefits of cloud computing and reducing their expenditures.

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