Cloud Security

Security Aspects of GIS Cloud

Soumadip Biswas
Roll No – 10IT60R12
School of Information Technology
Indian Institute of Technology
Kharagpur, India
soumadip.cse@gmail.com

Guided By: Prof. S. K. Ghosh

Abstract

This report is basically talks about the topics to be presented on this topic. At first there's a little about what is basically the cloud computing is, what is the concept is all about, what is going on under the hood, then there is section which tells about the basic security issues of cloud computing. Then to be specific this report shifts to one particular domain of cloud computing, which is GIS cloud. GIS (Geographical Information System) if implemented in a cloud, then what would be the scenario is one of area of the talk. Then there are some issues that can arise in case of the Information System to be implemented in a public cloud.

CONTENTS

1. *Introduction*

There are no standard definitions available for a Cloud. The definition section of cloud is still somewhat Fuzzy, as because people are implementing different types of software which are basically provides a service oriented architecture, which is the main theoretical definition of cloud, and call it a cloud. So we cannot find a definition out of such a number of diversified examples, so for instance we will concentrate over service oriented architecture, and then move over to the concept of cloud.

Service oriented architecture is "*A paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations*"[1]. Here the term '*Service'* is defined as "*a logical representation of a repeatable business activity that has a specified outcome, self-contained, may be composed of other services and a "black box" to consumers of the service*".

Well now moving to cloud computing a very primitive and novice definition for this would be [2]

- ✓ *The storing and accessing of applications and computer data often through a Web browser rather than running installed software on your personal computer or office server*
- ✓ *Internet-based computing whereby information, IT resources, and software applications are provided to computers and mobile devices on-demand*
- ✓ *Using the Internet to access web-based applications, web services, and IT infrastructure as a service*

2. ***Evolution of consumer computing****:*

From a user's perspective, the evolution of consumer computing can be divided into three phases [4]:

- *The stand-alone personal computer* in which the user's operating system, word processing system, database software and data are stored on a single, easily protected machine. Examples: word processing, spreadsheets on a standalone server.
- *The Web* in which most of the software a user needs is still on their own PC, but more and more of the data they need is found on the Internet. Example: using a Web browser to read a Web page.
- *"Cloud Computing"* in which users rely heavily on data and software that reside on the Internet. Examples: using Amazon's Simple Storage Service (S3) and Elastic Computing Cloud (EC2) to store unlimited photos on Smugmug, an online photo service; using Google Apps for Word-processing; virtual worlds such as Second Life that enable users to build 3-D environments combining Web pages and Web applications (e.g. feeding a Webcast into a virtual theatre); grid computing.

3. Cloud Computing: Components

3.1 Basic concept:

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [5].

This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models [5].

3.2 Characteristics of cloud:

There are 5 essential characteristics; they are as follows [5]

- On-demand self service
- Broad network access
- Resource pooling – location independence
- Rapid elasticity
- Measured service

3.3 Cloud service models:

There are 3 main service models that clouds will provide; they are [5]:

- Software as a Service - Use provider's applications over a network, there are services of potential interest to a wide variety of users hosted in Cloud systems. This is an alternative to locally run applications. An example of this is the online alternatives of typical office-applications such as word processors. This scenario is called Software as a Software as a Service (SaaS).
- Platform as a Service - Deploy customer-created applications to a cloud, Cloud systems can offer an additional abstraction level instead of supplying a virtualized infrastructure, they can provide the software platform where systems run on. The sizing of the hardware resources demanded by the execution of the services is made in a transparent manner. This is denoted as Platform as a Service (PaaS). A well-known example is the Google Apps Engine.
- Infrastructure as a Service - Rent processing, storage, network capacity, and other fundamental computing resources, IPs manage a large set of computing resources, such as storing and processing capacity. Through virtualization, they are able to split, assign and dynamically resize these resources to build ad-hoc systems as demanded by customers, the SPs. They deploy the software stacks that run their services. This is the Infrastructure as a Service (IaaS) scenario.

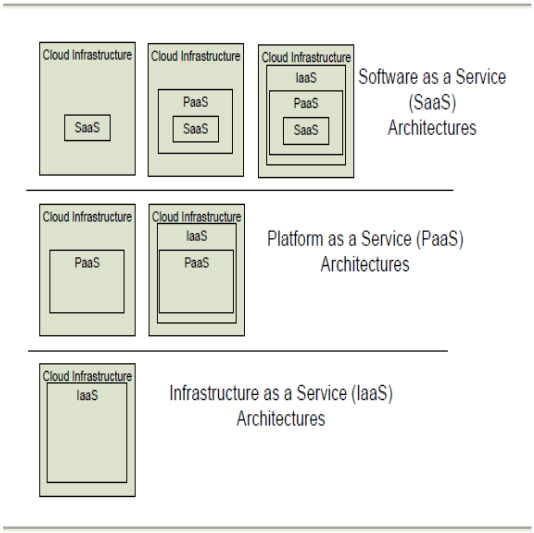

Fig-1: Service model Architechtures [3]

3.4 Cloud Deployment Models:

There are 4 deployment models as per NIST [5], they are:

- Private cloud – enterprise owned or leased
- Community cloud – shared infrastructure for specific community
- Public cloud – sold to the public, mega-scale infrastructure
- Hybrid cloud – composition of two or more clouds

4. Issues in Cloud Computing -

- Privacy issues
- Trust issues
- Legal issues
- **Security issues**

4.1 Security is major issue

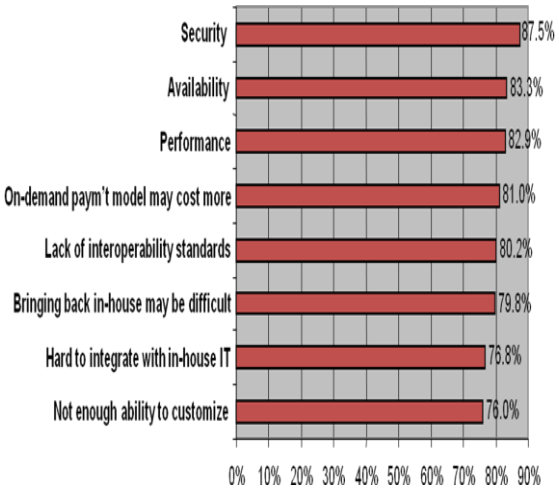

Fig-2: A rating of many different issues in cloud computing [6]

5. Cloud security

Clouds are massively complex systems can be reduced to simple primitives that are replicated thousands of times and common functional units.

Key issues are trust, multi-tenancy, encryption, compliance, Authentication and Identity Management, Access, Availability, Backup, Control over data life cycle, Audit.

Though this is massive, there are both advantages and challenges.

Here are list of general security Advantages:

- Shifting public data to a external cloud reduces the exposure of the internal sensitive data
- Cloud homogeneity makes security auditing/testing simpler
- Clouds enable automated security management
- Redundancy / Disaster Recovery

Now the list of general security Challenges:

- Trusting vendor's security model
- Customer inability to respond to audit findings
- Obtaining support for investigations
- Indirect administrator accountability
- Indirect administrator accountability
- Proprietary implementations can't be examined

- Loss of physical control

Components in cloud that attracts attention relevant to security:

- Cloud Provisioning Services – this service enables availability (by provision of multiple data centre/instances), gives rapid reconstitution of services. At the same time the challenge is compromise of this service itself.

- Cloud Data Storage Services – this gives the provision of data fragmentation, dispersal, automated replication, encryption etc. And the challenge in this case would be isolation management with data multi-tenancy, storage controller management as chances of single point failure and more over data mix-ups.

- Cloud Processing Infrastructure – this has ability of secure masters and push out secure images, whereas the challenge is application multi-tenancy, reliance on hypervisor and implementing process isolation.

- Cloud Support Services – this is basically the security controls on demand. When integrated with customer application, seeks extra care.

- Cloud Network and Perimeter Security – it provides distributed DOS protection, capability of using VLAN, can provide perimeter security in terms of firewalls, authentication. Needs to implement virtual zoning with application mobility.

- Elastic Elements - Storage, Processing, and Virtual Networks

Now it is evident that this discussion on cloud and cloud issues can go on, just like that. That's why in the next part of this document this discussion is gets narrowed down to a specific domain of cloud application. This is basically Geospatial cloud, which will especially takes care of the different services that provided by geographical information system.

6. Geospatial Cloud-

Geographical Information System is any system that captures, stores, analyzes, manages, and presents data that are linked to locations. In the simplest terms, GIS is the merging of cartography, statistical analysis, and database technology. Different services available in GIS that are needs to be considered are

- WFS – Web Feature Service
- WMS – Web Map Service
- WPS – Web Processing Service
- WCS – Web Coverage Service

Geographic Information Systems (GIS) applications have been moving into the cloud with increased momentum but like other fields where software drives the business model, the move from complex software to the software as a service cloud model was slow to catch on due to the business of delivering software - not the technological constraints of doing so. This presents a new market for those previously locked out of GIS due to high start-up costs and a potential paradigm shift for how this niche segment of the software industry does business from now on. The

GIS example is representative not only of how large-scale application areas are tentatively approaching the cloud from a technological and business model standpoint, but how such shifts can begin to have an instant impact on the new user groups enabled by the delivery model.

Different functionalities that a GIS cloud can provide are as follows:

- Organize and Share GIS Projects – multiple projects can be handled at a time, moreover there can be secure and easy up and download facilities for sharing purpose.
- Create and Edit Spatial and Non-Spatial Data – users will be able to create new geospatial data and can even edit them time to time, can be further extended to mobile and handheld devices.
- Import and Interoperability – services like WMS, WFS etc. will be provided and will support all GIS vector formats e.g. KML, MapInfo, ESRI, Shapefile etc.
- Styling – customization will be available to users as per their requirements.
- GIS Attributes Information – information can be retrieved from the map itself easily.
- GIS Analysis – Hotspot, Buffer, Layer Coverage, Statistical intersections, Powerful and flexible Spatial Wizard etc.
- Export Spatial Data – export vector and raster GIS data, to any formats available, export to pictures and maps.
- Publish and Share – share with other users, publish your data through WMS server, printing support etc.
- WMS and TMS Server – host and provide your data, connection with Third party based clients like Google maps, Open layers etc.
- Publish GIS Projects on Google Maps – Google provides APIs (Javascript and flash), these can be used to integrate your data to Google Maps.
- GIS Support for Mobile Devices – last but not the least, it will be most exciting when these facilities can be made available for mobile and handheld devices, this will have functionalities like data input from mobile devices, rich media like videos pictures can be collected, it will be highly customizable, automatic GPS retrieval etc.

6.1 Security aspects in Geospatial Cloud-

Data/ Information is a very important issue in case of GIS services, there's a lots of data are there with different granularities, all of them may or may not be of similar sensitivity, for example in a city information which are related to personal data of people are not supposed to be viewed by any user of the system, may be a subset of the users can have the permission to view them.

Thus different security concerns specific to this domain can be of:

- Data sensitivity management
- Access Control: Role Based Access Control

7. *A Geospatial Cloud*

7.1 GeoIQ: [7]

The GeoIQ platform powers the growing GeoCommons community of over 20,000 members actively creating and sharing data and maps across the world. With GeoCommons, anyone can contribute and share open data, easily build shareable maps and collaborate with others.

- Data and maps within the GeoCommons community are public and can be easily shared with other public websites and users.
- Maps created within GeoCommons can be embedded in other websites, blogs and wikis to be shared or can be exported via open standards.
- Import, export and share data and maps across a variety of standard formats such as OGC KML, GeoRSS Atom, GeoJSON, Spatialite and GeoPDF.
- GeoCommons provides a valuable data repository where GeoIQ customers can find and import data into their GeoIQ appliances.
- GeoCommons Community data is available for use under the Creative Commons license.

7.1 Architectural Overview

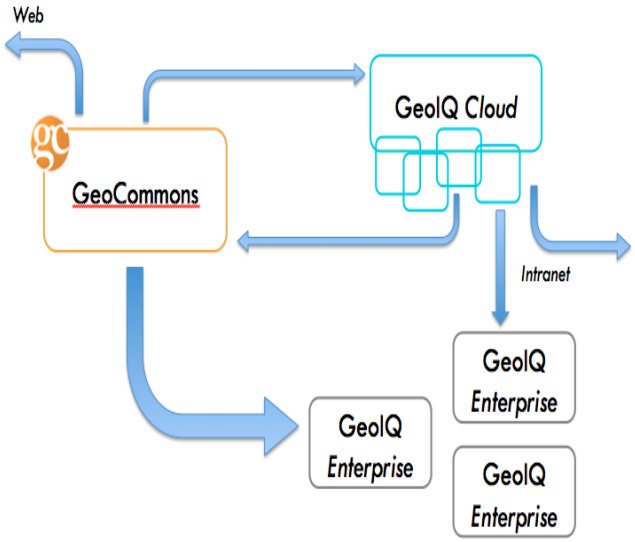

Fig-3: Architectural view of GeoIQ [7]

A very basic picture of how GeoIQ works is shown in the Fig-3, it uses a service called GeoCommon. GeoCommons is a powerful data sharing, visualization and analysis platform. This is used as a platform to host geospatial data such as storing, retrieving and editing data. In addition, the full API provides for building thematic maps, embedding them into applications and interaction via the Javascript Interface.

7.2 Some other works Geospatial Clouds

There are other organizations, those are also working on the same aspect, e.g. we already have Google Maps, it's a kind of public GIS service, moreover other organizations like Microsoft is working in this domain in the name of Windows Azure, 'giscloud', GIS Supercomputing in the RMSC Cloud.

8. Conclusion

As we can see that Cloud is crouching day by day in the public network, and as per the facilities that is supposed to be provided by a cloud this will be a essential tool of usage for people of different classes in no time. No doubt cloud is a very vast concept, thus in general talking about cloud and development will be clearly of least use. As cloud has a very large applicability domain, thus it is always of better understandability while the talking is been narrowed down, as in this report is done in terms of Geospatial Cloud. As there is a little work done in the name of Geospatial cloud so far, but GIS service is a matter of utter importance in various aspects of our life, this if it can be provided to common people as in the form of a service – by means of a cloud in the first place, it will be worth the value. As we have seen there are issues with this implementation can arise and potential issues are always with them, but as it has its own kind of challenges as the same time it is also considered that it got some of its own inherent advantages.

References

[1] Definitions of SOA, ver. 1.1, the Open Group.

[2] Cloud Computing Defined 17 July 2010.

[3] Cloud Software Service: Concepts, Technology, Economics, Harry Katzan, Jr.
Savannah State University, Service Science 1(4), pp. 256-269, © 2009 SSG

[4] Privacy in the Clouds, Ann Cavoukian 2000, p. 4.

[5] Effectively and Securely Using the Cloud Computing Paradigm, Peter Mell, Tim Grance, NIST, Information Technology Laboratory, 10-29-2009

[6] Cloud Computing 2010, An IDC Update, IDC Executive Telebriefing, 29 September 2009

[7] www.geoiq.com

[8] geocommons.com/help/