

Cloud Computing Approach on GIS Data Processing

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Abstract— The sustainable livelihoods development is a process to get better understanding of the livelihoods of people all over the society. The process may be used in scheduling and planning new developmental behaviors. It also evaluates the involvement of those activities for sustaining the livelihoods of the people. Sustainable livelihoods unite people with their communities and with spatial related matters. It has great impact on Environment, Socio-Economic condition of the society, health related matters and other resources on the earth.

The basic function of a GIS is to provide better knowledge and better perceptible of spatial data. Even it has got the decision making capability and can act like expert system in the field of computational science. GIS technologies are using geospatial and non spatial data. In respect of sharing the large amount of geo-referenced analyzed data Cloud Computing platform may be useful.

In this paper, a model has been proposed to process the data provided by GIS under Cloud Computing environment.

Keywords— Cloud Computing, Scalability, GIS, Sustainable Livelihood component.

I. INTRODUCTION

Sustainable development is a continually evolving subject. There are several ways by which sustainable development has been defined. As per the report of Brundtland [1], sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. There are two main concepts. Firstly, the concept of needs. Here, concept lies for searching of essential needs of the poor and overriding the priority which has to be given. Secondly, the concept of limitation imposed by the socio-economic condition, state of technology and the ability of the environment to meet present needs and also suggests for future needs. It is also an effort that relates the scientific and technological plan to enhance the contribution of knowledge to environmentally sustainable human development around the world [2].

This is known to us that the quality of life is a system. We always tried to be healthy and physically sound. But, if people are poor and don't have access to education, the reality says

the need of development on the area. Again, if people are not able to secure good income and can't feed properly to their families, then also good development is required. In the context of healthy environment, we need to think for the sustainable development also. The concept of sustainable development is rooted in this sort of systems thinking. It helps to understand ourselves and our world [3].

The resources that are needed for the sustainable livelihood of the individual people are the combination of the human resources, natural resources, infrastructural resources, institutional resources and mostly capital resources. Fig. 1. depicts the sustainable livelihood resources.

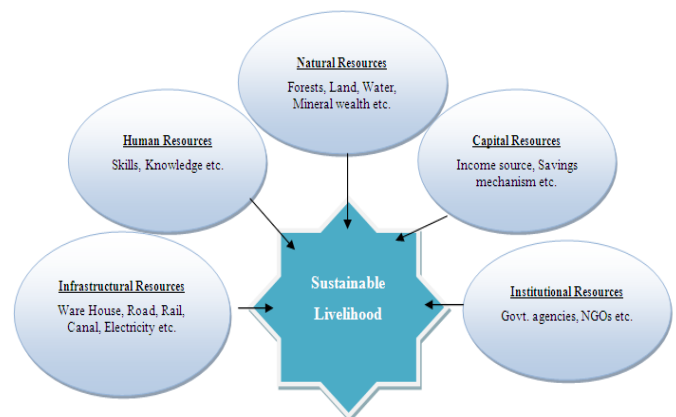


Fig. 1. Sustainable Livelihood Resources

Processing of the sustainable livelihood resources mentioned in Fig. 1. needs GIS application tools. For better accessibility, scalability and on demand availability of the GIS application and data, Cloud Computing paradigm is one of the good solutions these days.

The plan of this paper is as follows. Section II shows the important needs of GIS and Cloud Computing. Section III describes the GIS issues in traditional platform and Cloud Computing platform as well. It also describes their usability among the end users. Section IV describes reasons why cloud computing requires in GIS. We propose a Cloud Based GIS model on Section V. Finally, in Section VI we present the conclusion of this study with its modest demerits.

II. NEEDS OF GIS AND CLOUD COMPUTING

A. Needs of GIS

The acronym of Geographic Information System is GIS. It is a system which helps to design, capture, store, manipulate, analyze, manage, and present all types of geo-referenced data. Even it has the power of analyze and representation of various user defined formats. GIS is the amalgamation procedure of cartography, statistical analysis of spatial and non-spatial data and database technology [4]. GIS has the capability of digitally create, modify, analyze and manipulates the data of a spatial areas. Even GIS can process the data which not spatial and irrespective of boundaries. It is basically a system which integrates stores, edits, analyzes, shares, and displays geographic information for informing decision making [5].

GIS technology has been increasingly used for geospatial and non-spatial data analysis. It has advance data collection technologies from diverse data sources, no matter how much is volume and organizational restriction on the data. Even GIS can operate these data and distributed them geographically. The spatial analysis on large amount of data is complex and computationally intensive. We have seen the various resources of sustainable livelihood development [figure. 1]. Managing those data with their related fields is very cumbersome job. Thus GIS may be of useful tool in this respect.

B. Cloud Computing

Cloud Computing is a new concept and trend in information technology arena. Using this technological concept we can shift or transfer software and its related services from personal computers to the Internet. It is a centralized system where one can place data and software, which are used to be on personal computers. As these services floats on the internet, the name suggested as Cloud Computing. End user can access the computing infrastructure with available resources, even sitting in remote places by using internet [6].

Cloud Computing is often associate with the concept of a utility, in which an organization can “plug-in” to this virtual computing environment and use the computing resources available on an as-required basis [7]. Applications running on such a platform can be accessed via web clients, while the application software and data are kept at the server side. It is virtual kind of server. Consistency in using various intellectual property (IP) rights, private data, ownerships of data of different clients and components intermix with the “distributed” program executions, which may be deeply embedded all over the cloud [12]. The reason behind using Cloud Computing is to share and pool resources of GIS data and its computation results among geographically isolated users. It is also having a scalable and low cost computation platform. Thus GIS application requires the Cloud Computing platform.

III. GIS ISSUES : TRADITIONAL AND CLOUD COMPUTING

Traditional GIS application basically runs on the desktop environments only. The user has to collect the data from the real field observation and then analyzed data in the field and sometimes on the stand alone computers. After processing it, keeps analyzed data on the server or any linked repository. End user can manipulate or edit the data on the same computers. Analyzed data then may be available on the internet or any mode as resources. Fig. 2. shows the traditional GIS application.

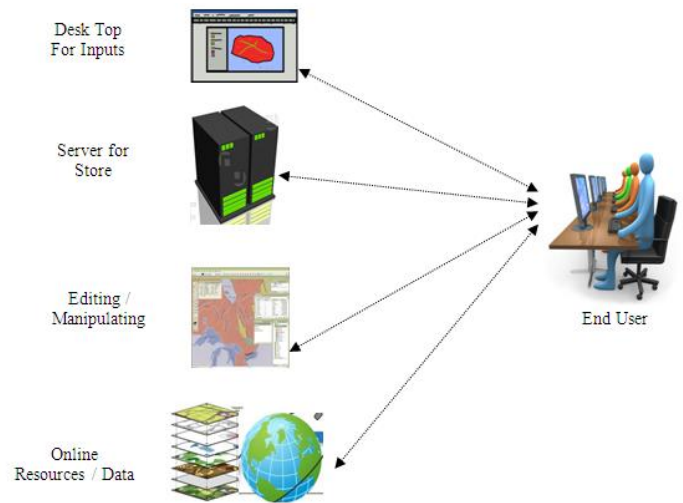


Fig. 2. Traditional GIS Application

In comparing with Cloud Based GIS applications (Fig. 3.), user may have difficulties purchasing of the GIS software full products, they are not suppose to think for the availability on the market. User directly can get access from the Cloud. Generation of GIS data on the Cloud application is simple and it is like adding points. These points can then be uploaded to

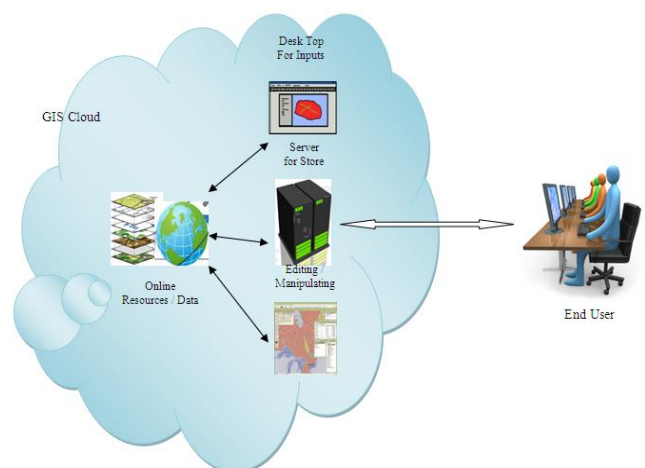


Fig. 3. Cloud Based GIS Application

any cloud based GIS Platform for analysis. Almost from any where one can access the data base to mange and analysis the data. Even end user does not need to be back at the office in order to see the results of the day’s mapping. Thus providing

flexible any cost effective platform for the end user. Fig. 4. shows how an online map on Cloud can be accessible among the various users with various devices in diverse geographical areas.

IV. WHY CLOUD COMPUTING ON GIS APPLICATION ?

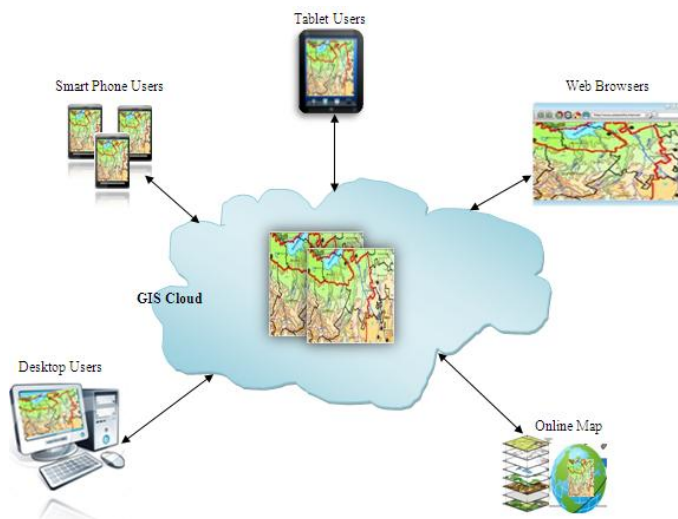


Fig. 4. Traditional GIS Application

Cloud Computing platform has been suggested a better approach to upgrade the GIS application in terms of providing bigger services to the end user all over the world. Cloud computing coupling with GIS application, is proving great success in the information system designing for any organizations and researchers as well. There are a few more reasons of using Cloud Computing paradigm as follows:

A. Widen Potentiality

Cloud computing in the GIS is day by day extending its services throughout the world. Having potential in accessing it is being the great platform in the information technology.

B. Easy Web Map Publishing

Web Map Publishing has been easy enough by the use of experienced GIS staff to create manage and host your Web Map to manage GIS data and assets using this platform.

C. Improved Collaboration and Sharing of Resources

Since an internet connection and user account is only needed to access geospatial data. User can easily collaborate and share processed GIS data among the users of different places easily.

D. Cost Effective Alternative

Cloud computing platform is cost effective as managing GIS data and developing user friendly applications which allow us to view, manage and maintain data anytime without having to purchase the costly hardware and software to run

our own in-house GIS application. Thus reduce the implementation cost.

E. Ubiquitous Access

Ubiquitous means always present or available. Cloud computing on GIS platform has the tremendous capability of providing location independent resource sharing. Ubiquitous access, i.e. any time and ever present access of the data. GIS data are readily available on the cloud. Pooling and processing of data is easy in this platform.

F. Scalability

Scalability is one of the important features of Cloud Computing. When there is a need of providing on-demand and ubiquitous services, Cloud platform is one of the good approaches. Scalability is concerned with how quickly Cloud Computing components such as servers, network access, or GIS databases can be make ready to meet the demands of the Cloud service and the user community of that service. Scalability is a desirable property of a system, which indicates its ability to either handle growing amounts of work in a graceful manner or its ability to improve throughput when additional resources like hardware are added. A system, whose performance improves after adding hardware, proportionally to the capacity added, is said to be a scalable system. Similarly, an algorithm is said to scale if it is suitably efficient and practical when applied to large situations for example, a large input data set or large number of participating nodes in the case of a distributed system. If the algorithm fails to perform when the resources increase then it does not scale [9]. In GIS data base this scalability is required very much.

Besides the above mentioned advantages Cloud Computing in GIS is having few more reason for their suitability now a days. These are:

- Elastic behavior and can expand when there is a demand.
- One can stay away from the Information Technology Queue.
- Business house can directly focus on business not in information technological part.
- One can just logged on and start working. No software and Hardware installation is required.
- Deployment and access is much faster.
- Depending upon the use user can bear the expenditure.
- It is economical and cheaper.
- Demand based application.
- Not directly dependent on Operating system and GIS applications.

There are few Cloud Computing environment with its applications are available dynamically using a pay-as-you-go model [10][11].

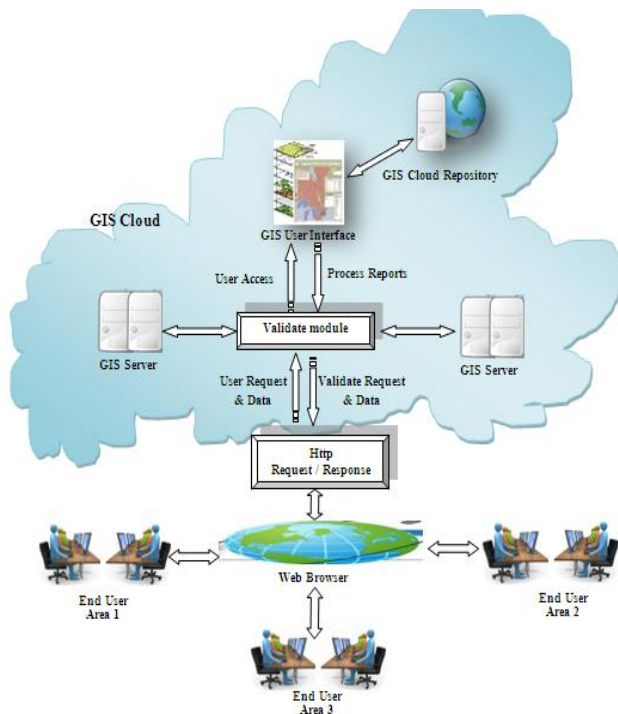


Fig. 5. Proposed GIS Cloud Model

III. PROPOSED MODEL

We propose a Cloud Computing Model together with the applications of GIS for sustainable livelihood data processing globally. Fig.5. shows the proposed model that may have taken the heavy data of the related field, process and analyze it and distribute the processed information among the user situated in different geographical locations.

We also propose a Private Cloud service platform. Here end users can access GIS applications and process, stores and retrieves the data from the GIS Cloud Repository. Sitting in different locations user can get access the GIS Cloud by sending request through their web browsers. One validation module is there to check the authenticity of the user. Once it is authenticated by the module, user can send their GIS data to cloud database. They can get access of the Cloud GIS interface, where they can process the data and even can save and distribute among the business users.

GIS Cloud Repository is actually a database server on the cloud to keep the information. User can get access large storage space on the cloud. For using the Cloud computing environment user have to pay very nominal cost. The charge depends upon the number of hours used in the Cloud GIS applications.

Since one of the important characteristics of Cloud Computing is omnipresent network access i.e. accessing cloud services through standard internet-enabled devices for information access. The GIS Cloud System will be accessed either by GIS Cloud Web Interface or by the area wise in-house computer systems located at the GIS-Service provider organizations [12].

In this study we have elaborated the needs of Cloud Based GIS platform for processing of sustainable livelihood development data. Different resources of sustainable livelihood development that we mentioned in Section I, are the basic data set which may be available on the Private Cloud. Cloud Computing endow with plenty of benefits for GIS applications as compared to the traditional GIS based approaches.

We have proposed a model for using GIS application which is readily available on the Cloud. We propose such a model which gives on demand elastic pool of storage area where user can contribute data, edit, manipulate, analyze, store, retrieve, share and display the spatial data. This would give high levels of usability, user-friendliness, accessibility and above all scalability of GIS information. Although Cloud Computing Platform is having enormous advantages still there is barrier for adoption of this technology due to wide illiterate population and low bandwidth and usability of the internet.

REFERENCES

- [1] World Commission on Environment and Development (WCED), *Our Common Future*, Oxford: Oxford University Press, pp. 43, 1987.
- [2] R. W. Kates et al., "Initiative on Science and Technology for Sustainable Development", *Sustainability Science*, pp. 641–642, Apr. 2001.
- [3] Robert W. Kates, Thomas M. Parris, and Anthony A. Leiserowitz, "What is Sustainable Development? Goals, Indicators, Values and Practice", *Environment: Science and Policy for Sustainable Development*, Vol. 47, No. 3, pp. 8–21, 2005.
- [4] "Geographic Information Systems as an Integrating Technology: Context, Concepts, and Definitions". ESRI. [Retrieved 9th June 2011].
- [5] Clarke, K. C., "Advances in Geographic Information Systems, Computers, Environment and Urban Systems", Vol. 10, pp. 175–184, 1986.
- [6] John D. Piette, Milton O. Mendoza-Avelares, Martha Ganser, Muhima Mohamed, Nicolle Marinec, Sheila Krishnan, "A Preliminary Study of a Cloud-Computing Model for Chronic Illness Self-Care Support in an Underdeveloped Country", *Am J Prev Med*, Vol. 40, No. 6, pp. 629–632, 2011.
- [7] L.M. Vaquero, L. Rodero-Merino, J. Caceres, and M. Lindner, "A Break in the Clouds: Towards a Cloud Definition", *SIGCOMM Comput. Commun.* Vol. 39, No.1, pp. 50-55, 2009.
- [8] Vogels, W., "A Head in the Clouds – The Power of Infrastructure as a Service", *In Proc. Of Workshop on Cloud Computing and in Applications (CCA' 08)*, October 2008.
- [9] Divyakant Agrawal, Amr El Abbadi, Sudipto Das, and Aaron J. Elmore, "Database Scalability, Elasticity, and Autonomy in the Cloud", *Extend Abstract*, [Online]. Available: <http://www.cs.ucsb.edu/~dsl/>.
- [10] (2013) Amazon Web Services, [Online]. Available: <http://www.amazon.com/>
- [11] (2013) ArcGIS for Server Cloud Solutions Offered by Esri, [Online] Available: <http://www.esri.com/software/arcgis/arcgis-for-server/in-the-cloud>.
- [12] Muzafar Ahmad Bhat et al., "Cloud Computing: A Solution to Geographical Information Systems (GIS)", *International Journal on Computer Science and Engineering (IJCSSE)*, Vol. 3 No. 2, pp. 594- 600, Feb. 2011.