International Journal of Advance Research in Science and Engineering
Volume No.06, Special Issue No.(03), December 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

Analysis of Paradigm Shift in Cloud-based GIS Systems

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ABSTRACT

Nowadays, every application including the GIS based applications are being migrated to the cloud.Several leading GIS based firms have developed Cloud based GIS solutions and alternative huge firms have already migrating their applications and information to the cloud. GIS solutions like ArcGIS, GIS Cloud, Map2Net, CartoDB, Mango Map have already their cloud based versions which have gained considerable market share compared to their contemporaries. In this paper, we presenta technological overview of the paradigm shift in Geographical Information systems (GIS) and Cloud computing technology. The aim of this paper is to depict how the advent of Cloud Computing technology has influenced GIS based systems. We also present the deployment models of the cloud based GIS systems and weigh their benefits. The evolution of ArcGIS, towards its cloud version, its environment and infrastructure is also described in detail. The paper is concluded by presenting the GUI user expectation of such systems and its future scope.

Keywords - Cloud computing, GIS, ArcGIS

I. INTRODUCTION

In everyday life, we tend to should have availed services like door-step dish delivery, emergency medical services, period flight data, and pursuit and delivery of shipments on time. Most organizations like fast-food chains, hospitals, banks and the aviation trade, use Geographic data system (GIS) and alternative machine-controlled systems to produce period skilled services to their customers. Organizations use GIS as a decision-support-system. for instance, banks will use GIS to investigate the population density in a very state and judge if to put in new ATM machines (ATM) in specific areas, to extend their client base. [1]

The purpose of GIS is to automate the process of capturing, storing, editing, updating, analyzing, and displaying all types of geographic data. GIS eases the process of manually collecting geographic data and its conversion to digital form. This tends to reduce the number of errors creeping in during the manual process. **Fig. 1.1** depicts data capturing through satellite in typical GIS. [2]

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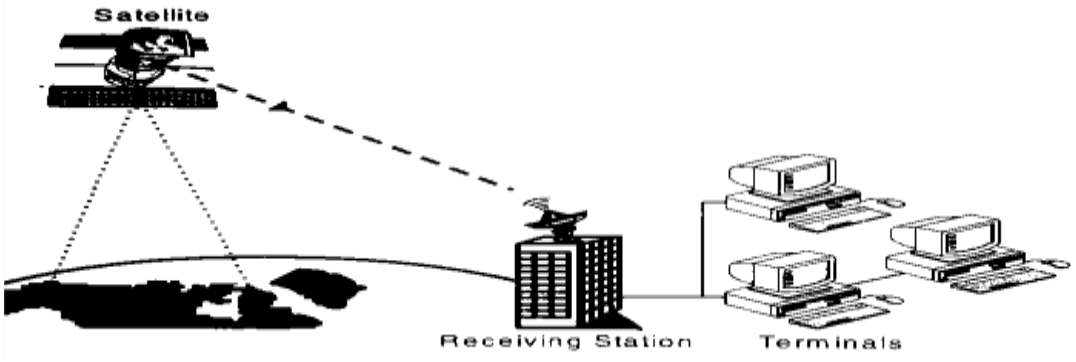

Figure 1.1Data Capturing in Typical GIS [2]

As shown in the figure, a satellite image of a region on earth is transferred in digital form to a receiving station on earth and is available on individual computer terminals for use.

Cloud Computing and GIS

Cloud computing is associate rising trend that is employed all over thanks to its low value service and physical property. It's a technology advancement that created a revolution in fields like medical, IT and little scale businesses. It's apace rising as a technology trend that just about each business that gives or consumes package, hardware, and infrastructure will leverage. The technology and design that cloud service and readying models supply are key areas of analysis and development for geographic system (GIS) technology. Cloud GIS offerings will vary from information storage to end-user net applications to different targeted computing services. Most GIS developer considers cloud computing and technology vital within the development and vision of the ArcGIS system platform solutions.**Fig. 1.2** shows how Cloud Computing speeds up the ArcGIS applications.

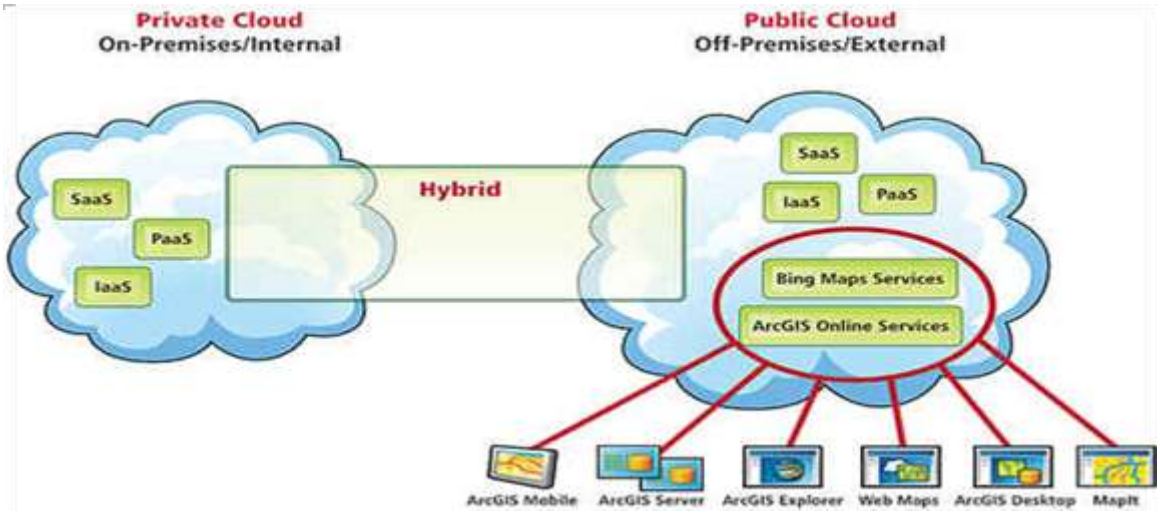

Figure 1.2Cloud computing speeds delivery of applications and can reduce costs.

Cloud Service Models

Three core options compose the service models within the cloud computing environment. [3]

- **Software as a Service (SaaS)** includes end-user applications delivered as a service instead of as historically put in, on-premises package. The foremost normally documented example of SaaS is Salesforce.com, that provides a client relationship management (CRM) system accessible via the net.

- **Platform as a Service (PaaS)**provides an application platform, or middleware, as a service on that developers will build and deploy custom applications. Common solutions provided during this tier vary from APIs and tools to info and business method management systems to security integration, permitting developers to make applications and run them on the infrastructure that the cloud merchant owns and maintains. Microsoft's Windows Azure platform services square measure typically documented as PaaS solutions at this middleware tier.
- **Infrastructure as a Service (IaaS)** primarily encompasses the hardware and technology for computing power, storage, operating systems, or other infrastructure, delivered as off-premises, on-demand services rather than as dedicated, on-site resources. Examples include Amazon Elastic Compute Cloud (EC2) and Rackspace, among many others.

Cloud Benefits

Cloud computing provides opportunities for organizations to become less expensive, productive, and flexible to deliver new capabilities.

The *pay-as-you-go* rating model is usually quite flexible once dealings cloud applications or infrastructure, permitting prospective cloud purchasers to *"try before they buy,"* whereas existing cloud customers pays ahead to require advantage of volume discounts and satisfy budget prediction needs. dealings assets shift the duty of maintaining on-premises information centers to the cloud seller, assuaging the customer's responsibility for computer code and hardware maintenance, current operation, and support.

Cloud Computing Deployment Models

There are several types of cloud computing deployment scenarios. TheNational Institute of Standards and Technology (NIST) is emerging as thepreferred provider of the de facto definition of cloud computing and thedistribution models. [4]

Some organizations, concerned about security, may opt for a private cloudor a hybrid deployment model.

- **Private cloud.** The cloud infrastructure is provisioned for exclusive use by one organization comprising multiple shoppers (e.g., business units). it's going to be closely-held, managed, and operated by the organization, a 3rd party, or some combination of them, and it's going to exist on or off premises.
- **Community cloud.** The cloud infrastructure is provisioned for exclusive use by a selected community of shoppers from organizations that have shared considerations (e.g., mission, security needs, policy, and compliance considerations). it's going to be closely-held, managed, and operated by one or additional of the organizations within the community, a 3rd party, or some combination of them, and it's going to exist on or off premises.
- **Public cloud.** The cloud infrastructure is provisioned for open use by the overall public. it's going to be closely-held, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud supplier.
- **Hybrid cloud.** The cloud infrastructure may be a composition of two or additional distinct cloud infrastructures (private, community, or public) that stay distinctive entities, however area unit certain along by standardized or proprietary technology that allows information and application movability (e.g., cloud detonating for load equalization between clouds).

II. LITERATURE REVIEW

Bhat et al. projected a multi-tiered design for GIS Cloud System that may be a consolidated, elastic pool of figure and storage system to collect, manipulate, analyze, and show abstraction knowledge. though this was an abstract framework however a powerful contestant for meeting the high-level demands of GIS applications and a well-engineered Cloud Architectures for such applications will probably improve the measurability, accessibility and value of GIS resources. [5]

Ahmed Gamal Aly et al. proposed GIS model based mostly cloud computing for earthquakes prediction has been given. They enforced this model exploitation windows azure as cloud computing platform, power of process and storage of GIS applications are increased. They tried to transfer GIS applications and services to the cloud computing setting and build up a sort of GeoCloud to reinforce the GIS field significantly emergency management that depends on GIS. Using cloud computing technology provides an embarrassment of advantages for GIS applications as compared to the standard approaches, like measurability. [6]

Eman Mahmoud et al. mentioned cloud computing technology within the GIS application. They centered on a way to apply the cloud computing techniques within the GIS abstraction knowledge storage and process, also as its impact on GIS code development and products patterns; and projected a model during which the method of group action GIS application into cloud platform. They enforced this model exploitation Amazon EC2 as cloud computing platform, power of process and storage of GIS applications are done to reinforce significantly the emergency management system. They pointed the issues that required to be improved like applying, enhancing the projected model to support formation knowledge of GIS system, and additionally exploitation full utilization of computing services within the cloud computing infrastructure to host massive volume of information as doable exploitation Amazon storage services like Amazon S3. ArcGIS Server one in every of the thriving experiences are often used with Amazon internet Services however it had been terribly expensive to be used. [7]

Abdelrahman M. Helmi et al. over that merging the Geospatial Information Systems with the Cloud Computing supported the Hybrid preparation model may offer them with impactive resolution for the health sector in Egypt to assist in determination the issues associated with the dangerous distribution of the resources and therefore the knowledge location dependence that effect on the taken selections. [8]

According to Taha M. Alfaqih et al., with the event of industries, and therefore the huge technological leap, it became necessary to integrate GIS with cloud computing specifically GIS Cloud, therefore benefit of the services provided by computing (Storage, Computing, networks, sharing), also as resolution several of GIS issues, that is that the massive size of geospatial knowledge, that need immense storage and multi computing. presently GIS Cloud is considered very hip and utilized in several places and areas and has several applications and plenty of edges.

Cloud GIS is that the combination of running GIS code and services on cloud infrastructure and accessing GIS capabilities exploiting the net. within the literature review, section divided the GIS cloud into four areas as (Geospatial Information, A spatial web portal (SWP), Emergency Management, Social Media). [9]

Qichang Chen et al. concluded that data-intensive GIS applications are beyond the capacity of what a single processor can process in a reasonable amount of time. The challenge requires them to resort to some form of

parallel computing. Unfortunately, writing parallel programs is inherently difficult especially for those scientific programmers most of who have not been well trained. MapReduce architecture provides a promising way to parallelize the existing applications. They bestowed a platform for running distributed GIS applications over MapReduce clusters. The experiments show that MRGIS (MapReduce GIS) will improve the performance considerably. [10]

Rashid Amin et al. It performs a critical appraisal of accessible and attainable use of technology for a project that needs combination of Cloud computing and net based mostly GIS application to realize its objectives. It additionally encompasses style and implementation of a cloud based mostly GIS application to research road traffic accidents in Cloud based mostly GIS to research Road Accidents. It will serve the aim of serving to quickly to seek out dangerous roads accidents and implement accident hindrance measures. It can serve the aim of helping quickly to find dangerous roads accidents and implement accident prevention measures. It additionally helps to spot what are the most causes of accidents, and judge that ought to get on the best priority within the road safety designing. [11]

III. ArcGIS IN THE CLOUD

Cloud computing is viewed because the next evolution that may impact businesses and the way they manage their IT infrastructures. Cloud computing features a direct impact on GIS and GIS users. Esri*(Environmental Systems Research Institute)* has already been investing cloud computing resources for variety of years, and can supply extra merchandise for direct use within the cloud. Esri's rising cloud-ready strategy is to supply customers with a spread of opportunities for selecting the foremost economical, efficient, and secure mixture of on- and off-premises GIS applications and services to fulfill their business desires. [12]

Figure 1.3Cloud-based content, servers, and applications provide cost-effective and flexible opportunities for organizations to deliver and consume GIS content and services.

ArcGIS within the cloud makes it potential to require advantage of the advantages of cloud computing, as well as preparation of Web 2.0 applications that need versatile measurability. ArcGIS Server and ArcGIS on-line give new, efficient, and versatile opportunities for organizations to deliver and consume GIS content and services within the cloud. mistreatment ArcGIS within the cloud shifts the duty of maintaining on-premises resources to the cloud marketer, assuaging the customer's responsibility for maintenance and support.

Esri considers cloud computing and technology vital within the development and vision of the ArcGIS platform. Many choices area unit out there for firms that wish to boost productivity and potency whereas reducing expenses and releasing up valuable IT resources to target newer business initiatives.

GIS services area unit out there within the cloud in order that ArcGIS users and developers will access ready-to-use maps as well as representational process, topography maps, and street base maps likewise as task services like routing and geocoding services for North America and Europe. ArcGIS Server is deployed within the cloud via the Amazon EC2 in order that organizations and developers will publish and quickly deploy custom GIS mapping applications among minutes.

GIS computer code as a Service provides centered, cloud-based shoppers and applications that simply solve complicated business issues mistreatment GIS tools and knowledge however do not need GIS experience to use. For additional data, visit Arc supply, Business Analyst on-line (BAO), or Community Analyst.

The mobile GIS cloud will give a vital role within the field-based management method through the mixture of the client-side within the field (mobile components), GIS functionalities and also the server facet (cloud components). Mobile GIS services area unit running on the cloud, in order that associate degree organization's field workers, business professionals, and customers will access GIS capabilities and knowledge mistreatment nearly any mobile device.

With ArcPad, users will cash in of the ArcGIS Server ArcPad extension to send edits back to the enterprise geodatabase directly from the sphere. Edits from ArcPad is enabled on prime of the ArcGIS Server on Amazon EC2 Amazon Machine Image (AMI), that is preconfigured with SQL Server categorical. Optionally, if extra space for your editable options is required, ArcPad edits is synchronous to the Enterprise Geodatabase AMI, conjointly out there with ArcGIS Server on Amazon EC2.

Esri has been providing computer code and Services (S+S) for a few times, permitting customers to leverage their on-premises solutions with on-demand services. Esri's ArcGIS on-line map and GIS services give S+S users with immediate access to cartographically designed, seamless base maps to that they'll simply add their own knowledge in associate degree Esri on-premises product. As a community cloud, the ArcGIS on-line Content Sharing Program permits users and organizations to contribute geographic knowledge content. investing Amazon's EC2 and straightforward Storage Service (S3) cipher and storage services permits Esri to host the content and supply access 24/7. ArcGIS mortal users will consume ready-to-use base maps and layers from ArcGIS on-line services within the S+S model. Also, ArcLogistics provides computer code and access to on-line services that assist you produce best vehicle routes and schedules.

IV. CLOUD INFRASTRUCTURE FOR ArcGIS

Cloud computing is growing in importance for GIS professionals. Reasons for its importance embrace value, measurability, flexibility, and fast preparation. Two specific situations for GIS within the cloud area unit significantly compelling:

Increasing Operational Efficiencies with On-Demand GIS - Cloud infrastructure permits GIS users to consistently or briefly increase their computing power and knowledge storage capability while not impacting their native IT infrastructures. Users area unit selecting this because of the clouds elastic scaling and cargo

equalization features—in alternative words, its ability to increase AN organization's capabilities to support larger audiences and handle peak hundreds throughout the busiest times. Additionally, the cloud atmosphere involves zero up-front capital investment, complete access by any device anyplace and at any time, and low system administration value.

Streamlining Application Development and Deployment -GIS application developers are finding ArcGIS in the cloud an ideal environment for building and testing application prototypes. They can carve out their own space in the cloud so that they can provision computing resources that match the destination infrastructure, pull in application templates, access hosted APIs and software development kit components, and connect to shared widgets and add-ins. When the applications and services are ready for beta testing, they can be shared with specific user groups or with the actual customers for gathering feedback and making refinements. When it's time for deployment, the applications can be migrated to the on-premises environment or moved to a production environment in the cloud.

ArcGIS on-line Works to enrich and Extend Desktop and Enterprise ArcGIS. ArcGIS on-line is intended to operate complete package as a Service (SaaS) application for internet mapping and geographic info management. it's conjointly been designed to completely integrate with ArcGIS package deployed on-premises.

ArcGIS on-line maps and services may be employed in any shopper, as well as desktop, mobile, and internet applications. Users will author their maps with ArcGIS Desktop package or just produce maps by uploading their knowledge employing a browser. they will then publish these maps as map tiles or feature services in ArcGIS on-line and supply access to any ArcGIS shopper via open REST APIs to any internet or mobile shopper.

Users will management access to the maps they need to share whereas, at an equivalent time, supporting multiple open collaboration opportunities. Once a map is made, it may be shared with a cluster or everybody. Because of info is keep within the cloud, anyone WHO has access to the map will discover it, view it, add extra layers and graphics to that, and share it title of respecting as a replacement map—all in a very cloud atmosphere.

V. DEPLOYANYWHERE FOR ArcGIS

You can deploy ArcGIS 10 on-premises or in the cloud for greater scalability and convenience. Esri provides pre-loaded virtual machine images on two popular cloud platforms.

1. ArcGIS Enterprise on Amazon Web Services
2. ArcGIS Enterprise on Microsoft Azure

ArcGIS Enterprise on Amazon Web Services provides you with Amazon Machine Images (AMIs) to help you to deploy the components of ArcGIS Enterprise (ArcGIS Server, Portal for ArcGIS, ArcGIS Data Store) on Amazon Web Services (AWS). ArcGIS Enterprise components run on Amazon's hardware and is administered through web services.

Advantages of deploying on AWS include the following:

- No installation required.
- Scalable on demand.
- No hardware infrastructure to maintain.

ArcGIS Enterprise on Microsoft Azure allows you to deploy an ArcGIS Server site or ArcGIS Enterprise on Microsoft Azure virtual machines.

The advantages of deploying on Microsoft Azure include the following:

- You don't have to maintain hardware infrastructure.
- You can create or remove sites as demand requires.

VI. GIS USER PERFORMANCE EXPECTATIONS

Cloud computing has become an awfully common vocabulary in recent years. the mixture of GIS (geographic information system) with cloud computing will improve the performance of GIS. **Fig. 1.4** shows however user performance expectations have modified beside the technology. GIS project efforts are often completed in but 0.5 the time it took simply ten years past. GIS professionals wantto assist computers to try to their work – these days computers area unit anticipating users to review and supply feedback. [13]

User show performance expectations in 2005 were around 3 seconds—a challenge for medium map displays viewed within the pc space. constant map service these days are often rendered in less than 0.3 seconds. These performance enhancements open opportunities for:

- More complicated dynamic map services.
- Deployment of ArcGIS Server on easier-to-manage virtual server environments.
- Deployment of internet services on a hosted cloud computing setting.
- The chance of abundant richer dynamic services that use a lot of refined applied math analysis or network routing algorithms (two to a few times the complexness of current GIS progress baselines).

These opportunities can introduce new challenges. As heavier process choices area unit introduced, it'll be progressively vital to set up, set performance milestones, and manage compliance throughout system preparation.

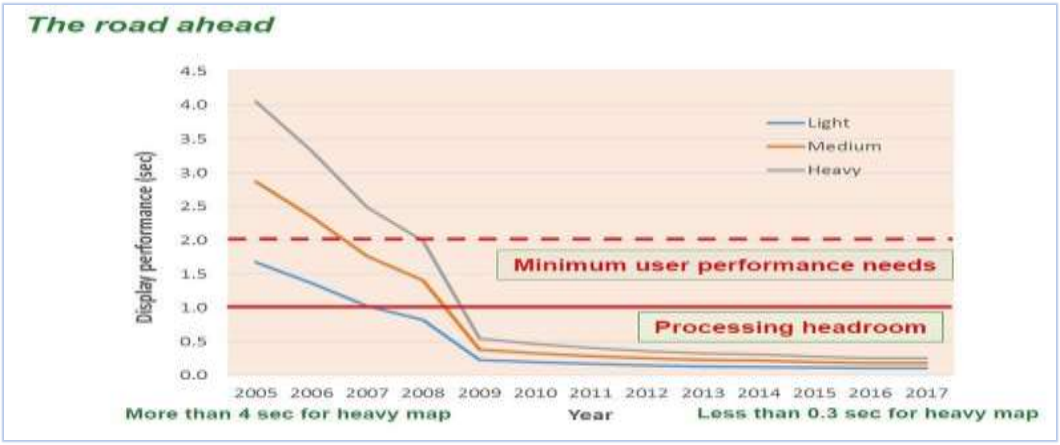

Figure 1.4User performance expectations have changed over the last 10 years primarily due to faster hardware processing technology. Heavier processing loads can now be supported without impacting user productivity. [13]

VII. CONCLUSION

GIS with Cloud computing has become very popular in IT companies due to its quantifiability, low cost, flexibility and practicability. In this paper, we summarized the idea of Cloud Computing and mechanism of GIS exploitation of this paradigm. In this paper, we present a technological overview of the paradigm shift in Geographical Information systems (GIS) and Cloud computing technology. The aim of this paper is to depict how the advent of Cloud Computing technology has influenced GIS based systems. We also present the deployment models of the cloud based GIS systems and weigh their benefits. The evolution of ArcGIS, towards its cloud version, its environment and infrastructure is also described in detail. The paper is concluded by presenting the GUI user expectation of such systems and its future scope. The move to the cloud provides edge and have an impression on GIS applications. In our future analysis we'll investigate the performance analysis of various software package used for GIS Cloud.

REFERENCES

Journals/Paper References

[1] Shafat Khan, "Empirical Evaluation of ArcGIS with ContemporaryOpen Source Solutions - A Study", International Journal of Advance Research in Science and Engineering, Volume No.06, Special Issue No.(01), Nov 2017, GKU ICRISAEM-17, ISSN: 2319-8354.

[2] Asoke K. Ghosh, "GIS and AutoCAD Map", NIIT, Prentice-Hall of India Private Limited, ISBN-81-203-2519-2.

[3] Victoria Kouyoumjian, Esri IT Strategies Architect, "GIS in the Cloud", The New Age of Cloud Computing and Geographic Information Systems, Reprinted from the Fall 2010 issue of ArcNews magazine.

[4] Peter Mell and Timothy Grance, "The NIST definition of cloudcomputing", NIST special publication, 2011.

[5] Muzafar Ahmad Bhat,RazeefMohd Shah and Bashir Ahmad, "Cloud Computing: A Solution to Geographical Information Systems (GIS)", International Journal on Computer Science and Engineering (IJCSE), Vol. 3 No. 2 Feb 2011.

[6] Ahmed Gamal Aly andNevineMakramLabib, "Proposed Model of GIS-based CloudComputing Architecture for Emergency System", International Journal of Computer Science and Mobile Applications, Vol.1 Issue. 4, October- 2013, pg. 17-28

[7] Eman Mahmoud, Osman Hegazy and Mohamed Nour El-Dien, "Integration of GIS and Cloud Computing for Emergency System", International Journal of Engineering and Computer Science, Volume 2 Issue 10, October 2013 Page No. 2889-2893

[8] Abdelrahman M. Helmi, Mona M. Nasr andMarwa S. Farhan, "The Pivotal Role of Geospatial Information Systems based on Hybrid Cloud Computing for the Health Sector in Egypt", International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 4, Issue 5(2), September - October 2015

[9]T aha M. Alfaqihand Mohammad Mehedi Hassan, "GIS Cloud: Integration between cloud things and geographic information systems (GIS) opportunities and challenges", high-performance GIS simulation frameworks," International Journal of Digital Earth, vol. 6, pp. 383-403, 2013.

[10] Qichang Chen, LiqiangWangandZongbo Shang, "MRGIS: A MapReduce-Enabled High Performance Workflow System for GIS", eScience, 2008. eScience '08. IEEE Fourth International Conference on12 Dec, 2008, http://ieeexplore.ieee.org/abstract/document/4736879/

[11] Rashid Amin, Muhammad Munwar Iqbal, Mudassar Hussain, Zeeshan Iqbaland Naeema Saleem, "A Cloud based GIS Application framework to Analyze RoadAccidents using windows azure", International Journal of Computer Science and Information Security (IJCSIS), Vol. 14, No. 1, January 2016.

Web References

[12] See Esri at http://www.esri.com/software/arcgis/arcgisserver.

[13] http://wiki.gis.com/wiki/index.php/Software_Performance.