Utilization of Cloud Computing for Presentation of Cadastre Data

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SUMMARY

Recent developments in Cloud Computing (CC) technology affect Computer Aided Design (CAD) and Geographical Information Systems (GIS). Due to harmonization of these technologies a new area called Spatial Cloud Computing (SCC) has been emerged. CAD and GIS are essential tools for a cadastre application. SCC will bring efficiency and velocity to process of cadastre applications done by government or private sector. Internet's accessibility will make spatial/non-spatial file shares easier and faster. As an example a surveyor in land may easily access to maps, satellite views or any data relevant without any obligation of going to office. This access also can be possible with smart phone, tablet or laptop thus just necessity is internet connection. With SCC user will be able to view, edit or share cadastre data or land title independent of installing any CAD or GIS software. On the other hand, at cadastre applications SCC brings functionality, high capacity and scalability besides accessibility. In this paper the innovations SCC brings to cadastre and related geospatial studies were researched and some of these were tested, verified with case studies.

1. INTRODUCTION and LITERATURE OVERVIEW

Geographical Information System (GIS) is one of the most efficient tool for directing and sharing cadastre datasets like other spatial datasets. During the last 20 years we have witnessed concerted efforts worldwide to develop internet-based infrastructures to make data and information products more widely accessible and shareable to support science, public policy in different thematic areas, and provide improved services to public sector, citizens and business (Borzacchiello and Craglia, 2013).

Due to the incredible development in information technology, the information management function has been substantially improved over the last few decades, with many attempts to establish effective information systems to deal with land information (Demir and Coruhlu, 2008; Steudler, 2004). Usage of internet technologies for share of spatial data in terms of e-government applications is a necessity (Aydinoglu, 2002). In our day, there is a new concept for sharing spatial data and making it accessible to different user cluster. This technology is called Spatial Cloud Computing (SCC).

SCC capability can be as simple as running a GIS on a cloud platform and using Cloud Computing (CC) for GIS services (Yang and Deng, 2010) or as complex as building a well optimized CC environment based on sophisticated spatiotemporal principles (Yang at al., 2011; Srinivas et al., 2011). SCC is built on the benefits of CC and the advantages of leveraging the geographic component in data (Xue et al., 2010).). SCC presents new important research eras in terms of development of GIS technology (Kouyoumjian, 2010). In this paper we have investigated and tested usage of SCC technology for share any presentation of cadastre data. Advantageous and disadvantageous criterias were researched using SCC technology instead of classical server system for cadastral applications.

2. CADASTRE AT TURKEY

Two core cadastral projects in Turkey are; Land Title and Cadastre Information System (TAKBIS) and Real Estate Inf. System (MEGSIS). TAKBIS is one of the most important e-Government projects of Turkey. TAKBIS aims spatial data share and collaboration between associated organizations. It is an integrated objective oriented information system containing multi-functional aspects in terms of geospatial applications. 21 million land title and 5,5 million cadastre file were incorporated into system. After three TAKBIS project steps, hardware and software infrastructure of TAKBIS is evolved up to now but it is clear that this is a developing process and maybe TAKBIS 4 of TAKBIS 5 step will be under cloud technology.

MEGSIS is a project aiming gathering CAD based local based in same share pool and matching these CAD files with related tabular files as Land Title information. MEGSIS has three components;

1-Web based application software
2-Internationally standardized web map services
3-E-government web map service

Current situation at MEGSIS is shown at Table 1 displaying local manager office studies of General Administrative of Land Title and Cadastre for Turkey.

Table 1: Current situation of MEGSIS

Local Office	Land Title Parsel	Cadastre Parcel	Integrated Parcel	Integration Rate	Multiplecing Geometry
Kastamonu	2.368.603	2.374.003	2.370.730	99,98	3.49
Yozgat	2.228.153	2.240.699	2.230.396	99,82	942
Samsun	3.339.994	3.341.519	3.309.511	98,79	2.687
Erzurum	3.052.933	3.065.595	3.014.279	98,35	2.377
Trabzon	3.161.355	3.142.549	3.117.597	98,35	1.568
Sivas	2.573.946	2.569.027	2.542.690	98,13	2.944
Antalya	2.789.089	2.833.109	2.787.862	98,05	1.255
Bursa	3.989.663	4.004.826	3.916.018	97,98	3.391
İstanbul	2.679.216	2.658.470	2.625.659	97,92	1.278
Konya	3.457.728	3.426.931	3.382.426	97,58	3.364
Eskişehir	3.879.682	3.850.565	3.781.660	97,31	3.699
Ankara	3.577.535	3.727.770	3.493.654	96,36	18.855
Diyarbakır	1.094.032	1.069.839	1.051.804	95,94	474
Hatay	2.536.803	2.516.072	2.442.251	95,87	4.972
Edirne	1.735.914	1.754.336	1.666.313	95,82	3.393
İzmir	3.455.326	3.386.711	3.311.584	95,56	3.069
Kayseri	2.701.734	2.687.943	2.603.316	95,52	3.629
Denizli	2.683.806	2.632.995	2.570.485	95,52	2.024
Van	1.063.084	1.048.515	1.011.438	94,62	4.487
Şanlıurfa	1.304.027	1.242.401	1.207.859	92,29	1.335
Gaziantep	1.386.196	1.312.476	1.257.472	90,52	2.002
Elazığ	1.899.488	1.817.875	1.718.391	90,11	8.417
TOTAL	56.958.307	56.704.226	55.413.395	97,29	

3. ABILITIES OF SPATIAL CLOUD COMPUTING

We argue that the latest advancements of cloud computing provide a potential solution to address these grand challenges in a SCC fashion (Yang et all., 2011). There is a strong contender for meeting the high level demands of GIS applications and a well-engineered cloud architectures for such applications can potentially improve the scalability, accessibility and usability of GIS resources (Bhat et all., 2011)

3.1 Lower Cost

Because the geo-technology infrastructure, the services and the data are provided; there is no large initial investment in time and cost, or ongoing maintenance. This is important because the cost of an enterprise GIS can be quite significant from a variety of factors including software licensing, applications development, data management, and (Information Technology) IT infrastructure (Williams, 2010).

3.2 Solving Data and Computing Intensity Problems

SCC optimize CC infrastructure by helping arrange, select and utilize high end computing for computing intensive problems. (Yang et all., 2011). Huge and various spatial datasets can be stored and processed with SCC technology. ESRI systems showed that 4.5 billions of spatial data records can be analysed in 10 seconds with cloud computing and big data paradigms. In future studies this will open an inspiring door in front of geospatial sciences.

3.3 Scalability

This scalability on demand, when viewed against the backdrop of the typical software and hardware procurement process in many organizations, is a very real benefit. Furthermore, the flexibility this provides to organizations, through the capability to deploy this additional capacity on demand (Kouyoumjian, 2010).

3.4 Interoperability

Cloud infrastructure supports working with other geospatial or non-spatial systems. Various spatial datasets applications can be easily linked to existing systems with API's or web services. Also basemap function enables taking huge satellite view, Streetmap, or NASA geodatabase to existing system easily.

4. CASE STUDY

4.1 Study Area, Geodatabase Design and Load to Cloud

Case study area is Pelitli neighborhood, across Trabzon airport Turkey. Cadastre data was taken in CAD format and converted to GIS geodatabase with special software. After conversation some attributes were linked automatically to these files. Then all the cadastre data was loaded to cloud as it can be clearly seen at Figure 1. We used Esri's cloud services as a preference of cloud DAAS, also Used Arcgis Online (Esri) for SAAS. Geodatabase is comprised of polygon and line vector GIS files.

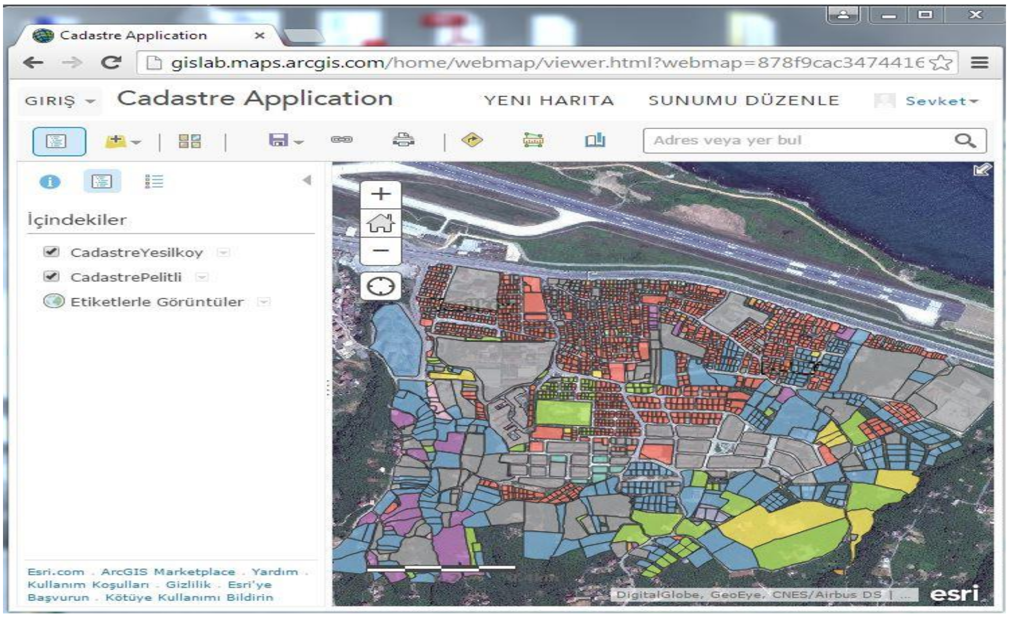

Fig. 1 View of cadastre data at cloud

4.2 GIS Queries and Analyses on Cloud

Some GIS analyses and queries were applied with the purpose of showing SCC capabilities and what can be done with cadastre data on cloud. As a small example attribute query and labeling due to request is shown at Figure 2. Some well known GIS analyses were done with SCC like; Buffer, Intersect, Overlay etc. Also optimum route analyse from one cadastre parcel to another parcel was done on cloud.

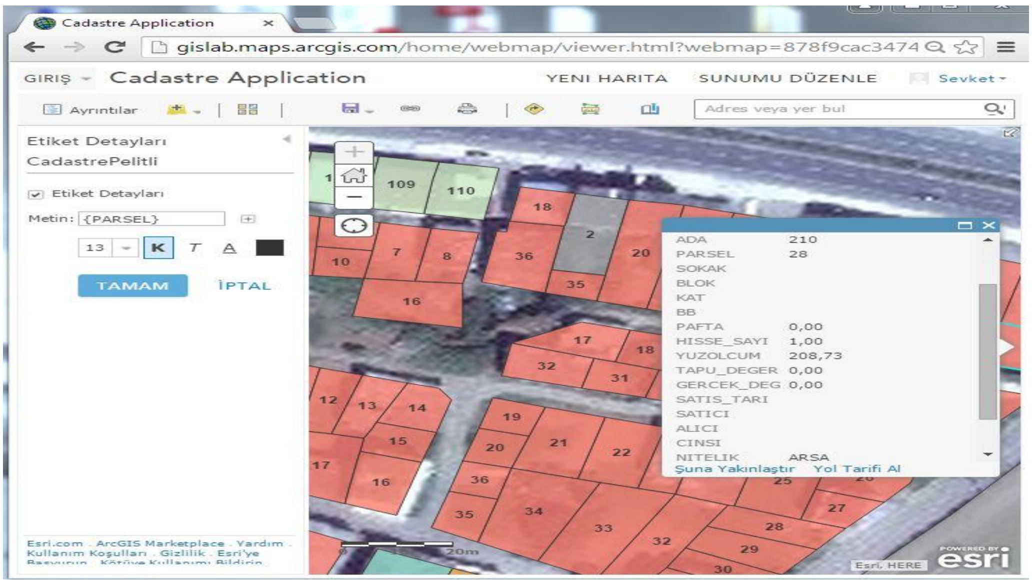

Fig. 2 Attribute query and labeling

4.3 Building Fast Web Applications

On the other hand dynamic web applications can be done with SCC quickly. In Figure 3 a useful web application can be seen. This application shows instant changes in cadastre attribute changes corresponding to instant data shown at screen. As an example at screenshot (Figure 3) there is 103 cadastre parcels and average area of these 103 parcel is 30.705 m^2. At other information pane average selling value or a special defined attribute average such as owner type (person, government or foundation).

Fig. 3 Building Web application with SCC

4.4 GIS Based 3D Model Integration on Cloud

After all GIS based 3D model of buildings at study area was rendered by City Engine and then sent to cloud. 3D model contains all the attribute information about the cadastre parcel which the building is settled on. If anyone clicked 3D model, all the information can be quickly seen in information panel.

Fig. 3 3D model of buildgs at study area

5. CONCLUSIONS

This paper focuses on advantageous and disadvantageous results of storing, analyzing and sharing cadastre data with CC. SCC principles have been applied at this paper. Case studies stated that many benefits of SCC are scalability, economic efficiency and opportunity to work in an interoperable environment. SCC has also practical system building and sustaining structure for GIS and non-GIS users. At the other hand researches outside of case study showed that, SCC supports working with huge spatial datasets in terms of Big Data processing. Because power of parallel computer includes into system at this point. Basemap function brings access opportunity to necessary supporting spatial datasets. As it has been declared at past projects, SCC has some problems in terms of security and privacy. But there is promising future plans for overwhelming these issues. Last improvements with MEGSIS and TAKBIS are promising about Turkey's cadastral web applications. Acceleration line of online services is good when to compare with past but exactly existing systems are not enough to support today or future demands. In conclusion, power and efficiency of SCC may be included to Turkey's cadastral applications and vision.

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BIOGRAPHICAL NOTES

Sevket Bediroglu is a doctoral research assistant at Karadeniz Technical University (Turkey) Department of Geomatic Engineering since 2012. His master thesis was about Cloud Computing (2012). His research lines are centred on Spatial Cloud Computing (Cloud GIS), interoperability, location based services, computing law and web based 3-D geovisualition models. He maintenances University funded Cloud Computing research projects with his supervisor.

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Ebru Colak is Assist. Prof. Dr. at Karadeniz Technical University (Turkey). Her PhD thesis was about analyzing factors effecting cancer incidents at Black Sea region of Turkey. Nowadays she is studying about analyzing environmental pollutants with GIS. She has many journal papers and research projects about subject.

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