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Efficient Implementation model for Public Geographic Information System: Case Study

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Abstract: ***Public Geographic Information system (GIS) is a solution that automates the process of collecting community contributions of spatial data, cross-referenced to base maps. It provides the capabilities of analyzing such spatial data giving effective decision support information. On the other hand, the most important implementation models for GIS used recently are Client-Server and Software as a Service (SaaS). This paper focus on giving typical situation as a case study for exploring the advantages of SaaS implementation model over Client server one where public GIS services are implemented first as client server model and secondly when implemented as SaaS. In our new urban City state office, SaaS implementation achieved huge reduction on the total cost of ownership for users of public GIS solution rather than previous GIS Client-Server implementation. High level of cooperative collaboration between departments has been achieved (e.g. survey dept. , land use dept.). Achieved huge reduction on front-up cost required to start using the GIS solution (typically it costs 4.26% of the total front-up cost in case client-server model is used which was 214000USD), and reduction in maintenance /installation hours needed to fix a bug or install new feature across department rather than previous GIS Client Server implementation where the same maintenance /installation hours must be replicated to install new batch containing the fix for new feature. Hence, SaaS implementation model for public GIS overcomes Client Server model in many different aspects and increased the Return On Investment (ROI) value for public GIS solution as it empowers departments in state office to focus in delivering more spatial business's value rather than being busy with having a dedicated data center to operate and manage separate installation of GIS software in client server model.***

Index Terms**: *Cloud Computing, Public Geographic Information System, Software as a service, Client Server.***

I. INTRODUCTION

Public GIS is a system that automates the process for collecting community contributions of spatial data cross referenced to first base map. It provides the capabilities of analyzing such spatial data giving effective decision support information such as decisions for appropriate land use, planning pedestrian areas in crowded streets. On the other hand, the most important implementation models for GIS used recently are client-server and Software as a Service (SaaS). Of course, the easiest and lowest cost of ownership way to let people to consume public GIS Services are to provide those services over cloud using software as a service

II. TECHNICAL CONCEPTS

A. Geographic Information System (GIS)

Suppose that we have Census data across typical governorate at the Census tract level and written in the form of a long table, if you read the table, you have to imagine the Distribution by looking at numbers and city names inside table.

However if, we upload this census data to GIS that has the geographic base map for such governorate, then you can easily Visualize the distribution of the census per each city across the governorate by looking directly to GIS map having census data in map layer cross referenced with governorate base map[2].

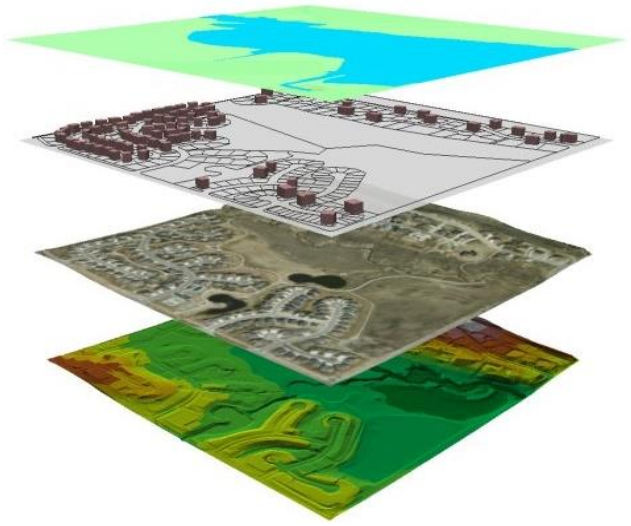

Figure 1 Layers for a sample GIS map [1]

Another feature of GIS is its organization of data into layers as in Fig. 1. For example, GIS may display downtown in distinct layers such as a street layer, a building layer, a parcel layer, and a zoning layer. These layers can be analyzed in isolation or be cross-referenced and analyzed together. For the above governorate census data example, suppose that we had a layer of Census data at the Census tract level in addition to, the layer of clinics. We could view the two simultaneously to determine if the clinics were in the areas of greatest population. Moreover, because a GIS is based in geography, it is possible to query these data layers based on location and distance. There are several reasons why GIS is a useful tool for the nonprofit community. First, viewing data in a map as opposed to in a list or table format makes the data easier to understand, interpret, and easier to communicate to others.

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Another benefit of GIS is that it allows users, quickly, to get past the questions of "what" and "where" and move on to the question of "why". When problem solving, the most important question to answer is "why". Why is crime higher in one area than another? Why a certain service is underutilized? When "why" answered, meaningful discussion and solutions is can be addressed. Being able to see spatial patterns of data rather than simply looking at tables or graphs facilitates the understanding of root causes of problems and helps lay foundations for solutions [3].

B. Client server

Client server attempt to balance the processing between the client and the server by having both do some of the logic. In these networks, the client is responsible for the presentation logic, while the server is responsible for the data access logic and data storage. The application logic may reside on the client on the client or on the server, or it may be split between both. These are many ways in which the application logic can be partitioned between the client and the server. The type of the client server consists of two-tier, three-tier and multi-tier client server. Two-tier client server is one of the most common. In this case, the server is responsible for the data and the client is responsible for the application and presentation. The two-tier client server uses only two sets of computers, one client and one server. Another type of client server architectures is three-tier client server uses three sets of computers. In this case, the software on the client computer is responsible for presentation logic, an application server is responsible for the application logic, and a separate database server is responsible for the data access logic and data storage.

C. Cloud Computing and SaaS

Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), The three core options compose the service models within the cloud computing environment. Each service category can be leveraged independently or consumed in combination with other service tiers. SaaS model comprises end-user applications delivered as a service rather than as traditionally installed, on-premises software. Of course, the software building blocks for public GIS system itself are based on Service Oriented Architecture. Ideally, cloud adopters should be confident that they are consuming state of-the-art systems that are highly reliable and flexible enough to handle large traffic fluctuations and the same time handling massive map images while maintaining high performance. The burden, then, is on the vendor to scale and continually reinvest in the on-demand IT architecture and service so that consumers are consistently provided with a robust, updated GIS solution. Moving parts of the corporate data and computing center to the cloud also reduces the amount of fragmented infrastructure, driving down up-front capital spending.

D. Public versus Private Cloud

There are several types of cloud computing deployment scenarios. The public cloud is what is most commonly being referred to when discussing cloud computing, where the infrastructure and applications are owned by the organization selling cloud services. Since many traditional vendors and users are not quite ready to jump into public cloud computing or are restricted from doing so, the cloud service tiers are replicated within a private cloud environment, behind the firewall, on-premises and maintained within the parameters of the host organization. Many believe that the sweet spot for cost optimization in an organization will be found in a delicate balance of public, or community, and private clouds.

III. EFFICIENCY FACTORS IMPLEMENTATION "CLIENT-SERVER VS SAAS"

A. Hosting

In Client Server model, the main GIS software reside on a central server whereas users require installation of software on their personal computers to use the solution, hence computing resources are shared between server and clients. In SaaS model, public GIS solution normally utilizes a multi-tenant architecture, in which the application serves multiple businesses and users, and partitions its data accordingly. Users rely predominantly on the Web and only require an internet browser to use the application.

B. Elastic Service Provisioning

In Client Server model, in case new GIS service is needed it should be implemented both at Server level and client level, so that service can be provisioned to users to work with and that's not flexible, however, in SaaS model, it only needs development of the new service and binding it to SaaS architecture at data center level and users can use the new service right way from their browsers if they have credentials to it, and of course, this is better for end users.

C. Total cost of ownership

In Client-Server model, typically, the GIS software is purchased upfront and there is an annual support fee to cover upgrades and customer support services by each related department separately not only the state office [4], in our case study it costs the city's state office 214,000 USD to cover four departments having a total of 20 end users plus recurrent support fees of 6000USD, just to start using the public GIS. Whereas, in SaaS model, public GIS solution and data are hosted and are managed at a central data center operated by the software vendor. End users simply access the system through their web browsers and a broadband Internet connection. The software vendor will manage data backups and periodic updates. The management state office will typically pay a monthly subscription fee to use the service [4], in our case study, it costs the city's state office 38USD monthly per each user, So, to use the public GIS for a year, the city's state office with four departments having a total of 20 end users will pay 38×12×20=9120 USD, resulting a huge reduction in total cost of ownership to use the public GIS software directly.

D. Co-operative Collaboration between users

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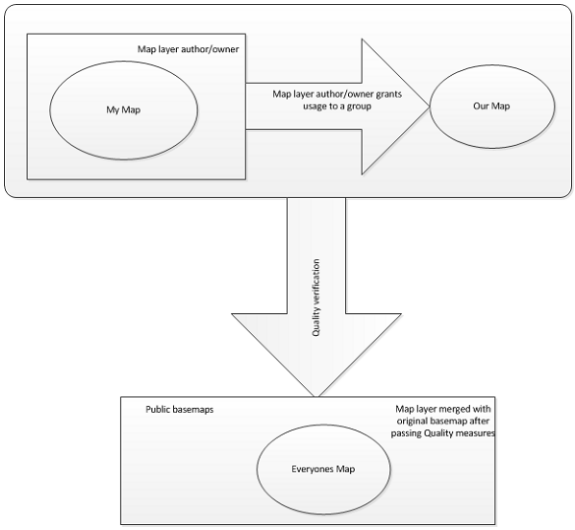

Figure 2. Collaboration and levels of Involvement

In Client-Server model, spatial data contributions are isolated by nature, as each department has its own separate GIS software with different perpetual license, whereas, in SaaS model, as seen in Fig.2 above, public GIS solution normally utilizes map involvement and contribution from various departments and results in rich maps with collaborated information shared between departments; so that efforts are not duplicated.

IV. CONCLUSION

In this paper, a reliable Implementation model was applied to provide public GIS solutions' services; this model is software as a service (SaaS), when we implemented public GIS in our City's state office using SaaS, it achieved higher efficiency in maintenance time and higher reduction in total cost of ownership fees as there are no up-front fees at the same time it achieved higher cooperative collaboration in maps production eliminating duplicate work and efforts.

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