Technical Analysis of GhanaPost GPS (AsaaseGPS)

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***Abstract*—This paper seeks to investigate and analyze the technical details of the GhanaPost GPS application and try to give recommendations on how the system could be made better, this paper also demonstrates that the technologies used to build the solution has drastic implications whereas if careful attention was given, a stronger and more secure solution could have been achieved. I also try to debunk the current argument of progressive development.**

***Index Terms*—AsaaseGPS, Ghana Post, Digital address.**

1. Introduction

”GhanaPostGPS is Ghanas official digital property addressing system which covers every inch of the country and ensures that all locations in the country are addressed. With GhanaPostGPS, every location has a unique digital address.” [1]

This is certainly a very modest idea but in this paper we would look at security and architecture of the system; while at the same time hinting on Data security for the Ghanaian. This paper in no way dismisses the work done by the developers of ”GhanaPostGPS”.

2. Architecture

Before any system is built it must be designed first. The idea of what goes where needs to be visually drawn in order to not sway from it or end up with a broken system. Any architecture must have 3 fundamental properties
* It must have a core
* Abstraction for the core
* and Finally the initial plan

If the core architecture is not defined well, changes to the core would be made in the short and long term which renders the core design useless.

The GhanaPostGPS architecture as seen in (Figure.1)

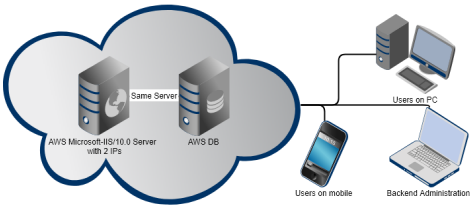

Figure 1. Architecture Overview.

Developers of the system seem to have taken the easiest path and designed the system as they would a traditional web application without consideration for scaling and High Availability(HA).
With the aim of the project becoming a national requirement the developers should have factored that into their design.
It should be said though, that the Developers did make an attempt at load balancing using the DNS method as seen in (table.2)

2.1. Tools Used(ServerSide)

On the Server Side the developers chose a .Net(dotnet) framework running on Microsoft’s IIS Server; as can be seen in (table.3). Even though these are common platforms used in many deployments its usage globally has been declining in the past few years in favour of more robust and stable platforms. In recent times Windows has discontinued either its platforms or development tools [5] [6] [7] [8], and in some cases both. It is therefore careless to not consider all these facts when deciding on what systems to base a National service on. A more modern development tool(s) would have allowed for guaranteed time support and usage.

The developers also used MySQL or MSSQL (as I have not verified this yet); if they did use any of these database engines, then it should be noted that, even though facebook and twitter initially run with these platforms they have long learnt from their mistakes and are using more bespoke and modern solutions like NoSQL.
The System seems to also be running on a single instance

TABLE 1. CLIENT SIDE URL HANDLERS

URI	SCHEME
asaasegps.com	asaasegps
www.asaasegps.com	https
www.gps.ghanapost.com.gh	https
gps.ghanapost.com.gh	ghanapostgps
www.ghanapostgps.com	https
ghanapostgps.com	ghanapostgps
www.ghanapostgps.com.gh	https
ghanapostgps.com.gh	ghanapostgps

of AWS(Amazon Web Services).
I'll talk about the security implications later.

2.2. Tools used (Client Side)

I only investigated Android. The android client is written in B4A [1] [2], it should be noted that the developer has experience in B4A. I believe B4A was used for portability but there are better options which are best suited for this type of application. Google Maps is re-used in the android client[2].

The Android client is designed to open the urls specified in (table.1)

For some reason they designed custom schemes "asaasegps://", "ghanapostgps://" et al as specified in (table.1)

The Client also opens the website even though it has near native code that is suppose to handle that.

3. Security

I will consider security in terms of System and user.The "System" would be in reference to server side and client side whereas "user" would be about anything that is user centric. The system lacks a lot of security checks; so much so that I believe security was not part of the fundamental design consideration.

The location is based on Google's OpenLocation [3] [4] Code[3] with slight definitions specific to Ghana; Using and open system like this means one does not even need the application to generate ones own addresses.

1. B4A (Basic 4 Android) was written by "AnyWhere Software" as a wrapper for android for developers who are used to programming in Basic and can't or don't want to change to Java

2. It uses Google Maps API V2 with the API key AIzaSyAn_vsgpw36hMASIgNgjUk8vdw4ljhJGxA

3. Open Location Codes are short, 10-11 character codes that can be used instead of street addresses. The codes can be generated and decoded offline, and use a reduced character set that minimizes the chance of codes including words.

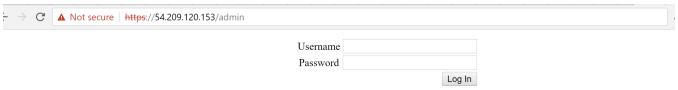

Figure 2. Admin login.

On the server side the admin is exposed on https://www.ghanapostgps.com/admin as seen in (figure.2)
there is no capture apart from a CRSF[4] token, which does not really protect from a "brute force" attack.

The services are hosted on foreign territory therefore Ghanaian data would not be Governed by the Data Protection Laws [10] of Ghana. The European Data Protection Laws [11] takes precedence and do not match the Ghana Data protection Laws [10]. The data stored on these servers are kept for a maximum of 5 years under the European laws and can be held further without notification to the developer or the Ghanaian.

This problem also affects the usage of Google Maps; we are in a monitored world and the western world is more autocratic in on-line services than any other, Google retains the data provided willingly and uses these data for targeted marketing and other known and unknown purposes, this means that; by just opening the app google already has your data and on top of that we are providing our GPS locations freely. This is clearly stated in the Google Maps privacy rules.
User tagging[5] technology makes it easy for anyone to be able to track any user on-line and with the help of GhanaPostGPS to their very doorstep.

I believe careful analysis should have been done for a

Codes are able to be shortened relative to a nearby location. This means that in many cases, only four to seven characters of the code are needed. To recover the original code, the same location is not required, as long as a nearby location is provided.

Codes represent rectangular areas rather than points, and the longer the code, the smaller the area. A 10 character code represents a 13.5x13.5 meter area (at the equator. An 11 character code represents approximately a 2.8x3.5 meter area.

Two encoding algorithms are used. The first 10 characters are pairs of characters, one for latitude and one for longitude, using base 20. Each pair reduces the area of the code by a factor of 400. Only even code lengths are sensible, since an odd-numbered length would have sides in a ratio of 20:1.

At position 11, the algorithm changes so that each character selects one position from a 4x5 grid. This allows single-character refinements.

4. Cross Site Scripting Forgery

5. User tagging has seen a boost in recent times and is used by almost all the top on-line services to track user movements without user notification or authorization

TABLE 2. DNS LOAD BALANCING STRATEGY

ghanapostgps.com	54.209.120.153
ghanapostgps.com	54.88.252.118

TABLE 3. SERVER SIDE TOOLS

Server	Microsoft-IIS/10.0
Database	MSSQL/MYSQL
Language	.NET/ASP.NET

TABLE 4. CLIENT SIDE TOOLS

Platform	Android/IPhone
Map Engine	Google Maps
Language	B4A

National project with sensitive Citizen data and it should have had a higher priority than the "Version 1" concept.

3.1. Data

As stated above the data stored no longer belongs to the Ghanaian but to foreign governments and entities regardless of whether they are allies or not. This data is also not very well protected and therefore stands a good chance of being accessed by crackers; this means we the Ghanaian are going to have our identities stolen and sold on the black market.

3.2. Possible Attacks

Potential attacks include but are not limited to DDoS attacks, Direct Attacks, Data theft, impersonation.

4. Conclusion

So in conclusion, I choose not to be too detailed but at least demonstrate the dangers and bad design tactics that were used to build the system. I hereby propose the desired architecture and system design that can mitigate all these issues and more.

NITA[6] [9] has a Datacenter that has been designed to handle systems of this scale, and systems that hold National Data.

The proposed system would take into consideration security. In the design we assume here that physical security is taken care of and properly catered for by NITA.

Before we continue lets look at the issue of progressive development. It is believed among a certain group of the developer community that projects should start with barely any functionality and progress as time goes on, this idea is normally referred to as the "Version 1" concept also known as the waterfall cycle except the part about specification and design is ignored to try and impress with rapid UI[7] development. But as time has proven over and over again these ideas never work because they do not consider the fundamentals of architecture design and are never implemented well.

6. National Information Technology Agency
7. User Interface

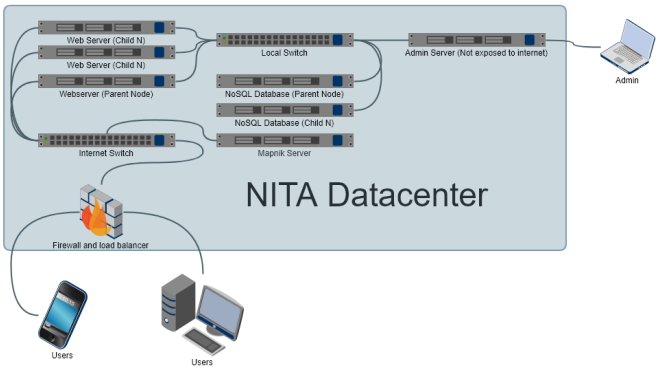

Figure 3. Proposed Architecture Overview.

TABLE 5. PROPOSED TOOLS AND SETUP SERVERSIDE & CLIENTSIDE

Server	NodeJS
Map engine	Mapnik
Database	MongoDB/CouchDB
Language	Javascript
Load Balancer	Firewall and multi server
Android & iOS	Ionic Framework

Figure 3 shows the proposed architecture while table 5 shows the proposed technologies to use. The proposed system uses a distributed architecture. It proposed to have the admin side of the system only exposed to the internal network. The database is also to be exposed only to the internal network. The reason why we only expose these services to the internal net work is because they pose a serious security risk when exposed to the Internet, and there is no need for them to be exposed to the Internet since its hosted locally at NITA.

The system also takes advantage of the distributed property of NodeJS applications where replicas of the same application can be used as a superior form of High Availability and Scaling.

The admin node is also a separate server in order to avoid excessive administration work coinciding with user activity. This design also allows for proper checks and accountability should there be an incident.

For the Map engine, I "highly" recommend using Mapnik [12]. Mapnik allows us to host our own map engine and service which is similar to Google Maps and is used by OpenStreet Map [13].

On the client side; which is mostly smart phones. I suggest the usage of Ionic Framework [14]. Ionic lends itself to us in a very convenient way through the usage of only HTML5[8], this is far better than the usage of B4A; which has its own flaws which would not be discussed here. When further invesigated it can be confirmed that the whole system can be designed in Ionic as the app ends up opening the website[9].

In view of all of this I highly recommend that a second critical look is given and that the suggestions given in this paper is given a chance; because I as a Ghanaian am also affected by this system.

Acknowledgments

The author would like to thank KBO Dev Support Group members. If you want to join follow these
SLACK : https://kbodevgroupinvite.herokuapp.com
TELEGRAM : https://t.me/kbodevgroup

8. HTML is the new standard for web development
9. GhanaPostGPS Website

References

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Data-Protection-Act-2012-Act-843.pdf

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[12] http://mapnik.org

[13] https://www.openstreetmap.org/

[14] http://ionicframework.com/