

INTERNET OF THINGS (IoT): NIGERIA ROAD TO DEVELOPMENT

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ABSTRACT

With emerging development in computing world; Internet of Things (IOTs) is the new wave. IoT is turning into an inexorably developing subject of discussion both in the work environment and outside of it. It is a novel idea that will have a positive effect on how Nigerians live, yet function very well. Countries have deployed this new technology to eradicate myriad societal problems combating humanity. The paper seeks to investigate whether Nigeria can attain United Nations declaration for year 2020 as benchmark for developing countries to have met different targets to move them from extreme poverty, insecurity, illiteracy level and increase Gross Domestic Product by industrializing the economy with basis on Information Communication Technology. This paper seeks to examine the positive impact of deploying this phase of technology to Nigeria economy and everyday life (social and ethics). The paper is a theoretical one, with different researches consulted; they all agreed that Nigeria will benefit a lot from investing on IoT, with the gains seen instantly.

Keyword: Internet of Things, Economy, Gross Domestic Product, IoT architecture, RFID.

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INTRODUCTION

With recent developments around the world; countries have sought different ways to enrich its country economy. Nigeria as a whole has tried a different formula, which seems not to work to increase its economic base; including a rebasing by the Dr. Okonjo-Iwela, the erstwhile Minister of Finance who served under Ex-President Goodluck Jonathan.

The emergence of Internet of Things (IoT) is a global wave, but with relative discussion about the penetration of this term and growth of this new computing term (Szewcyk, 2016). The definition of Internet of Things by International Telecoms Union was defined as “*the network of devices and everyday objects embedded with technology, connected to the Internet.*” (ITU, 2016). Internet of Things refers to intelligent networks of connected systems for the purpose of communication and information processing. (Ndubaku, Okereafor, 2015). The term “Internet of Things” was popularized by the work of the Auto-ID Center at the Massachusetts Institute of Technology (MIT).

With Nigeria experiencing a post-recessionary phase, researchers have sought to determine how fast the economy can be developed to meet the VISION 2020. The subject matter has been seen as a verified solution to the myriad of problems combating the country road to VISION 2020. African countries have taken advantage of the IoT technology in different sectors and already seeing tremendous growth in these sectors. (Ndubaku, Okereafor et al). A Worthy example is the Finance sector where virtually all customers have the banking applications on their electronic devices and can do banking transactions, irrespective of location.

IoT can be explained as a pervasive technology using connectivity of people and things (Szewczyk, et al) now entering Africa as a continent from western world. With cloud computing and new technologies in computing world, it is seen as a big driver in economy development. IoT has a lot of expected possible solutions (services) that can be offered to individuals and organizations across Nigeria, which can provide answers to high relative poverty, security concerns, illiteracy and poor basic amenities to half of the country population.

The main aim of this paper is to bring IoT to the awareness of Nigerians with focus on developing the economy and country as a whole considering the problems it might face and possible solutions to conquer these problems.

PROBLEM STATEMENT

With the VISION 2020 set by United Nations drawing nearer, it is unfortunate to know that Nigeria is not near achieving all the goals set. With different policies by policy makers in the country, nothing seems to have been achieved by these policies. African countries that are par with Nigeria on development have improved their economy by expending more on ICT infrastructure, which Nigeria hasn't done. Looking at Rwanda economy and general well being, much can be seen after the country genocide; the solution Rwanda took was to invest more in STEM projects that are beneficial and the country has seen the gains from it.

LITERATURE REVIEW

Nigeria road to development has been on paper right from independence from 1960, and yet Nigeria is still ranked amongst developing nations or third world countries. Despite funding from international donors and oil sales the country is still bedeviled with different problems. Diversification of the economy has been the key word as of the turn of democracy in 1999.

IoT seem as a viable option as it offers enormous potentials to increasing the flow of funds directly to the country. With increased knowledge of computing and development of high end solutions or applications, this technology is expected to create an income that will have direct impact on the economy and the populace.

There are other connectives that may seem to look like Internet of Things as explained by Kalebalia (2016); Machine to Machine (M2M) and Internet of Everything (IoE). Machine to Machine is explained by Wikipedia (2018) is the direct communication between devices either wired or wireless, e.g. is the common utility meters used by power distribution firms to calculate rate of power. Internet of Everything is a new term in computing which was coined by a big networking firm, CISCO; it explained that IoE is the intelligent connection of people, process, data and things. The Internet of Everything (IoE) describes a world where billions of objects have sensors to detect measure and assess their status; all connected over public or private networks using standard and proprietary protocols (CISCO, 2013)

INTERNET of THINGS (IoT) ARCHITECTURE

Architecture for this system can be explained as a design for the specification of a network's physical components and their functional organization and configuration, its operational principles and procedures, as well as data formats used in its operation(<http://www.iot-a.eu/public/public-documents/d1.2>) Understanding how this system works serve as a base, to discover how much potential it can deliver. Since IoT uses different devices at a particular time; it shows that there must be connectivity in between these smart devices. The domain of IoT, comprises of different devices at a particular time, including hard and real time devices, embedded sensors, receivers, actuators and different processors are what IoT devices use to communicate with each other. (Sethi and Sarangi, 2016).

In the history of IoT there is no defined architecture as different authors, scientist have come up with different framework to determine the right architecture. In the course of research through scholar readings and scope of this paper, the most suitable architecture is been described as a three –layer architecture which was identified by (Sethi and Sarangi, 2016). This includes

- Perception Layer: This is the layer that does the information gathering. It identifies problems or challenges about a subject matter. It uses the sensor in the device to search for physical parameters depending on kind of application it was deployed for, and keep up to tabs with other smart devices near it search areas.
- Network Layer: As similar to the OTP layer in operating systems, the network layer major role in the architecture is for connectivity and onward transmission of information gathered, to all devices in the system. For example there are three smart devices; this layer is responsible of connecting all devices and transmitting of information in between these devices.
- Application Layer: The application layer is responsible for delivering application specific services to the user. It defines various applications in which the Internet of Things can be deployed, for example, smart homes, smart cities, and smart health.

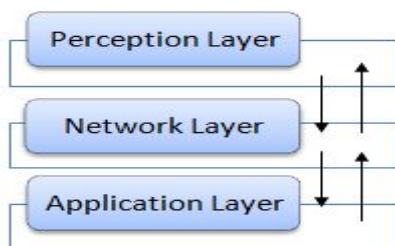


Fig 1: Three-layer architecture (Sethi and Sarangi, 2016)

One of the major things considered to design an appropriate architecture is the security of the IoT based system due to nature of deployment of the application. The development of reference architecture standards, or architecture ecosystems, should be considered; depending on specific

domain use cases (e.g. identification, transaction, finance, healthcare etc.) leveraging applicable accepted international standards for the use case domain. The domain basically helps in designing the application as well as deploying suitable security measures to counter any intrusion from suspecting fraudulent or ethical attack by cyber terrorists.

IoT in AFRICAN COUNTRIES

Despite Africa backwardness in certain technology, some African countries have taken the leap step to be leading user or deplorer of IoT in its infrastructure. The countries have seen tremendous growth in those areas where IoT were being deployed. Although many will argue that Nigeria has the a very big market for technology; this hasn't reflected in any way to developing the country as most times this technologies have been misused by most citizens. Below are highlight from the four major economic block from Africa.

- **South Africa**

According to different telecoms journals, South Africa has the highest number of firms in Africa that are technology based. This country has been harnessing the power of IoT for the past 10 years even at a time the most popular mobile phone network in Africa MTN (Mobile Telecommunications Network) deployed the technology using cameras connected to each line; this helps nursing mothers to watch nannies keeping watch over their respect babies while they are out or at work. It helped reduce crime wave in cosmopolitan areas by installing different sensory based camera in main and suburb areas. South Africa enterprises have seen major investment on IoT and this has led to major increase in more innovation, business efficiency, and lower cost of operation. (Kalebila, 2016)

- **Kenya**

Kenya has become one of the few African economies growing at a fast pace, and becoming the major business hub for the eastern African region, the government in Kenya developed an economic master print to make Kenya an industrialized middle-income economy where her citizens would enjoy high quality of life in clean and secure environment. A research was carried out a team led by Aisha Bryant tried to set up waste lorries with devices, that tell residents which lorry is free for waste disposal, drivers behavior with residents and orientation of residents amongst all other features of the application; it was discovered that it improved waste disposal amongst residents thereby making the city clean (<http://ibmresearchnews.blogspot.com/>).

- **Egypt**

Scientists comprising of academia, researcher together with software engineers steered a committee that showcased various IoTs application to be used to solve the country major problems (societal and innovations) (<http://iot-egypt.com/steering-committee/>). A very good example of the application showcased was an IoT embedded software chip into phones and devices mostly used in a house (Fridges, camera and Televisions e.t.c.), it was use to manipulate these respective devices from anywhere in the country, which makes devices at home controllable at every given point depending on the nature of task involved. (<http://siapsprogram.org/tools-and-guidance/edt/>).

- **Rest of Africa**

Rwanda amongst other technology savvy countries is increasing the budget for the ministries responsible for ICT according to a report from a workshop organized by international telecommunication union (<http://euroafrica-ict.org/wp-content/plugins/alcyonisevent-agenda/files/PROBE-In%28on%29T--- Probing-EU-Africa-Cooperation-on-Internet-of-Things.pdf>). Also countries in

East and South Africa designed an application to solve the problematic power supply in their countries and these help solve erratic power supply into a constant light usage.

ROLE OF INTERNET OF THINGS ON NIGERIA DEVELOPMENT

Different variables help to know when a country is on its way to development or derailment. With advent of internet since the 1970s, has helped developing countries turn into first world countries. These variables are examined critically with relations to developing Nigeria economy at a rapid rate and thereby making the VISION 2020 a viable achievement.

1. **Security:** first world countries have seen tremendous improvement on their security apparatus due to different applications or solutions developed by computing experts. A critical example is the use of sensor based cameras on streets and helps identify when the minimum crime is being conducted. This crime include but not limited to; petty stealing, traffic offences, burglary and sophisticated crimes (homicide, felony, treason or attempted treason and arson by various individuals. These devices can provide coverage on a level which cannot be matched cheaply by other technology (Ahubuke and Ugbari 2017). It is worthy to note that implementations plans and roadmaps are being formulated (Kushalnagar, Montenegro and Schumacher, Year not Provided)
2. **Agriculture:** subsistence and commercial farmers are more than a billion in Africa and this show the sector play an important role in any country development as it vies to make basic needs from agriculture readily available. During the tenure of Dr. Akinwunmi Adesina as the Minister of Agriculture (2011-2015), he introduced IoT based innovations into the agriculture sector (an application developed on android phones) that connected different subsectors of agriculture with Bank of Industry (BOI) and Ministry of Agriculture. The resulting effect of the application was seen as it helped reduced fertilizer corruption, increased value chain of products produced by the sector. With NIMET

giving advices on weather, farmers can now know what kind of produce to plant at a giving time since the devices given to them gives accurate weather conditions.

3. **Health:** Different health schemes are coming up daily since the introduction of National Health Insurance Scheme (NHIS), which 50 percent Nigerians are on currently. Health care providers now provide applications to clients that allow them to consult doctors, ask for prescription, check vitals and other sundry issues. Using Ghana as a case study, there was a vaccine monitoring system where vaccine administered by UNICEF are monitored from point of arrival at port to entry to when it is being administered. Sensors on packages and bottles could let consumers ensure that their medications are legitimate. Furthermore, IoT technology can be used to ensure that medical supplies are stored and transported correctly, to avoid wastage or administering ineffective treatments,
4. **Employment:** due to vast opportunities in different aspect of computing, jobs are created. Since more IoT applications are being developed and thus leading to jobs for computing experts and other sectors needing such system. Going by recent statistics, without the introduction of IoT in the country, ICT has created more jobs after the Agriculture and Manufacturing sectors.
5. **Economy:** The only way to improve any economy in this Jet age is to invest more on ICT. Without referencing any country in particular, any country that increases its expenditure on this sector will see tremendous growth on its economy. Early this year, the country Vice-President Prof. Yemi Osibanjo, noted that any new business coming need not to go through rigorous process of registering their company as they can register online from any part of the world, and this made Nigeria to improve its ranking in the ease of doing business index from 189 to 145. More business is entering the country due

to the fact that the process has been digitalized using IoT framework. This led to more Foreign Direct Investment (FDI) and thus increasing revenue base for the country.

CHALLENGES FACING DEPLOYING INTERNET OF THINGS TECHNOLOGY IN NIGERIA

Despite the advantages accrued on deploying IoT based infrastructure around the country; it is worthy to note that Nigeria, level on Information communication technology, amongst the populace and government, it give rise to different challenges (technical or policy).

(<http://www.inveneo.org/wp-content/uploads/2014/07/FINALTop-ICTHardware-Challenges-White-Paper.pdf>). These challenges when solved will be the forebear in deploying state of art IoT infrastructures.

1. Technical Challenges

With the erratic power supply in this country, it will likely impossible to deploy this application except the government is ready to use back up power projects such as generators or solar power. According to Laura Hosman of Inveneo, the top five hardware challenges in the application of ICTs in development are: electricity/ power/energy; cost; environment; connectivity; and maintenance and support

Another great limit is the natural human behavior. The reluctance to adopting new innovations may occur, just as seen in the case of polio vaccinations and Northerners. Indeed, according to some projects, human behavior may prove a more significant barrier to adoption than some technical challenges. With less than a million practicing STEM expert who can provide the expertise needed, training citizens will be quite challenging. In part of corporate organizations, it may be hard for an entrepreneur to quickly adopt this technology except for big private firm who can purchase this system and have ability to train employed on what to do training. For instance, if 80% of the target population is illiterate, is SMS text really the

best form of communication? There may also be an inadequate number of trained people or technicians to respond, once a system signals a problem. Nigeria still lacks the financial and technical capability to be able to use the Internet of Things in a large wide scale.

Using Nigeria has a case study, the internet version for IoT to fully operate is internet version six of IPV6, the short-term, the transition to IPv6 has proved challenging for some countries and some organizations to date. However, practically speaking, IPv6 may even prove a limiting factor in some M2M deployments, requiring all partners in a project to have made the transition.

2. Policy challenges

The biggest form of challenge IoT has is the case of security issue, intruders can break into this devices; steal personal information about users and attack networks thereby, making the system vulnerable and breaching users privacy. Users may not know that or a system to run effectively large amount of data will be used (The Internet of Things: An Overview,” [Online]). While ICTs do provide greater opportunities for communication and income related activities for lower-income populations, careful consideration is needed of the risks associated (loss of privacy, etc.).

Amongst many ideas set up by policy makers in Nigeria, the local content is one, that is still a major challenge in different sectors. There is just little number of apps currently running an IoT framework built using local languages in the area of deployment. The only major time local content was being raised was when RIM (Research in Motion) owners of Blackberry device asked Nigerian app developers to build app using local languages

The ‘full’ IoT or Internet of Everything (IoE) is likely to require more ‘joined up’ regulation, with telecom/ICT regulators working more closely with their counterparts in data protection and competition, but also with emergency services, health and highway authorities, as legacy regulatory models (e.g. power utility regulations) may prove inadequate to deal with emerging technologies (e.g. ‘smart grid’ technologies).

The IoT needs to handle virtually all modes of operation by itself without relying on human control. New techniques and approaches are required to lead to a self-reliant IoT. Spectrum and bandwidth requirements may impede the adoption of IoT devices and services. According to Cisco’s 2015 Visual Networking Index study, over 10 billion new devices will come online between 2014 and 2019, and total global IP traffic is growing at 23% Compound Annual Growth Rate (CAGR)

RECOMMENDATIONS AND CONCLUSION

A lot still need to be done for this technology to be used in Nigeria, ranging of government good will to penetrating all areas in the country with large scale deployment of IoT. Listed below are recommendations noted by the authors of this paper.

- 1. Increase number of Data Centre’s:** except for Main one Data centre in Lagos, it seems no other data centre exist again in the country except for the national data centre. Data centre should be established virtually in all states or per geographical zone to combat the

use of data. The data centre will help compress data to be used in a more effective way; the issue of breaking into the devices will be limited.

2. **Have a set up standard in line with Local content:** there should be an act that backs the building of IoT devices with local content, so it can be able to penetrate the general populace (Literate and Illiterate). Having a standard guideline will help eradicate proliferation of devices that seems to do similar work, when it can be stacked together in one meaningful application.

3. **Policy Framework:** In the UK for instance, Prime Minister David Cameron announced [in March 2014] an additional GBP 45 million funding for the development of IoT (www.bbc.com/news) Malaysia's Ministry of Science, Technology and Innovation and its applied research agency released a National Internet of Things (IoT) Strategic Roadmap in mid-2015(<http://telegeography.com>) Independently, some donor partners in the ICT4D community have also established "Principles for Digital Development" that aim to facilitate the adoption of the IoT in development (<http://digitalprinciples.org/>) Governments and policy-makers should work closely with industry to understand the issues involved. This policy should also consider how new IoT systems can interface with pre-existing legacy infrastructure to protect and make full use of existing investments in infrastructure.

4. **Trust and Confidence:** the IoT are fundamental and must be designed into the IoT from the outset. Two key components to ensure trust and confidence are privacy and security:
 - Strategies to protect privacy must take a range of risks into account from a variety of different sources as well as adapt to local regulations; and
 - Accelerate research into IoT related security threats to minimize the downsides of the IoT across M2M and M2P communications. The exponential growth of

increased attack vectors (in terms of type of data generated and the variety of things and devices connected to the Internet) may give attackers easy ways to access networked data.

These recommendations were made in particular, in order to make Nigeria road to development a easier and fast one. Gone are the days when Countries depend on foreign donors and Oil money to develop. A country willing to develop needs to think out of the box; and IoT has been has a viable option.

The Ministry of Science and technology should combine with other major ministries (Information, Petroleum, Health, Agriculture and Finance) to create a road map that will indicate how Nigeria plans to bring IoT into the consciousness of its citizens.

In conclusion, Nigeria needs a paradigm shift to build any infrastructure using IoT as a base, and this will lead to increasing the rate of development in the country thereby meeting United Nations MDG goals by the year 2020.

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