The Beginning of Internet in Africa

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Abstract

The is the story of a computer scientist trained in the USA in the '70s returning to his home country Ghana and experimenting with technology acquisition, development, deployment and assimilation in an emerging Internet country. The report is based on personal experience partaking in the struggle to make technology freely available in developing countries. The author's experience covers a long period from 1979 till now. It addresses in detail the period of introduction of the internet technical standard TCP/IP in networks in Africa spanning four segments from 1986 to 2005. The author reflects on that journey

Introduction

After having completed a PhD in computer science in 1977 and worked in the USA I returned to Ghana on an assignment at the University of Cape Coast(UCC) in Ghana in 1979. I found working at the youngest university in Ghana, the University of Cape Coast, would give me a good initiation through the building of a fresh computing science curriculum.

I immediately recognized that we were confronted with a major digital divide and I was challenged to make a contribution. I was often guilty while overseas wondering what to do to avert this danger and now was a chance to make a difference. For someone who had been building mini computer CPUs and high performance systems, a known distributed systems researcher I was in the wrong place

I was indeed awakened by the depth of divide and frightened at the same time. As we would have it, the divide was everywhere; was economic, educational, social, industrial and wellbeing. It rears its ugly head in geography, gender, status, age and by family. As concerned as I was, literally no one seemed to notice nor cared. The authorities who had their own "experts" were not informed, suspicious and yet one cannot be seen as disagreeing with the powers that be. We ourselves were aware of the deficit we had in technical capacities in the region. This was the atmosphere at the genesis

I became a lone soldier in a very unprepared industry and unbeknownst to the people. I was also unprepared but committed myself to computing science to show what it is. We could not engage in meaningful discussion without working with illustrations and demonstrations. We had to educate, appeal to public. Sometimes our expectations were not well aligned with capacities and capabilities

This is the story of how one contributed to computing and the deployment of internet in Ghana and around me. It is also a story of how we navigated the rough policy terrain prevailing at places very far from centers of development of high technology, which was the USA at the time. It also narrates the sacrifices it took to develop a more open policy environment in Africa that accepted internet

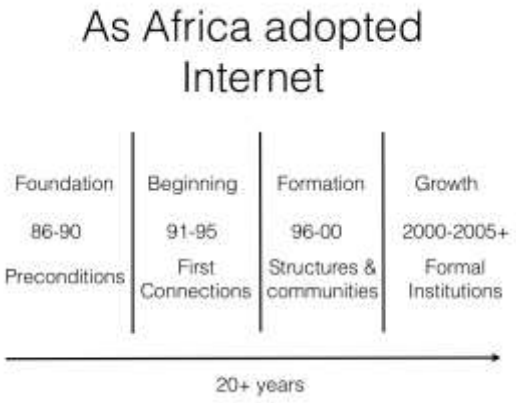
The beginning of Internet working in Africa is hard to tell as there were many initiatives and attribution of any starting points to particular initiatives would be from a perspective. This is in part because there was no system of recording or documenting the actions which were occurring rather very quickly and in new areas. Our attention was focused on getting going. The African media was yet to notice computing science and the Internet and that did not feature much in the press at the time. My first encounter with media and internet was when a local newspaper that was posting negative stories about government in 1993 would not want the government to also have a say through subscription to a public internet access provider NCS.

As things happened information was around and some institutions attempted to document Internet initiatives in Africa. As expected they have focused on their global participation in process, interests, global funding and network of activities in their realm. Some were research programs. Others were voluntary while others were from projects from numerous countries and international organizations. We had called for mainstreaming technology in UNDP projects in the ninety's. We are also mindful that Africa is very large in area with very different economies and people making it difficult to have a comprehensive record of Internet at the beginning in Africa

I present a qualitative and historical account of the dynamics that engendered the introduction of Internet in Africa looking from around me. The prerequisites as I was them. This is after I was already familiar with networking decnet and Internet from working in the USA for Digital Equipment Corporation and studying TCP/IP protocol in graduate school. There is a passionate

side of the story which has not been adequately told in previous writings and that many also felt we were in a liberation movement to free Africa from potential enslavement due to lack of technology know how. A liberation struggle against techno-colonialism. A techno-liberation movement to create sustainable technology development. The fear that whole economies can miss out the benefits of networking was enough adrenaline for many pioneers

There was a also grand collaboration involving many institutions and individuals that focused attention on internet and technology in the process.
We consider four sections: the foundation from 86-90, the beginning period covering 91-95, the formation period from 96-2000 and period of technical institutions Af* from 2001-2005



In the foundation period the basics of computer technology was being assimilated into African societies and economies. Computing and technology were gaining priority in planning in organizations

During the beginning the Internet was introduced to the continent and extended the existing computing systems in the countries into wider more global coverage

During the formation period communities began to self organize into communities focusing on specialized interests and networking with each other and cooperating to advance the internet

This was followed by the establishment of Af*, African technical institutions, in support of the Internet operations in Africa. Some remained informal but others are formal institutions offering services

The Foundation (86-90)

The section takes stock of what was in place prior to the arrival of Internet in the region. The burgeoning computer education programs, the computer industry, the community scene are described. The synergy of personal computers (PCs) and arrival of email were pleasant precursors to the introduction of the Internet

In the foundation period the basics of computer technology was being assimilated into African societies and economies. Computing and technology were gaining priority in planning in organizations. Universities and computer learning schools were being developed. For Ghana all the departments of computing science at the three universities were established in the '70s and matured in the period

I encountered an ICL batch system running COBOL programs for the university administration and physics department. There was one COBOL programmer at the university computer center and few programmers in the country on the whole. Most programmers worked with COBOL, RPG and Fortran and worked in multi programmed batched execution environment with cards.

There were operators who collected cards, processed them and returned cards and print out. There were no interactive systems in the country except a PDP 11 system I carried along with me from Marlboro, Massachusetts at DEC

Interestingly enough one quickly discovered that the computers were classified as accounting equipment and often times the few operators worked for chief accountants of the institution.

Likewise the entry software application in my university at the time was a pay roll system that the department built for the university

For starters I was employed in the physics department as a director of computer center, known as the coordinator of computer center but was teaching in mathematics department. There was no computer science department at the university so it became the task to initiate a computer science department to create more programmers. My first students were math students who chose one year computer science option in 1979

There was no academic computing science being taught at UCC when I first returned and and this would turn out to be one of my motives for selecting to join the faculty. University of Science and Technology had the oldest computing science department started and had close relation with mathematics and physics departments. University of Ghana computer science department had a program and associated with statistics department while the Ucc program the youngest started in 1979

I had also been recruited to join university of Ile Ife and University of Lagos in Nigeria and University of science and technology in Kumasi, Ghana and in the end chose UCC. In the process I had become aware that all the universities in the region were starting to prioritize in having an academic program in computing science alongside improving provision of data processing services for university administration

The universities were largely national universities and few. In Ghana there were three national universities and computing subjects were being introduced in to courses in physics, mathematics and engineering. They were somewhat constrained to the subject area while computing science as a separate field or discipline was yet to be established

Departments of computer sciences and informatics were just getting started with small class sizes at the time. There were very few PhDs in computer science in Africa and lecturers were in short supply. Additional lecturers were drawn from the more established disciplines especially experimental physics for hardware and mathematics for software in the initiative

The first batch of undergraduates graduated in '81 with mathematics bachelors degrees with the one year computer science option. We were rigid and only taught 7 one semester subjects: architecture, algorithms, operating systems, languages, data base, artificial intelligence and numerical analysis. We found an Algol compiler on the ICL machine at UCC and used that in exercises. Some of the graduates went overseas for further studies. Fortunately some who went overseas returned later to continue building the department. There was growing demand for technical skills and the business department at UCC began to also offer courses around computer use

In this period several enterprises in Africa were acquiring computer systems to manage businesses including mundane duties such as payroll, accounting, human resource management, fleet management, finance and administration. There were however other organizations in natural resources sector from mining to oil and power as the economies grew in this era. This latter group used plotting and digitizing equipment with geographic information tools

Computer literacy became important and small businesses developed to provide training services in make shift classrooms or personal executive training

The policy environment was quite centralized and technology policies were the sole domain of ministries of transport and communications

In most countries there was a monopoly telecommunications operator, the national telecommunications company, who was also the postal service. This organization often was also the regulator for downstream value add services and the advisor to government. The national operator had knowledge of telecommunications

A big part of the revenue of the national PTT was from settlement of international telephone calls terminated into the countries. Policy regime seemed comfortable with do little and earn international settlements. The networks were based on largely copper cables and fixed switched network telephony. Data service offering were cable and telex messaging. These telex employed terminals of the switched network to initiate messages. Mobile phones, as we know did not exist however there were wireless services for maritime uses and other HF and VHF radio frequency applications including TV, Radio and other handset solutions

Private networks were taking hold in Africa and several notable vendors were providing system integration and networking services to enterprises in Africa. These were dominated by multinational computer companies such as IBM, digital equipment corporation, NCR, Wang and others. The configurations of the installations were smaller mainframe or mini computer systems. There were a pockets of programmers developing software with cobol, rpg, fortran, basic and other languages running some applications. Similarly local companies were emerging that could provide technical installation and maintenance services. These system integration companies often partnered with global providers to provide turn key solutions to governments and corporations

All the vendors offered enterprise network solutions with different identifiers and communication schemes. Multinational organizations, large enterprises and institutions were adopting these solutions in their operations at the time

Some of these computer systems had network infrastructures that spanned wide geographic areas including some international dial up links using variety of protocols. These systems used variety of modems and communications concentration equipment dependent on vendor architecture

My private sector company, network computer systems (NCS), a systems integrator was agent of digital equipment corporation and operated a DECnet wide area network in Ghana at the time. The network spanned the Vax VMS installations we had including VRA, GNPC and Research Department and NCS offices. Incidentally VRA had over forty softwares engineers supporting a host of applications imported and beginning to develop its own. User literacy in some corporations were high with GNPC attaining 80% literacy over 600 staff at the time

System integration and engineering companies were being established in this era and a work force was gaining experience. Institutional capacity was being built and workforce developed

There were a number of major bids at the time to supply computer systems and these were fought fiercely by local companies and their partners. A bid could take 18 months to conclude and had frustrations on the way due to lobbying

Although the sciences in the academic institutions were quite well developed, the computing sciences were just being introduced and many departments offering bachelors degrees were actually teaching more of industrial computer courses than academic courses. Nonetheless, workforce to support these complex technical systems

were being developed and the immediate need for industry ready skills. The background needed was generally not available and one often developed the technical capacity by recruiting physics and math students and training them internally

During this era there were two forces driving community activities of professional and industry as a whole. The first is the practice of vendors organizing their user base through user groups and user group meetings. An isolated community. The second is attempts to establish associations of local vendors meant to be an advocacy group to lobby for policy positions favorable to computer companies. Both of these groups were not concerned with making policy decisions or standards. They were communities with common interests of sharing similar tools or business or professional interests. For this reason most attempts to form vendor associations from this era failed as the interests continued to degenerate to associations

For a computer scientist there were few forums to cooperate. We were not exactly recognized by the existing science associations and some viewed our work as overlap of physics or mathematics. Neither were we readily welcomed by engineering associations who viewed us as creative engineering lacking the rigor of real engineering. Most of computer scientists from developing countries began to rally to Abdus Salam international center for theoretical physics especially around the microprocessor workshops which were run in different locations around the world. I joined the instructor team and taught Motorola 6809 assembly language alongside interfacing, DSP courses being taught to scientists from Trieste and CERN. The collaboration would spread instrumentation know how to scientists around the world to improve measurements in scientific research. The workshops were held in Italy, Sri Lanka, China, Columbia, Mexico, Ghana. These workshops created many offshoots workshops including VLSI and networks in future

I also discovered the CARI network and community which was very active in French speaking Africa. I subsequently made presentation in CARI conference and attended an event in Burkina Faso. I was engaged with Nigeria in computer industry and also published at Computer association of Nigeria conference

At about the end of this era PC became more affordable and introduction to Africa was brisk. The lower price and performance of PC gave hope that Africa could participate in use of technology. Now small companies and individuals would be able to afford the computer. Of course there were also wild imaginations that these PCs would eliminate need for larger computer systems but that was not to be. However, this became a crucial enabler for access to the Internet in the future

Email scene was very mixed. There were private enterprise networks that enjoyed near immediate delivery of emails kept centrally on servers. Some enterprises arranged arranged interconnection to other networks including bitnet and internet. Others offered live chat systems within the enterprise network. In the DEC customer base it was popular to use a decnet phone application, an implementation of chat

There were other public email services running uucp and others using fidonet nodes for relay of store and forward messages. There were others using global providers like MCImail and Sprint.

The widespread use of corporate email and other public email services would become an important foundation for the Internet era

The Beginning (91-95)

This section describes how we adopted internet protocols, the contest between existing circuit switched and packet switching of the internet, other proprietary networks, the community, introduction of the web and the rise in demand for domain names on the internet. We had a new culture emerging, the Internet culture

With the foundations of computing well established by 1990 in Africa and a flourishing computer industry with mini computers, micro computers and PCs available on the market some of the important prerequisites for the internet was in place and we were poised for the glory era of fascination, learning and teaching. Yet the migration from proprietary networks to open standard networks would remain a challenge for some time and would be resolved in the coming years

The beginning of Internet in Africa was unorganized but a gradual evolution, sometimes rushed, to an increasingly technology oriented society. Much of the proof of concept and case for Internet provision and adoption were established during this era. One could not look far in the future as we struggled to be abreast with the rapid development

This evolution eventually became a scramble to get Africa connected later on when the benefits of computing became more accepted in African society. This was in part due to known concern of an emerging digital divide among nation states and geographies. Those with Internet and those without. One wonders if we have been as efficient as we could given the rush and the weak coordination among actors. There were actors from among donor agencies, intergovernmental agencies, governments, civil society and private sector all with varied interests. Was Africa to become simply a market for those with know while both civil society and private sector took positions satisfying different interests. Fortunately there were natives who also saw the same but interpreted it differently that it was an emancipation opportunity. This was a dynamic that most of previous authors missed but in our history was significant local contribution

Given the sheer size and diversity of the continent it is difficult to ascertain with certainty where and how first TCP/IP speaking network started in Africa. Additionally, with the extensive non-internet based email options in place at the time and with email being a dominant Internet application it took a while before the Internet's distinction would show and the web made a bigger difference as connectivity continued to improve

There were indeed several initiatives occurring in the networking space based on economic, scientific and industrial relationships. There were thus initiatives with universities, research centers, commercial, government through the national PTTs and civil society networks all offering services integrated and related to their work but using networks. In Ghana we had to contend with not only the enterprise networks like the IBM SNA, DECnet but also some email services some based on Fidonet nodes associated to Padis project of UNECA at University of

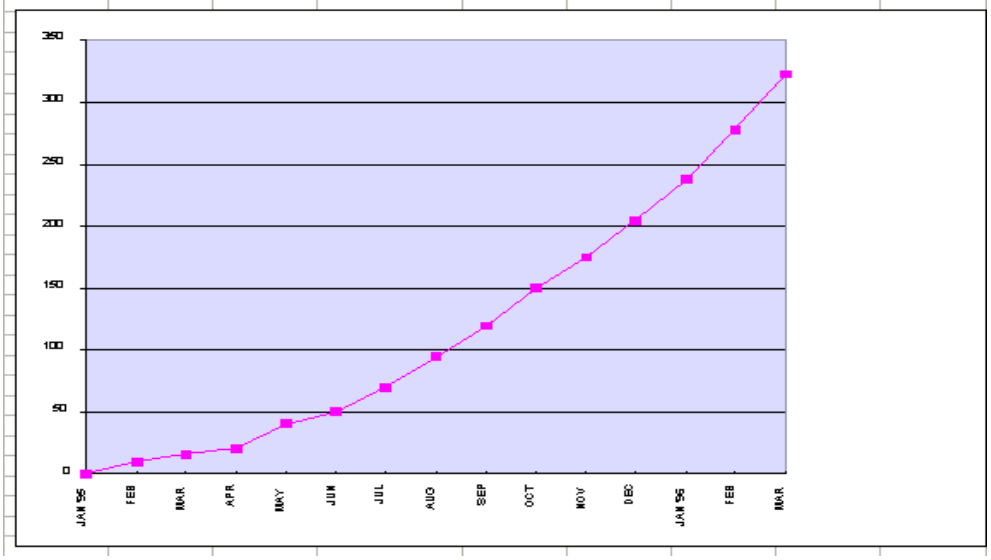
Ghana and CSIR libraries. I was aware of a uucp node at Association of African Universities and also saw the work of L'Ostorm uucp network around the region

There were also burgeoning providers who extended their solutions by partially opening access to subscribers at certain times of day by doing dialup IP to save costs and were not fully connected by dedicated links but on often enough not to notice a difference. The users were tolerant and saw it as part of the struggle to open up and improve communication

The internet may have arrived in Africa at multiple locations at the same time as there were varied initiatives in a global momentum to evolve to inter networking. In this period South Africa, Tunisia, Egypt, Ghana, Senegal, Kenya were among early adopters with in country points of presence and ccTLD operation. We can recognize Tunisia and South Africa for being in first year of Internet in Africa 1991

CUMULATIVE SUBSCRIPTION RATE(MONTHLY)

MONTH		NO. OF SUBS
JAN '95		0
FEB		10
MAR		15
APR		20
MAY		40
JUN		50
JUL		70
AUG		95
SEP		120
OCT		150
NOV		175
DEC		205
JAN '96		238
FEB		278
MAR		323



For us in Ghana Network Computer Systems fully phased off it's DECnet network infrastructure and moved to tcp/ip standard in 1993 becoming first commercial ISP in Ghana and the region. The country code top level domain (ccTLD) .GH registry was delegated in 1995 when greater than 64 Kbps was available

We naturally had barriers. Many providers were coming from system integration backgrounds on proprietary systems and had to learn new techniques. The places to go learn the skills were unknown to us. In a similar vane there were no customers and policy makers were uncertain if they wanted the internet and some were concerned about the potential dislocation of national PTT which had been a worthy economic resource for governments. Connectivity was sparse and of low bandwidth making reaching the customer difficulty. We often had to aggregate traffic coming by telephone dialup lines at PTT location and privately carry to our data center on private microwave radio network

Given that different countries got Internet at different time we knew that there were local preconditions that enabled capital city connectivity to be established. I am of the view that it required an interplay of policy, academia and a capable private sector. It also required a focal point that was credible with a known track record of technical work. That was the case in Ghana where I played the role of a computer scientist who had established a computing science department at UCC; I was the executive chairman of then a large system integration company, NCS, that was agents of successful mini computer companies including DEC. I had adequate access to the government of the time who was interested in its human engagement potential to harness its large youth population in constructive work

Policy and regulations were centered around the national post and telecommunications company monopoly. However in these same period governments across Africa began a process of reform of the telecommunications sector. This took several years but caused the separation of postal services from telecommunications. It also resulted in the creation of independent telecommunication regulators setting the stage for growth. The motivation for reform was to increase investment as at the time governments had difficulty raising investment needed to grow the then small subscriber base

Africa was gripped with excitement of the possibility of the last African country, South Africa becoming independent of colonization and Nelson Mandela being freed from incarceration for fighting for freedom for his people. There was in parallel a techno liberation movement to contribute to what seemed to be a potential to create a more level playing field for the underprivileged. There were many local initiatives, there were also partnerships with global development and education community. There were other participants from the global internet technical community and business wishing to contribute to containing a potentially huge disadvantage of a digital divide, an exclusion of societies because of lack of technical know how or of technical infrastructure and consequently impact economies in Africa negatively

There was a climate of liberation which galvanized global interest and support of African development leading to a grand collaboration for Internet into Africa. Central to this collaboration is the role of the Internet society (ISOC) and related institutions. ISOC organized a conference called INET and we liked to attend and present papers on our networks in proceedings. ISOC also organized network technology workshops and several of us were students. These life changing workshops would continue into the next segment

The spirit was Africa can do and there was a techno liberation feeling within a grand collaboration to make technology more available to scientists and the poor. We had a common interest to gain access to Internet and to not miss the benefits and opportunities of having access. Policy to provide affordable access would become a theme in the next segment

The Formation (96-2000)

In this section we describe the issues of the second quartile which saw pressure for service coverage expansion by operators, telecommunications policy reforms, increased global policy for interest in information society and the Internet and the response of the African community. The mobile arrived and patterned with the Internet in the era.

We had the foundation having started building a workforce and depending systems as an economic society. We also had the Internet as a new communications system with potential to go beyond the predominant circuit switched telephony of the time. Packet switching was to transform communications to be closer to users and cheaper. Hitherto, in my homeland Ghana there were few homes with telephone and the public had to go to the national ptt office to make telephone calls. International cable would come and be placed in P.O. Box as they could no longer deliver in homes. To make international cable you go to national Ptt office. Telex was serving some offices on teleprinters

This was to change and suddenly in this era with adoption of mobile and the internet. This was to be more efficient and with location independence. This required major policy shift and governments were struggling with these. In the telecommunications there was a need to dismantle the all in one PTT who was a postal, regulator and operator to increase investments after accepting it alone would not realize the investment to serve all users. This ultimately resulted in firstly, the separation of postal from telecommunications. Then an independent regulatory organization was created and a competitive telecommunications market created. This brought in a few other operators to compete with the national Telco who had a partner

Several countries in Africa were undergoing similar reorganization of their telecommunications sector to permit competitive market including the incumbent operator

The internet was not a major consideration in the reforms. In Ghana we tried to make it recognized without success and accepted that it was a value added service. This is understandable since the internet had only been in Africa for a few years. Ghana had first Internet connection in 1993, while Tunisia and South Africa had it in 1991

I did not want to surrender the new openness of the Internet to regulation so early in the transformation from telco-centric centralized communications into distributed to direct regulation at the time. I chose not to push for regulation and only offered telecommunications policy advise and resisted all other attempts by the environment to consider the Internet. These ideological positions would cost me later in the next quartile

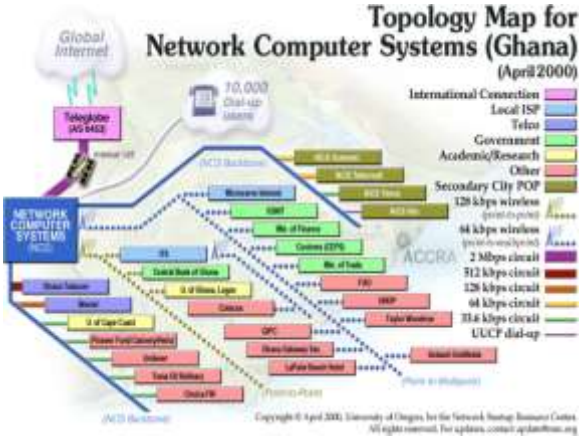
At the time, internet communities in countries were expanding to secondary city connections. In Ghana we connected Kumasi and Takoradi cities and other countries were doing the same. In many situations there was not enough infrastructure in the regions to cope but there was lease lined to those few locations and expansion on network and service pops were established

Competition arrived and mobile was introduced. The mobile services were also initially in capital cities and struggled to roll out countrywide services in subsequent years. Thus in Africa the two services of mobile telephony and internet grew together and followed similar scaling challenges. In Ghana the first mobile license interestingly was given to enhance the Non Alined Nations Meeting occurring in Ghana in 1995 illustrating global influences in technology adoption

Integrators and ISPs who were purchasing infrastructure from telcos knew they would eventually be blown away by the mightier telco who now had coverage capabilities and isp was a customer. In Ghana, we turned to become service providers for the telcos and offered initially internet access to telcos and eventually offered consulting services to build internet network infrastructure

Competition in the ISP market also started in the quartile. With regulatory reform completed in 1996 in Ghana, there were new Acts introduced to support the reform. Alongside the reforms countries were developing ICT plans and in essence preparing to fully adopt technology and build an information society

As a user community emerged some of us saw it important to have a forum for exchange among users and we started to organize meet ups among users. As these gathered speed we followed the isoc chapter model and in Ghana we incorporated an isoc chapter, the Internet society of Ghana in 1997. It still serves the purpose of a community forum, a source of reliable technical information and advocacy policies that affect growth of the internet. Other countries also formed chapters in this quartile



Global interest about the internet was heightening and ISOC was at the center. Africans were also concerned about our poorer state on internet infrastructure and know how so the few of us who were able to attend global meetings began to meet alongside the sidelines of global events to talk about our issues and update each other. Soon enough we got recognized and in 1996 we organized the first African networking symposium at ISOC INET. It was well attended and we began to share roles among those present to focus on particular challenges we faced. I identified point of contact for social and economic interests, cctld, number resources, capacity building and so forth. These would later become the foundations for the new ecosystem we were creating for Africa

About the same time, there was increased interest around the long term coordination of the internet and ISOC had a role and a new process to develop the long term plan. The Internet Ad Hoc Committee (IAHC) process started and had the occasion to chair a session in the discussions. I was particularly struck by the limited participation of Africans in the process and vowed to recruit more Africans to become more engaged. This IHAC process would eventually lead to the formation of ICANN.

While the ICANN process was ongoing a first internet governance conference was held in Benin. This became known in our community as the Cotonou convention. A good part of the discussion was the formation of the African numbers registry, Afrinic. At the time only few registries existed, namely Arin, RIPE and APNIC. Both Lacnic and Afrinic did not exist. There were natural concerns in global community that it was better for all five regions to have started activity around internet number registries before he new co, what has become icann today. However, I had a much larger vision of a more complex ecosystem yet to be developed. At the conference, I argued though we had a fixation on numbers, numbers, numbers we had an obligation to be broader in our thinking and use opportunity to prepare for the whole infrastructure. I thus presented a proposal to build the African technical institutions of the Internet detailing what we might work on building and even assigned point of contacts for them. This was the concept of Af* for as many organizations as we need whenever we need

I attended my first ISOC Network Technology Workshop (NTW) in 1995 in Hawaii, USA. I had missed two previous workshops in xyz and in California. Network Computer Systems sent a staff member, to attend the first workshop. It changed my network operations based on DECnet and within months after we all our corporate networks onto the Internet. That benefit coupled with my interest in training institutions meant when the opportunity arose as ISOC considered transitioning Network Technology Workshops (NTW) from global workshops into regional workshops in 1999, the community welcomed it and formed African Network Operators Group (Afnog). Afnog held its first workshop in 2000 in Cape Town, South Africa. This started the institutionalization of Af*. Afnog was to become the incubator for the organizations. The meeting place for African technical community arrived in Africa and quickly became the growth

pole for internet adoption in Africa. We began training the network engineers for the industry and building a community of engineers in Africa

The Rise Af* (2001-2005)

At this time global acceptance of technology was high and several countries in Africa were actively developing national ICT policy or planning such policies. Countries believed the adoption of computers and communication technology had impact on development and wished to harness it

Similarly several international organizations were keen on mainstreaming technology in their development agenda. It was an intense period in which the world was gripped in defining information society so that may set objectives towards policy for accelerated development. It was need also quite a confusing era as the technology was new to the man arms of the paradigm namely government, private sector and academia. To an extent it was like the blind leading the blind. There were risks and the few with exposure and insight were sought out. Many ventures failed or had poor yield. Nonetheless, we were determined to acquire the technology with nation states charting a way and many initiatives were in force. The African Union was not going to be forgotten and it had its own initiative of the eAfrica commission alongside national plans. There were also United Nations initiative UN ICT ask force to mainstream ICT into development programs at UNDP as well as a World bank initiative Dot force with economic viewpoint. We knew then that we had succeeded in getting the attention of the world behind technology and development

All these initiatives wrestled with defining an information society yet to the internet community had a working definition based on the internet and how it's supporting institutions are organized in a more bottom up multi disciplinary and multi stakeholder context. Sometimes it felt how dare one go against the top down methods inherently practiced in national governance systems and there were political interests. Meanwhile in the quest for government to meaningfully contribute to growth of ICT and to wrestle with the tough issues of public policy world summits on information society were held. After two world summit events in 2003 and 2005, we were unable to reconcile approaches to the issues and roles. There were no easy answer on how to adequately accommodate the civil society, private sector, technical community and academia. The working group on internet governance (WGIG) wrestle with governance of the internet appreciated the robustness of the bottom up processes in practice in the internet engineering community. All these culminated in a non binder forum which was to be a healthy engagement at the internet governance forum (IGF) to continue with the cooperation

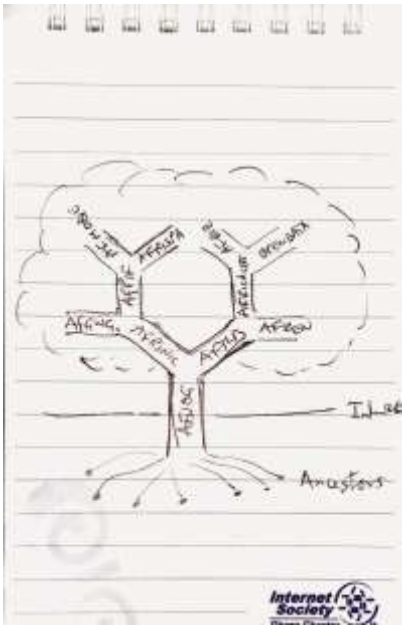
With the increased interest by policy makers the policy environment also improved for investment in infrastructure and major cable infrastructure projects were beginning. The cross border interconnection issue was on the plate of policy makers. By this time there was no

question that even though infrastructure access is a barrier the technical know how, capacity and education were equally contributors to impediments to internet growth in Africa

To support the technical operation of the Internet-networks in the region important institutions evolved focussing on various technical operation and coordination aspects. These have now come to be known as the African Internet ecosystem. Some of the resources being managed include numbers, names, research networks, technical capacity and security

A summary of the institutions in the African Internet ecosystem and their roles presented subsequently

The African technical leadership of the time knew that the Internet was so important for education and social well being that we had to spread it and do a campaign. It was evident that there were few who knew or would talk to Africa about technology given the numerous development challenges facing her however we were determined to blow it wide open for all and increase opportunity. A meeting was organized in Cotonou, Benin in December 1998 to formulate African response to global changes on Internet coordination leading up to establishment of ICANN. It was at this meeting that I proposed the core technical organizations that became known as Af*. These were conceived of as organic formation of any number of groups with distinct roles as relevant who all share and coordinate their activities



We were aware that several of the grand collaboration genuinely wished to see Africa technologically liberated yet we came across some people who liked to do business with Africa's depravation. In particular there were many who saw it as the last liberation struggle frontier after political and economic independence noting the huge intellectual advantage of those who have over the have nots. We had to build an intelligence network to acquire the knowledge and to share despite these

Africa was only starting and did not have many resources. We were also faced with monumental repressive political establishments who were weary of the technology and became barriers in themselves aside from the high costs and unfriendly policy environment

A core group of African pioneers used to meet at various global events and meet alongside discuss, plan and coordinate their involvements. They had to manage all the varied interests and emotions in the coalition it took to bring the internet to the continent.

AfNOG's multilingual multitrack workshop environment
We leveraged on the existence of AfNOG which started in 2000 to become a forum for consensus building in organic development of the other parts of the Af*. Aftld was the next to become incorporated in Mauritius after AfNOG. As some ccTLDs were already in existence

there was easy and natural identification with AfTLD but the business case and orientation remained a challenge beyond the era

Consensus for AFRINIC also was developed in AfNOG community recognizing Afrinic and AfNOG share same community of operators. The accreditation of AFRINIC in 2005 was a joyous moment for many of us having worked on maintaining consensus for a decade. Having to combine customers from three service regions was not going to be easy. We kept hearing negative and discouraging remarks during a good part of the decade. We kept hearing doubts if an Afrinic can meet same service levels enjoyed by members in southern part of Africa before Afrinic got accredited. We were not hearing about what may we do to ensure new Afrinic would supersede current service starting anew. We also heard from the doubting Thomas's that Africa could not do anything. Hence, this accomplishment by Africans, largely black Africans, needs to be commended who working with their governments and global friends got Afrinic established. We are grateful that African governments this time listened to us and supported us financially to start Afrinic. In the end, roles assigned were South Africa (technical operations), Egypt (backup technical operations), Mauritius (business)and Ghana (training). The cooperation among the RIRs to support Afrinic was very important in establishing Afrinic

The decade of wrangling preceding were perhaps about control amidst doubts about Africa's readiness. Too many saw things as property to personalize and keep but how would that be possible for things in held trust of community. I recall a meeting in which people proposed why not divide the internet number resources by country and be done. It had little to do with the predominant language spoken, French or English, but more to do with the vested interests of those satisfied with status quo. Africa, however was able to self determine its own policies in utilizing internet number resources as they see fit as result. We were focussing on securing the number resources for Africa by playing a part in the global change at the time of formation of ICANN and ensure inclusion of African voices and interests major global decisions. The team that planned and implemented the first decade of Afrinic deserve commendation as they proved many wrong and made Africa and the world proud. I can assure you that the outcome of second WSIS meeting in Tunisia might not have been as favorable to the Internet had Afrinic not been accredited by ICANN

Another bit of further wrangling would ensue in the domain name side with the expansion of the DNS root with other strings and this would continue well after this quartile. At the first opening for new tld proposals in 2000, there was a proposal to operate a .africa registry. The Africans saw it as not an African initiative and we all rallied and demanded more public interest participation of Africa in the operation of a Dotafrica registry. We felt strong enough about this for a community website, dotAfrica.org to be established in 2003 to support discussions on the registry. We had learned from watching the .asia delegation in the subsequent sponsored TLD proposal round. We made efforts for existing African cctlds to partner with a global registry operator to perform the service to no avail. We sought ways to also increase the public interest component in future proposals and approached the African Union and other African regional bodies to join our technical efforts. This eventually became the winning option but after a long legal battle well out of scope of the period

I had served on ICANN board from 2000 to 2003. I had also been member of the UN ICT task force and African Union eAfrica commission and thus was influencing policy as much as one could. We tried everything we could to get attention of authorities to appreciate the urgency for developing countries to adopt technologies in society and that Africa in particular could face a digital divide considering the more constrained policy and technical capacities of countries

These groups of internet technical institutions though independent are related and share same communities and values of openness in multi-stakeholder policy development processes. They work in loose cooperation and coordination arrangements to get their part in keeping the Internet working. Some are legal entities providing services, some are mailing lists and some are departments of other institutions. These communities have varied organizations some lightweight volunteers while others fully fledged organizations with staff. Some provide meeting places and others provide services. All of them pledge to open bottom up internet processes and build technical capacity

Some of the well known organizations in this set are:

AfNOG - African Network Operators Group building capacity of network engineers,
AfriNIC - African Network Information Center the African Regional Internet Registry
AfREN - African Research Education Network forum for regional RENs
AfTLD - Organization of African country code Top Level Domain (ccTLDs) providers
AfNOG Chix - AfNOG women network engineers
AfricaCERT - Africa Computer Emergency Response Teams
AfPIF - African Peering and Interconnection Forum
ISOC Chapters - Internet Society Chapters in Africa
AfRegistrars - ICANN Accredited Registrars

And many many others that incubate out of AfNOG community

On November 26, 2003 the pioneering Internet company, Network Computer Systems through which I explored networking technologies in Africa was deliberately shutdown amidst land disputes, political innuendos and victimization in Ghana while the independent regulator looked on. That ended an illustrious pioneering era of the mix between industry, academia and policy advocacy in adoption of technologies. It also took away a source of revenue for Internet community work we were engaged in

We made strenuous efforts to preserve the network but knew the economic underpinnings had been destroyed by the shutdown in which bailiffs with police escorts came to remove all items including 30 transport vehicles from the head office. The company folded in 2003 with revenues at $2.3 million. We were successful in keeping the network running by rolling traffic around different the premises. Unfortunately all the 87 staff had to go home leaving a scar on Ghana's computer and information technology industry. These quality technical professionals fortunately became the Internet pioneers leading other network operators of today in Ghana

We kept the network functioning for as long as they could and secured the ccTLD .GH operation. The ccTLD operation would later be taken over by NITA by Act 772 in 2008

Reflections

It was a long journey and much was accomplished and in so many areas. Africans and the world taking credit for the grand collaboration that caused Africa to become part of Internet. I have tried to tell the story as I saw it from my local context in Ghana and expanding out

I have wondered the interplay of practical technical skills development and academic education and relation to Africa. It appears fundamental education proves to be highly valued with the added practical technical skills. The limited number of educated and technically capable available for this historical achievement did not make a critical mass. As consequences, we had to compromise lowering the Taskforce, playing with priorities, as we had to be on many projects/activities at the same time. This would explain the feeling of several unfinished initiatives that some elders note and we had to grow representatives very fast to meet needs as an emerging internet community. We may not have identified and prepared people sufficiently for the task and then came the influence of search engines and other information resources making it difficult to separate those who really know from those pretending

Language barriers, non-uniform level of development and technologies adoption on the continent did not also help,
Strengthening the education system is necessary to advance technologies in developing countries with practical technical skills. The applied sciences are particularly of interest. The role of laboratories in science and technology education need be emphasized. There is high demand for those who can make things happen with technologies than those who talk about it in Africa

After having worked in private sector in Ghana installing large enterprise systems for governments and companies, I observe that the structure of procurement does not favor indigenous local technology organizations who are typically startups. The procurement cycle is rather long, requires bank guarantees and the process would be overwhelming to many. Hence development of the workforce became in the scope of large often foreign multinationals. Thus with no internal energies being attached directly from the opportunities for unorganized native works is limited. From another perspective we are happy and proud as Africa's good engineers are absorbed into global organizations. The global organizations who employ the professionals are helping the professionals to advance and grow which is good for Africa. Note however that once these are absorbed in to global realm their skills become somewhat inaccessible by the local edge ecosystem. Then who would work for the poor in the next billion? and would Africa be able to ever build critical mass of technical expertise if its it's local expertise disappearing at a high rate. We have work in progress

In a related matter we contended with some organizations who exist to be intermediaries between Africa and the global resource pool. They also come with their nuances. Some are difficult as they rather prevent Africa from knowing the technology but propose to do that service end to end for Africa. This believe it or not is often accompanied with fake news about how Africa is difficult that it lacks capacity and are corrupt and all the negatives meant to discourage and

embarrass. This results in capture of unimaginable proportions. Our counter had always been to bring diversity from other regions and institutions Africa finding ways to learn technology build technical capacity in a global

We also became aware that young African engineers are offered managerial positions in some companies terminating their hands on engineering work. Of course the young engineers get perks including better salary, management responsibility, transport and so on which constitutes advancement in the life of the engineer. On the other hand then African engineers will remain few and we have to train more to overturn this

It is possible that the term ICT, information and communication technology, brought attention to technology, internet, computers and phones and helped policy makers plan for investment in the sector. It however also created a dangerous misunderstanding that users are as qualified as technologists and engineers for engineering works. The media is not capable nor intended to build routing networks but amidst this confusion wrong contracts were assigned to unqualified resulting in poor performance in the sector. In the end we got a society where folks just talk and regurgitate news articles without appreciating that these are professionally distinct. We had failed to appreciate that the Internet as a technology has rather enabled information, communication and technologies to share same infrastructure. It does not make the professionals in the three fields equal

We have practiced multi stakeholder approach to variety of situations including coordination, administration, policy for sometime now and Africa has to decide which way it goes given it's culture of top down in governance in general. The lack of discipline to follow organized procedure can hinder organic development of community work leading to capture. There is a good reason why there are roles for stakeholders because they are the only ones that can make things happen in their realms be it governments, civil society, technical community, academia or business. But when folks try to cross roles without requisite professional background it can get very confusing quickly opening the door for capture. We have seen groups that were only shells with no real engaged membership and have seen individuals anxious for travel grants also distorting the ecosystem. Successful Af* organizations tendered to maintain neutral posture with community

As the Af* organizations share common values of openness and sharing in order to coordinate they are also open to global community. Africa's professionals are new and in emerging economies and would not be as assertive as global counterparts. From time to time, people get concerned when strongly opinionated personalities on lists are actually not from the region nor residing there nor being friendly to it. While we remain open the community has to determine it's own norms and taboos and Africa is no different. Increased participation by more Africans helps build the relevant cultural context for global participation

Governments have unique role in that it is local policies that promote and cause the expansion of the internet to where is not. This is consistent with the Internet structure of less at the core of it. Governments are also a representative of public interest having been elected by people and that comes with heavy responsibility of ensuring the development of information services through policies. They should thus make haste slowly and encourage technology skills development, use

and infrastructure bearing in mind this rapid growth area. It would be more rewarding to follow the tenets of the Internet and evolve best practices through community discussions. We should beware that a powerful and uninformed government can easily destroy years of technology work because of the pace of technology advances if go the opposite direction of community consensus. The common practice of changes in government leadership of the technology sector amidst confusion of whether it is science, industry, communication or information ministries does pose its own challenges begging for more technology in government . Government's in Africa would benefit from using more bottom up processes in developing policies ensuring that there is broader appeal and well informed before they are formally considered

To shutdown network or not does invoke heated debate in our community as governments in Africa have practiced raids on what they consider illegal or unlicensed communications with a force since time immemorial. My company NCS suffered it in a politically motivated. It is not what I wish would happen to any internet company, organization, country in the world. I also would not want any part of internet technical institutions to be involved in enforcing any shutdown or to inflict any artificial constraint on resources for internet for any network government operated or not

While developing the ecosystem and organizations we have sometimes encountered personal interests being prominent in people's judgement and enthusiasm while serving in the public interest. How is it possible that personal interests would not conflict with public interest in practice in Africa when incomes are low and the huge possibilities not obvious for many? It would not be unusual for a Board member to wish a job as staff of a regional organization, which leads to micromanaging of the organizations. In this case the loser is community work as things transition quickly to looking for favors, business and this could be real personal business for some. One can imagine how aggressive some parties would be about small given the circumstances. Where are the few that want to do right by Africa you'll wonder? They are there we are sure. What we worked for so long was to uphold selfless contributions to community and that is waning. There are many instances where personal interests of actors have held back projects/exercises, policies and appointments. Meritocracy has not taken hold in the multi stakeholder community fora and risk being engulfed in politics and power struggles. We cannot abandon service to community. It does get under pressure but I am certain that the trained and committed truly technical cadres will carry on the torch and success is assured for Africa

For Africa to attain self-reliance in technology development and innovations it is going to have to be more determined than we were in putting the Internet in place in Africa. We seem to be taking for granted and relaxing forgetting many sacrificed a lot for Africa to have the Internet. We are going to have to recognize that the pace of technology advancements are higher than in the beginning and keeping pace would require even more discipline and determination. Techno liberation would not come without continuous and intense deliberate focus on consciously developing the technologies

There are many who do not have access to technology in Africa and are disadvantaging our future development. The plight of these yet to be connected, next billions a large portion from Africa, is important in Africa's future. The technical institutions solved initial pieces of the

puzzle mainstreaming technology and encourage communities to develop around ideas and practices

Conclusion

It has been a long journey and I am glad to have had the chance to narrate an experience that spanned twenty years. The four quartiles enabled us to work through the significant issues of each of foundation, beginning, formation and rise of Af*

Evidently it was not as simple as connect a user interface and go. It was a complex dynamic involving development, infrastructure, political, economic, legal, governance, institution building, education, intergovernmental and the art of mobilizing interest, a grand collaboration in technology liberation for Africa

The Internet is designed to be light in the core of the network and hence the Internet grows fastest at the edge. This makes what happens in local context surprisingly very important in network deployment, network adoption, network education and development of an ecosystem of communities for the network. The local context is also the weakest at the edge and we have to build strength at the edge to protect the values of the network. Best current practices require the leadership of the local be engaged in the global sphere for the edge to remain consistent with the core.

The community oriented approach to decision making yields better results be it standards, code or policies and the multi stakeholder approach would thrive. Africa has the important technical institutions in place and we must make their work more impactful to the region. Africa now must move on but education still plays a major part

A common vision to make Internet live in Africa was easier to create when there was no network. As the Internet proliferates in Africa and people take it for granted getting a shared vision for Af* coordination would be more difficult. Nonetheless we should increase coordination and work relentlessly for shared vision. We have a good thing that can't be destroyed nor captured when public interest reigns supreme

I hope through my eyes you've been able to share in the experiences that solidified Internet in Africa. This paper is a contributed chapter in the book on the history of Internet in Africa

Internet is successful in Africa and we will add to it

Acknowledgements

I like to acknowledge recognize all who helped Africa reached where it is in technology today. I am delighted that though it has taken longer than we wished, Africa has built momentum over the decades. It will be unending to list people or organizations and it has been a while since 1986-2005 and it's a decade after the period we document. We thank the global I* institutions for being there for Africa. We thank our development partners, governments and intergovernmental organizations for their support. We acknowledge and recognize all those who built the Af* and

related bodies in the African technical community. The Af* leadership and their secretariats have contributed a great deal to Africa. I had to reach out to some of you to take on the leadership responsibilities you contributed to and I am glad that you embraced the opportunities. There are also some of you that because we follow the school of thought of Africa becoming technology liberated you often became targets of obstruction, but we prevailed. I acknowledge the pain and sacrifices. Lastly, the users and user organizations brought traffic on the Internet. New users power network operators and let's remember that there was a time when not a single user existed in Africa while we have a billion more to connect

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