Issues in Next Generation Wireless Network Technologies & Services for Developing Regions

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ABSTRACT

The paper deals with three important aspects of the deployment of next generation wireless networks and services in developing countries. A framework to support the growth of innovative and locally relevant mobile services from the different stake-holder's perspective is developed. The framework consists of three pillars of thought composed of next generation technology migration strategy, development of local content and service provider sector, and a mobile laboratory for service localization and usability studies. Finally the framework will be used to solve one of the affordability issues in mobile technology and services for emerging markets.

Categories and Subject Descriptors

C.4 PERFORMANCE OF SYSTEMS: Reliability, availability, and serviceability; AUTOFLOOD

C.2.1 COMPUTER-COMMUNICATION NETWORKS: Network Architecture and Design

C.3 SPECIAL-PURPOSE AND APPLICATION-BASED SYSTEMS: Signal processing systems

C.4 PERFORMANCE OF SYSTEMS: Modeling techniques; PAWS

General Terms: Technology migration strategy, Policy, Service Localization, Usability, Standardization.

Keywords: Next Generation Wireless Networks, mobile innovative services, localization, usability Lab.

1. INTRODUCTION

Next generation wireless networks (NGWN) and services will be based on heterogeneous wireless access technologies, together with web-based and innovative mobile data services. The majority of the communication and access networks in developing regions are based on wireless networks, due mainly to the unavailability of existing fixed line infrastructure. Furthermore, low deployment cost & time associated with wireless networks and the flexibility of providing access to information to remote areas through efficient radio technologies, has made wireless networks the technology of choice for communication infrastructures in developing countries. Network and service providers in developing regions should plan to utilize these facts and design innovative and locally relevant mobile services. This will help developing countries to harness the explosive wireless technology and services growth for a sustainable economic development. Communications infrastructure providers, network service and content providers should also partner with local educational, public and private institutes to address issues such as migration away from the current complacent legacy mobile network and associated voice and SMS only services. It is crucial to plan the path towards next generation heterogeneous and broadband wireless access networks, and promote web and content based services. A number of questions could be raised such as: 1) which migration path to take towards NGWN, 2) Is mobile broadband with 3G-High Speed Access mechanism, the GSM/UMTS path spear-headed by the third generation partnership project (3GPP), or 3) A combination of 3G/WiFi + WiMAX broad-band wireless access the path to take ? The IEEE 802.16, WiMAX broadband wireless technology is being championed by some quarters, and is showing good results for rural coverage in some implementations[13]. However, it still accounts to a small percentage of the mobile subscribers when compared to the GSM/UMTS subscribers in the near future. Hence the paper will discuss the issues focusing on the GSM/UMTS path. The next challenge for developing countries is the unavailability of local content and innovative mobile data services. It is therefore necessary to promote planning in developing countries for the creation of a service and content provider sector. This is necessary to make the new wireless services relevant, usable and most of all sustainable. Equipping regional universities with mobile laboratories and a curriculum for mobile application software development and usability testing, is also one way to go forward in solving the issues of sustainability and lack of competence in the area [1]. The availability of such innovative mobile data services will spur innovation by the network providers on service level agreements and revenue sharing mechanisms for mobile service and content providers.

The paper therefore will discuss and propose a framework to address three important issues in next generation wireless network and service development in developing countries. Section 2, will discuss the issue of Network Infrastructure migration towards wireless/mobile broadband access, a common IP core network and capable mobile terminals. In section 3, a mechanism is presented to increase the availability of mobile local content & services and the creation of a regional service and content provider sector, through a University-Industry collaboration and Incubation schemes. Section 4, will take up the issues of service localization and usability testing in the auspices of a university-industry collaborative mobile

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laboratory established for the purpose. In conclusion mention will be made to an initiative at the faculty of Computing and IT, Makerere University, to address the issues mentioned above, in the regional Eastern African context.

2. MIGRATION STRATEGY TO NGWN

The motivation to migrate towards next generation networks stems from the need to support the new services based on local content, the web2.0 and mobile-internet. It is expected that such a move will enable service providers to deliver relevant and innovative mobile data services, with the aim of meeting sectoral challenges in health, education, governance and banking in both urban and rural communities. Unless otherwise specified the migration path that is discussed in this section is the path taken by the GSM/UMTS networks. The reason is obvious, i.e, most developing regions have a large subscriber base utilizing the technology of GSM/UMTS [4]. Although there is a clear understanding of the benefits of migrating towards next generation wireless networks, the network and service provider industry shows reluctance on how fast to proceed with the migration process. There are two ways to migrate towards next generation wireless networks based on GSM/UMTS the revolutionary and evolutionary types of migration [2,8]. The first type of migration is based on taking a larger risk and moving towards the NGWN technology deployment on a single step. While the latter type, the so called evolutionary migration is based on a stepwise replacement of the legacy network following a defined standards based path, and is mostly chosen by operators due to the following reasons: 1) The high cost of initial investment. 2) For the protection of the legacy network investment. 3) The existing revenue flow from voice and SMS traffic is so attractive that operators are reluctant to change the status quo as quickly as it should. 4) Some operators have the presumption that there is and will be a very low subscriber demand for mobile data services in developing regions. Therefore, it is not yet time to invest in new technology to provide such services. However, these reasons generally vary from place to place.

Developing countries need to effectively utilize the benefits of NGWN, by planning a scheme to design the necessary mobile data, and content services. Migration path should be outlined and strategies to tackle the challenges in points 3 & 4 above have to be developed. GSM/UMTS is the dominating technology for wireless communications in developing countries, and is the main driver for the explosive growth in mobile phone usage [4]. On the other hand, wire-line telephone voice traffic revenue is decreasing. If this trend keeps up, there is a high probability that voice traffic will entirely shift from fixed to mobile communication leading to the so called Fixed-to-Mobile substitution (FMS). However, whether the FMS trend also repeats itself for non-voice services such as internet access using Mobile IP and mobile-broadband based web-services is yet to be seen. In [3,4] important technologies and key architectures have been identified for fixed mobile convergence and service development for emerging and developing markets.

2.1 The Common Core Architecture

One trend during the transition towards the next generation wireless technologies is the heterogeneous multi access radio and the common core architecture for the switching, control and subscriber databases. Such a network is appearing in many developing regions, where GSM/ 3G radio and WiFi/WiMAX access together with a common core architecture is developed as a modified release 99 UMTS architecture by 3GPP. Figure 1, shows such a network based on GSM/UMTS together WiFi/WiMAX broadband access. The heterogeneous wireless access and a common core architecture as shown in figure 1, is based on the fact that a converged core network would save operators the cost of installing switching, control nodes and providing customer databases for each access type. Many operators have opted for such a path as a first step towards a converged NGWN technology deployment [12].

However, in the absence of innovative mobile data services and mobile/wireless local content and web services, operators in many developing countries are using the network architecture as shown in figure 1, for extending voice and SMS services to more subscribers [5]. This is one of the scenarios that clearly indicate for a concerted effort to be made to promote regional service and local content providers in developing regions.

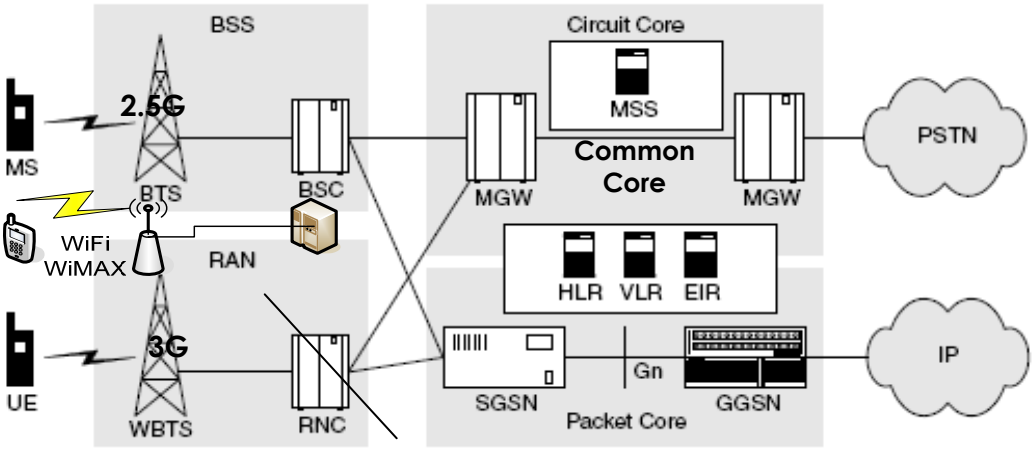

Figure 1, Common core architecture with multi-mode, modified 3GPP Rel. 5 architecture [3]. The mobile network architecture can support, a heterogeneous wireless access (GSM/UMTS & WIFI/WIMAX) and a common core architecture capable of circuit switched and packet switched mobile voice, data and internet services. (Accronym list: SGSN- Serving GPRS support Node, GGSN-Gateway GSN, RNC- Radio network controller, MGW- Media gateway, BSC- Base Station Controller, HLR/VLR/EIR- Databases.)

Existing third generation mobile networks deployed in developing regions, need to support innovative mobile data services and help sectors such as health, banking, education and governance for societal development. However, in the absence affordable and relevant services the network is being used for the extension of traditional voice services to more subscribers.

3. CONTENT & SERVICE CREATION

In section 2, the strategy of evolutionary transformation of the legacy wireless networks in developing countries towards the next generation heterogeneous wireless network technologies was discussed. The reluctance to technology migration by operators and service providers have been addressed. One important aspect was the unavailability of innovative mobile data services: such as services with mobile content, mobile internet and web services for social interaction. Operators are looking at the emergence of such services and local content provider sector to justify their investment in the next generation of wireless and mobile network technology. As mentioned in section two, due to absence of wireless data, content and web services, even those operators who have opted to deploy the NGWN at an early stage, utilize the network resources for services not intended for the purpose.

There are three issues that must be addressed to solve the unavailability of innovative mobile data services. 1) The placement of a regulatory and policy mechanism to promote a collaborative working relationship between network operators and 3rd party service & content creators. 2) Regional research initiatives in the areas of local mobile content creation, mobile data and web services. 3) Governments in developing regions through active public private partnerships, should promote software incubation initiatives for innovative mobile data services and local content development. And make use of this opportunity of employment creation through the emergence of mobile local content and service provider sector.

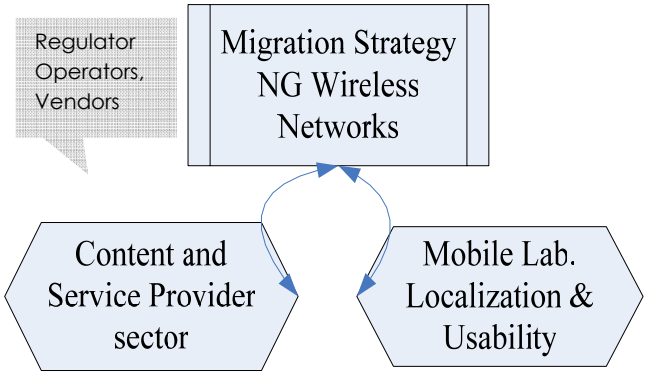

Fig. 2, A Framework for Content and service provision in an NGWN environment.

This is best performed and becomes sustainable when done in collaboration with regional higher learning and research institutions. In developing regions the sources of new ideas and innovations is mostly concentrated at higher learning institute. That is where the focus of efforts to promote local content development, mobile innovative data services and service provider sector creation should be directed.

4. MOBILE LABS FOR SERVICE LOCALIZATION & USABILITY

The need for mobile laboratory where service localization and usability studies is performed stems from the fact that, the vast majority of the population in developing regions, specifically the rural communities have lower literacy level, or have limited exposure to technological gadgets. In addition to mobile terminal and equipment providers provision of existing user interfaces, we need to address usability, local language and cultural context adaptation of mobile services.

The mobile laboratory can be seen as a resource center for the mobile telecom industry and regulatory authorities in developing countries to extend connectivity to rural areas by making relevant, localized, and innovative mobile data and web services available and supported with community based usability studies[5]. It is also crucial that the design of the mobile laboratory is made portable so that field usability testing of new innovative mobile content & data services is made possible with in the community that the service is designed for. The placement of the mobile laboratory can vary from place to place. For example for the Ugandan case, the mobile laboratory is designed for placement at the Makerere University. The main reason behind the decision for the placement of the mobile lab is to use the synergy created in educating graduates with a masters curriculum in Mobile Computing and Applications Software Development (MCASD). In combination with the mobile lab and collaborating public and private institutions, the MCASD program is expected to lead in massive growth of mobile data, web services and local content development. Recently, industry giants such as Vodafone, China mobile and Japanese operator Softbank have announced the launching of a mobile laboratory [7], to promote the development of new web-based mobile content and innovative mobile data services. Such specialized labs are even more required in developing regions to promote sustainable diffusion of the mobile technology and services in developing countries.

5. MOBILE SERVICES & AFFORDABILITY

As we proceed towards data intensive innovative mobile services, the affordability issue in developing regions is crucial for the success of mobile data and web services. Figure 3, shows the average total cost of ownership (TCO) of a mobile service [11], calculated for 50 low income countries over a period of 6 months in 2005 & 2007. From the figure, 78 % of the average total cost of ownership is composed of mobile service costs, while the remaining 22 % divided by the device and taxation costs. In this article it is argued that one way to reduce the 78 % service cost is through development of local content and mobile services, and the emergence of a sector to support this locally. Through active collaborative research it can be shown that developing regions can reduce 20-30 % of the service cost by locally producing innovative mobile data services [10].

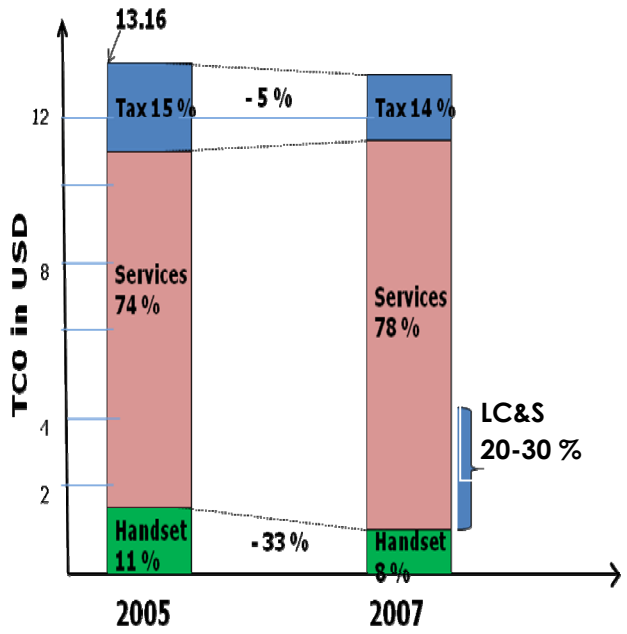

Figure 3, Average TCO of Mobile Services [11]

6. CONCLUSION

Developing countries should take the opportunity to harness the explosive mobile technology and services demand and use the technology as a tool, for providing effective mobile IT services, creation of a mobile services provider sector and economic development. A discussion of strategies for cost effective migration towards NGWN and the effective utilization of wireless networks to address societal needs have been discussed. This is necessary to support the large number of relevant mobile local content, voice, data and web services expected in developing countries. The paper therefore discussed a framework containing three pillars of thought to promote NGWN technology and services have been presented. It is becoming clear that the mobile platform can be used to design innovative ways of delivering necessary societal services, such as health, education, banking and governance in developing regions. Therefore, research and development with public private partnerships and high involvement of educational and research institutes is promoted in this paper. To meet the challenges for efficient and sustainable delivery of mobile content and innovative mobile data services in developing regions, we need also to address the affordability issue of mobile data services. The paper has shown that the developed framework can also help to address the affordability challenge in a constructive and sustainable manner.

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