

## Topic: Interactive West African Education Satellite model (IWASat)

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**ABSTRACT** : In this study, I propose a unified and interactive mobile learning (M-Learning) model to help with the expanding need of education in West Africa. The model enables efficient channel allocation, where communication channels can be allocated to specific and precise areas. The proposed model is referred to as the Interactive West African Education Satellite model (IWASat). The communication satellite can efficiently and effectively cover the entire West Africa and reach a wide area and mobile users that cannot be reached otherwise. Internet Search Engines were used to retrieve and review papers and e-books on M-learning. Interviews with experts in the field of M-learning were also conducted. Document engineering was used to synthesize complementary ideas from information and systems analysis; this facilitated the design of the conceptual M-learning model. A module in the M-learning model will be encoded in Java to create an M-learning System. The model implements existing interactivity components to enhance the learning process and meet international standards in education. These components are Communication satellite (NIGCOMSAT-1R), remote stations with VSAT terminals, main hub station with archiving capabilities, centralised broadcasting station, centralised content development and class scheduling and interactive and non-interactive class rooms. This work catalogs M-Learning models published in articles of major e-learning and M-learning Journals. It creates awareness and appreciation of previous work in the design of m-learning models. It also guides future researchers in m-learning model by highlighting the gaps and unexplored topics in the extant literature. IWASat incorporates hotspots, mobile broadcasting vans and mobile devices such as IPADs, Iphones, net books, Ipods e.t.c. This is an innovation when compared with other M-learning models.

**Key-Words:** M-Learning, Interactive learning, Education Satellite-NIGCOMSAT\_1R, Spot Beam communication.

### INTRODUCTION

Electronic learning (E-Learning) is about the transmission of learning content using communication and information technologies (CIT). Conventional learning involves identifying of information, conceptualizing, and making meaning to enhance user's knowledge base; understanding and skills, as well as finding the time and space for learning is left to the individual. The total E-Learning solution comprises the integration of three elements: content, technology and services. This concept is also underpinned by the assumption that learners will be responsible for the cognitive tasks that will lead to learning. In E-Learning, the information and communication systems, whether networked or not, serve as specific media to implement the learning process, and content is delivered via the Internet, Intranet/Extranet, audio or video tape, satellite TV, and CD-ROM. It can be self paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio. ELearning definition abounds to: the convergence of the Internet and learning, or Internet-enabled learning. The uses of network technologies to create, foster, deliver, and facilitate learning, anytime and anywhere. The delivery of individualized, comprehensive, dynamic learning content in real time, aiding the development of communities of knowledge, linking learners and practitioners with experts. A phenomenon delivering accountability, accessibility, and opportunity to allow people and organizations to keep up with the rapid changes that define the Internet

world. A force that gives people and organizations the competitive edge to allow them to keep ahead of the rapidly changing global economy. E-Learning is also known as distance learning (D-Learning). However, a recent form of learning, namely, mobile learning (M-Learning) was introduced due to the tremendous advancement in Internet technologies, and the exponential growth in the processing power, availability, and affordability of wireless mobile devices. The West African countries consist of 16 countries occupying an area of 8,034,573 Km<sup>2</sup> and accommodating 301,774,612 million citizens.( <http://en.wikipedia.org/wiki/Africa>). With its diverse demography, the West African countries constitutes an excellent example for launching mobile based education to provide education to all people in such diverse area. However, providing mobile education requires high performance connectivity for remote locations in countries with large area, small population, and with low income. This would be infeasible through conventional technologies due to high initial and operating costs. Therefore, the most obvious solution is to use the newly evolving approach that is based on establishing connectivity through interactive satellite system. In this thesis, in order to enhance, meet the needs of, and widen the education system in all West African countries, we propose a unified and interactive M-Learning model that utilizes a satellite based communication channels, which is referred to as the Interactive West African Countries Education Satellite (IWESat).

## **PROBLEM STATEMENT**

In West African, the problem of accessing information poses a major challenge to development. Lack of ICT (Information and Communications Technology) infrastructure hampers the efforts of governments to give citizens some essential services, for example; Effective Training. Mobile learning model for West Africa is a project which will focus on tackling the problem. Some countries in West Africa have terrains that makes it difficult for governments and Non-Governmental organizations to make delivery of conventional education easy. Some places are not easy to reach in the highlands therefore resulting in lack of essential basic services as electricity which could be used to power some teaching aids e.g. computers. The Mobile learning model focuses on taking these learnings to the people of West Africa, no matter how difficult their terrain, through the use of battery powered Mobile devices. The limitation of learning locations reduces access to knowledge and formal education. In the West African region, the population is 301,774,612 . (<http://en.wikipedia.org/wiki/Africa>) Far below this number have access to higher education due to few tertiary Institutions, diverse demography and cost of conventional education.

## **AIM AND OBJECTIVE**

The main aim of this work is to design and implement an M-learning model, that will incorporate an educational satellite; NIGCOMMSAT-1R for the provision of mobile learning or education on-the-go for West Africa.

The specific objective is to:

- i) Design a Schematic model, illustrating the M-learning domain with the Interactive Educational Spot beam Satellite (NIGCOMMSAT-1R)

## RESEARCH AND DEVELOPMENT METHODOLOGY

Extensive research was done using internet Search Engines to retrieve and review papers and e-books on M-learning. Interviews with experts in the field of M-learning were conducted.

The following techniques are also implored;

- Document Engineering.
- Normalization procedures will be used to separate elements into functionally dependent aggregates this would facilitate the design of the conceptual M-learning model.
- A module of the M-learning model will be encoded in Java.

## SIGNIFICANCE OF THE STUDY

M-learning is gradually taking a central stage, and this work will facilitate the implementation of an M-learning System via satellite, this will increase access to education for several learners across the West African region, including the nomads in the region.

## LITERATURE REVIEW

Mobile learning systems are described by the following features:

- Allows users to have access to course resources independent of time and place
- Allows authenticated users to have access to the system
- Allows users to have access to the resources in different formats (voice, text, picture and video)
- Allows the reuse of material
- Allows users to carry out the functions defined as an education component.
- Offers flexible environment in which other services and components can be added.

### **M-learning models and frameworks**

#### ***Model for m-learning adoption***

A proposed model for m-learning adoption, which contains an m-learning environment, which is underpinned by the traditional learning environment and also supported by effective m-learning policies and guidelines, was made by (Baker et.al, 2005). Within the traditional learning environment, as indicated in the model, learning can still take place through desktop PCs. Within the m-learning environment, there is a communication infrastructure (represented on the diagram as a dashed line) in figure 1 below, containing wireless access points which enables communication between the mobile devices. The mobile devices depicted in the model can be mobile phones, PDAs or any other wireless handheld device. This model proposed by (Baker et.al, 2005). demonstrates that the mobile devices can be used as academic support for learners via online assessment, providing course content and access to the Internet.

The mobile devices in this proposed model for m-learning adoption enable learner-to-learner communication, as well as learner-to-teacher communication. The model portrays some of the essential elements of a mobile learning environment, including at least one teacher, learners, learning and instructional mobile devices, and a communication infrastructure. The stakeholders identified in the proposed model (represented as ellipses) include learners, their parents, teachers, system designers, device vendors, and support staff. The designers of the systems that execute on the devices, the vendors that sell the devices, and the parents of the learners involved all occur outside the m-learning environment. However, they still have an impact on the m-learning environment. The system designers depicted in the proposed model include both software developers and hardware manufacturers. Teachers, learners and support staff are found in a learning institution within the m-learning environment.

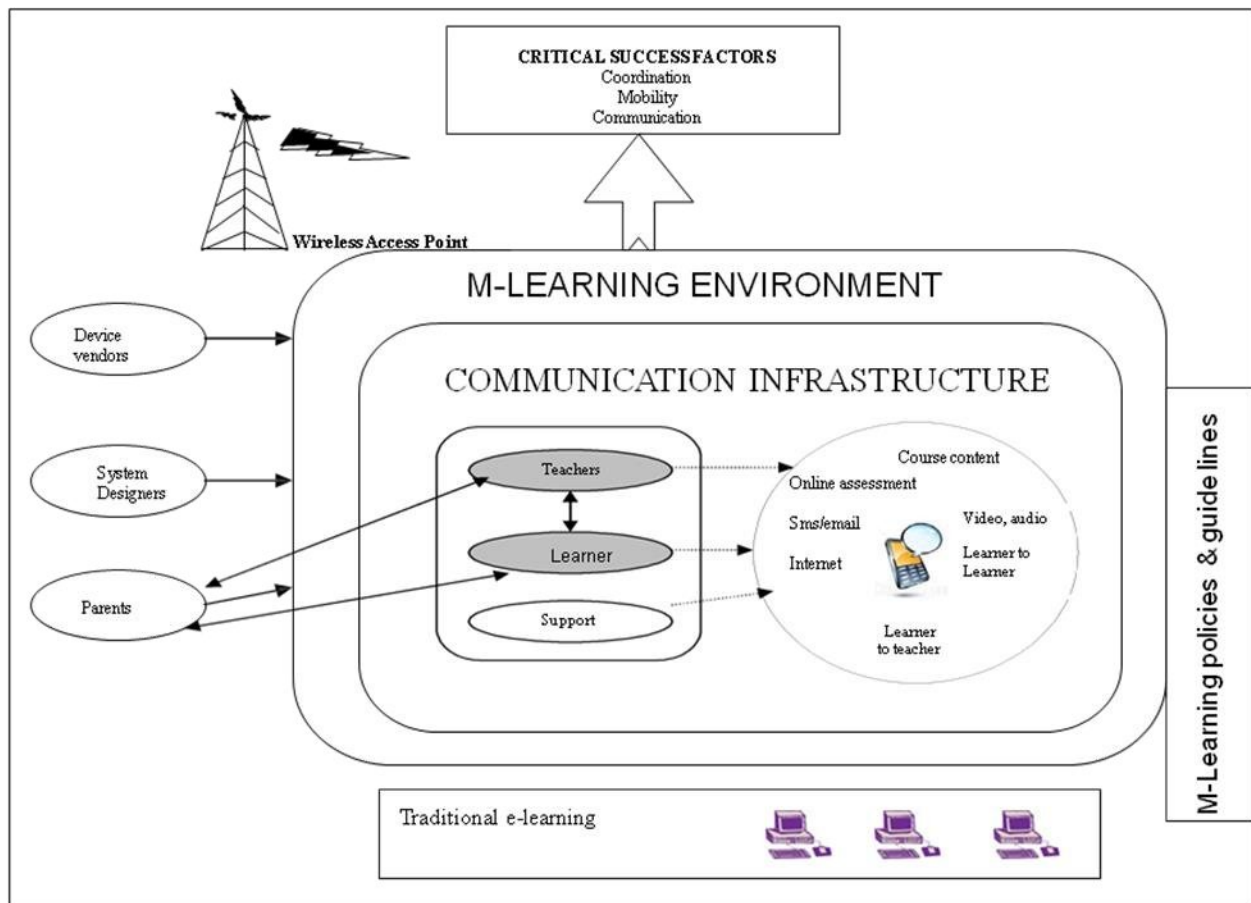


Figure 1: M-learning adoption model (Baker et al. 2005)

### Information System (IS) model

DeLone & McLean's comprehensive review of different IS success measures concludes with a model of interrelationships between six IS success variable categories. The categories of the taxonomy are System Quality, Information Quality, IS Use, Users' Satisfaction, Individual Impact and Organization Impact (Figure 2). The study revealed that the success of an IS can be represented by the quality characteristics of the IS itself (system quality); the quality of the output of the IS (information quality); consumption of the output of the IS (use); the IS users' response to the IS (users' satisfaction); the effect

of the IS on the behavior of the user (individual impact); and the effect of the IS on organizational performance (organizational impact)

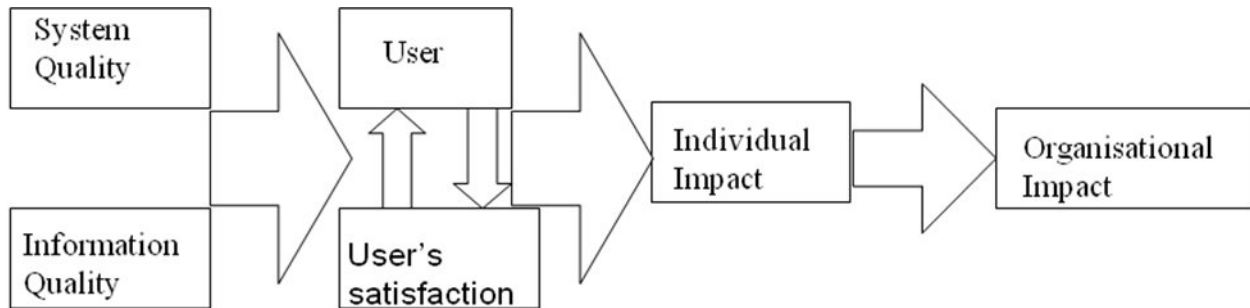


Figure 2: DeLone & McLean's (1992) model (courtesy: Chen, C et al.(2006))

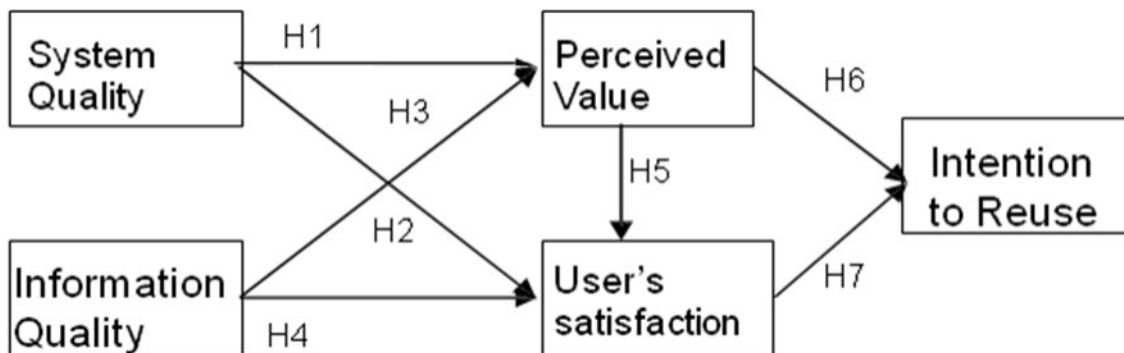


Figure 3: The research model of m-learning systems success (courtesy: Chen, C et al.(2006))

### Open learner model

The open learner model was used to promote reflection in combined desktop PC/mobile intelligent learning environments (Bull, et al., 2003). The authors defined an open learner model as, a model that allows the students to see information about their knowledge state held by the tutoring system, which they would not usually obtain through standard system feedback on their input. They said that, because students may automatically compare any such information to their own beliefs about their knowledge, this can be a powerful method of fostering reflection, particularly if the system's beliefs and the student's own beliefs about the student's understanding differ. The authors also stated that one of the ways of using the computer as a tool for learning through reflection is by employing open learner models as a learning resource to promote an individual's reflection on their evolving knowledge and on the learning process. Some approaches to open learner modeling are quite complex, requiring the user to negotiate the contents of their model with the system, providing justifications for changes they wish to make to their model. This not only allows the creation of a more accurate learner model, but discussion and argumentation over the representations in the model also focus the student's attention on their developing knowledge. According to the authors, other approaches to open learner modeling encourage students to contribute information directly to their learner model, or allow them to edit the model, with no argument from the system. As with negotiated learner models, editable models can also serve to encourage

reflection, as students must focus on their understanding if they wish to make changes in their learner model. These models have also been implemented in both textual form and structured graphical form.

An intelligent learning environment for Desktop PC and Handheld computer called C-POLMILE was also developed in (Bull, et al., 2003). It is an open learner model for C programming with two versions; Desktop PC and Handheld versions. These two combined environments use their learner models to help encourage students to reflect on their learning, by making the learner model contents explicit to the user. The interaction types in the model include browsing information; individualized tutoring sessions; multiple choice test questions; interacting with the learner model. The authors stressed that the essential thing in C-POLMILE is the ability of the user to modify its contents by interacting with the learner model. The benefits of such model however, depends on if the learner will ever view his learner model for reflection on how he is being modeled, even though he is aware of the feature, and on how the model is integrated with the aims and interactions of the system. The two intelligent learning systems in (Bull, et al., 2003). were presented as illustrations. In the first, the same interaction options are available in each version of the system. In the second, the main interaction takes place on the desktop PC, with individualized static revision material offered for synchronization to the handheld computer for later consultation. Each of these systems makes explicit the contents of the learner model to help encourage students to reflect on their learning. The differences in the two environments prescribe the use of different types of open learner model. The authors of (Bull, et al., 2003), however, concluded by saying that “combined intelligent learning systems such as the above are still new, and much research therefore remains to be undertaken to find out the extent of the potential for encouraging reflection through learner modeling in this context.”

### ***A model for m-learning in Africa***

A model for m-learning in Africa was proposed by Brown (2005). The following summarizes the model developed in 2005. The author stated that learners only have periodic access to the Internet via PCs at learning or community centers and that during these periods of access, the focus is on:

ICT literacy

downloading of content

access to articles/study materials/other resources

e-mail/bulletin board/chat room (communication and interaction)

Learners use mobile phones on a regular basis.

Academic support for learners via SMS communication and interaction:

- with educational institution

- with peer learners and study groups

This access, he further stated also provides Administrative and Academic support for learners via SMS

MMS and WAP for:

administrative information (reminders, notifications, urgent information, etc.)

access to examination and test marks via mobile service number, etc.

### ***Shih's mobile learning model***

The author Shih (2007) developed an M-learning model based on Keller's ARCS Model of motivational design Keller (1987). The learning cycle of the ARCS include: Attention, Relevance, Confidence, and Satisfaction (ARCS). The Shih's Mobile Learning Model is a variation to the ARCS model. It is based on ARCS learning model and mobile technologies' characteristics in promoting and enhancing human interactions, as depicted in Figure 6. The model was created to support instructional design for mobile learning. The learning cycle in the Shih's model, according to the authors includes:

1. Sending a multimedia message to mobile phones to trigger and motivate learners.
2. Searching the Web for related information by using embedded hyperlinks (URLs) in the message received in the phone.
3. Discussing with learning peers by text, voice, picture, or video messaging
4. Producing a digital story telling of what they learn by audio or video diary.
5. Applying what they learn in the simulated environment, such as online educational gaming.

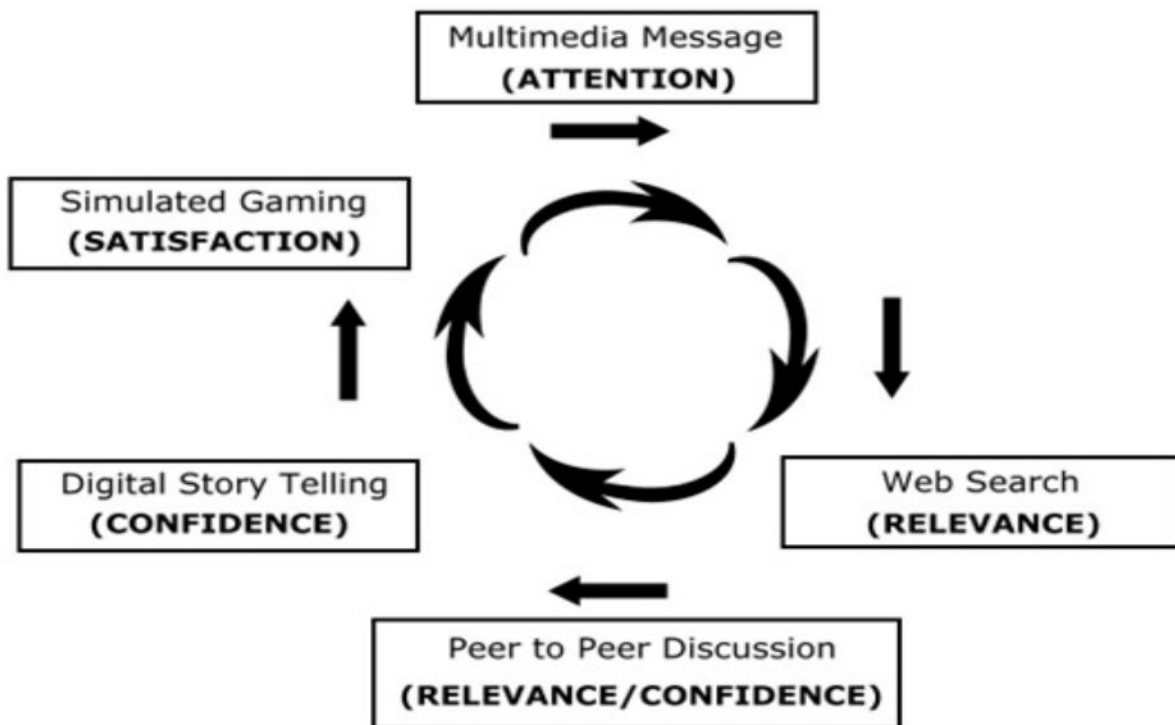


Figure 4. Shih's M-learning Model Learning Cycle (courtesy: Shih et al., 2007)

The authors stated that the Shih's M-learning model draws on the philosophy of social constructivism through the use of collaborative discussion and a learning style theory based on digital story telling. This learning model mainly relies on the mobile computing communication infrastructure, and would be most suitable for applications in blended learning and/ or pure mobile learning environments.

**Interactive West African Education Satellite model (IWASat)**

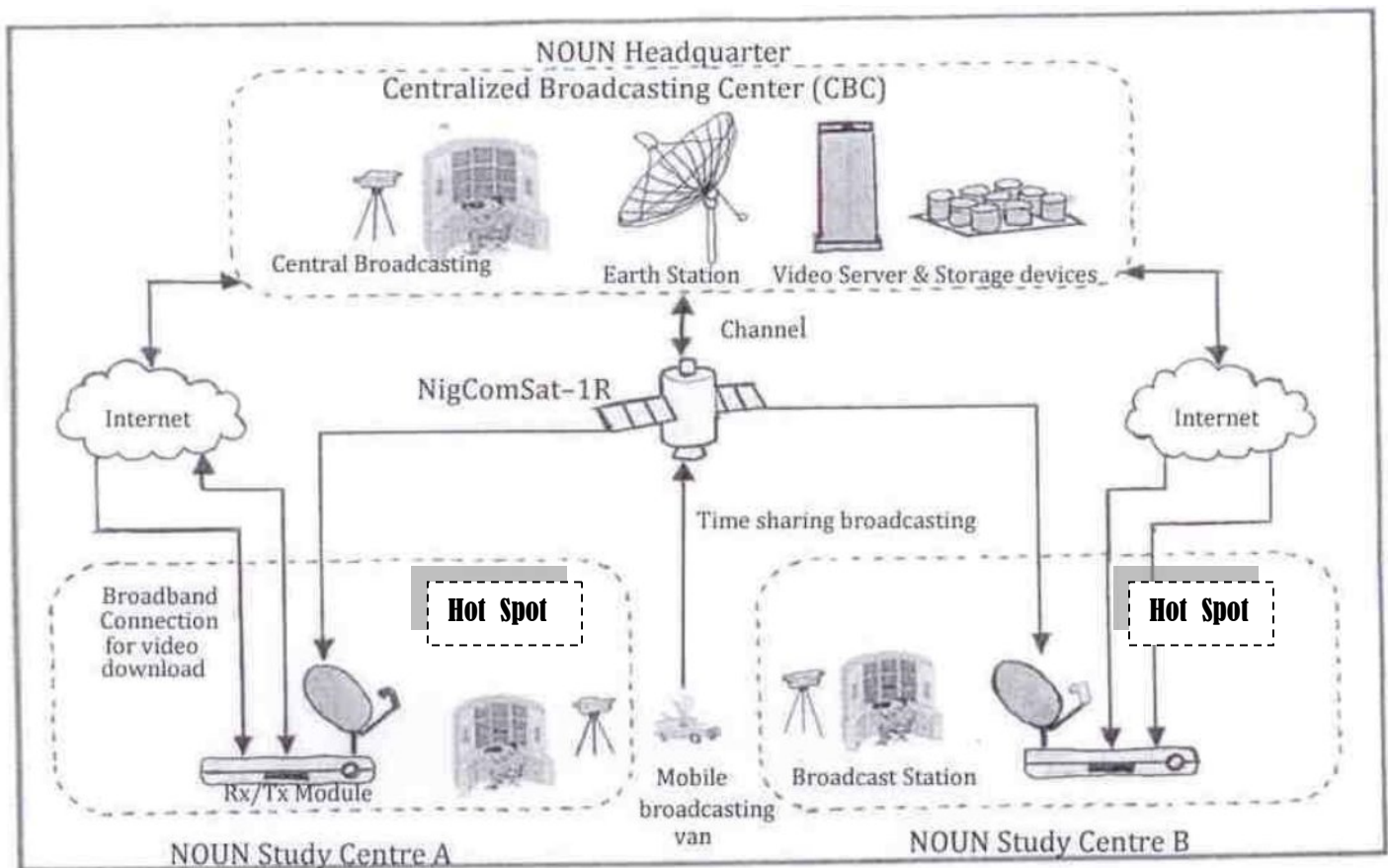


Figure 5: Schematic model, illustrating the M-learning domain with the Interactive Educational Spot beam Satellite (NIGCOMMSAT-1R )

## Components of the Proposed Model

The proposed interactive satellite consists of the following main components:

- Communication satellite (NigComSat-1R) with spot beam technology.
- Study centers (**anywhere within West African region**) with VSAT terminals.
- NOUN headquarters with archiving capabilities.
- Mobile Broadcasting Van
- Hot Spot

### Communication Satellite (NigComSat-1R) with Spot Beam Technology

NigComSat-1R is a communication satellite with spot beam technology because it's enabled to deliver more local channels to specific, precisely defined areas; which improves its ability to compete with cable broadcasters. The communication satellite uses beams that cover the entire West African Region. To provide local broadcast coverage, channels intended for only one local area (NOUN) are scrambled so users elsewhere cannot view them. NigComSat-1R is designed to project spot beams at selected areas, allowing the same radio frequencies to be reused in different areas, thus increasing the channel capacity.

### Study centers (anywhere within the West African Region) with VSAT Terminals

A typical study center described here constitutes an interactive receiving end (classroom) consisting of a variety of components such as a satellite dish, special satellite receiver, transceiver, computers, routers, multimedia equipment, E-Learning software. The two distinguishing components that can be used as remote stations are: the Very Small Aperture Terminal (VSAT) and Satellite Interactive Terminal (SIT).

**VSAT:** Is a low cost business terminal with small antenna. It is a two way data terminal or one-way data link depending on the situation. The most common VSAT configuration is the Time Division Multiplexing (TDM)/TDMA star network. VSAT has a high bit rate outbound TDM carrier from the hub to the remote earth stations and one or more low or medium bit rate TDMA carriers. Remote users' sites have several low bit rate Data Terminal Equipment's (DTEs) operating at 1.2 to 9.6 Kbits/s. These are connected through the VSAT network to a centralized host processor.

**SIT:** Is a satellite receiver with broadband internet connection. The multiplexer of SIT exchange video content with the multiplexer of the MENOS hub for:

- Live TV contribution/distribution (reserved channel)
- High speed streaming on reserved channel or best effort file transfer hub.
- Short time storage in the SIT or long term archiving in the network hub. These exchange sessions are synchronized and activated automatically by the hub's Multimedia Reservation

Server (MRS). The TV SIT is connected to the MENOS hub via two satellite subsystems: A Multiple Frequency TDMA (MF-TDMA) broadband subsystems for data and voice communication and a Reservation Access Multiple Access (RAMA) subsystem for video and fast file transfers.

### **NOUN Headquarters with Archiving Capabilities**

Part of the VSAT network is the hub, which is the centralized high performance earth station (with an antenna of up to 9m in diameter). The proposed communication network is constructed using a STAR topology with the hub at the center of the star. The hub plays an important role in enhancing the performance and efficiency of the proposed M-Learning system as:

- NOUN headquarters is considered as the heart of communication between NigComSat-1R and the study centers.
- All study centers are connected to NOUN headquarters at all times.
- NOUN headquarter provides the study centers with broadband internet services, and voice services.
- NOUN headquarters works as a centralized operational center that provides collaboration and media exchange between connected study centers.
- NOUN headquarter can be used to broadcast programs to all the connected study centers
- It can be used to direct specific programs to specific study centers utilizing the spot beam technology in NigComSat-1R.

### **Mobile Broadcasting Van**

This mobile broadcasting van could be located anywhere within the coverage area of NigComSat-1R. This will enable intending learners who are not opportune to be at any of the study centers access to NOUN M-Learning contents.

### **Hot Spot**

Hot Spots are wireless connection areas some meters around Study centers with VSAT terminals, NOUN headquarters or Mobile Broadcasting Vans. With any mobile device such as PDAs, iPhone, iPod, GPS, Mp3, Mp4, Palmtop, Laptop, Tablets or even digital cameras, students, staff of NOUN or authenticated users can have access to the mobile learning platform.

### **Features of the Proposed Model**

One of the main features of the proposed model is its ability to overcome the limitations of internet bandwidth while delivering E-Learning materials for users through the combination of satellite and internet communications. Several other features and advantages may also include:

- Ability to deliver full-length high quality multimedia educational programs.
- Live coverage of teaching classes and workshops.
- M-Learning video broadcast.
- Satellite video conferencing.
- Important educational news coverage.
- Interviews with prominent researchers and educators from all over the world.
- Sharing of educational media across the country.
- Educational media production.

## CONCLUSIONS

This model will utilize the new spot beam satellite communication technology to ensure allocation and customization of local channels to NOUN. Using spot beam technology improves the satellite capability to compete with other existing wire and wireless communications technologies. The communication satellite (NigComSat-1R) can efficiently and cost-effectively cover the entire West African region and reach the wide array of Learners across West Africa. The model also implement advance interactive component to meet the standards of the learning process.

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