

# MAXIMIZING WIRELESS COMMUNICATION NETWORK COVERAGE WITH MINIMAL OVERHEADS: PROSPECTS AND POTENTIALS

*Adekiigbe Adebajo; Aмоса B. Michael Gbadega and Awotidebe, Mathew Lanre*

## Abstract

Almost four years ago, Nigeria joined the League of Nations which has exploited the technology of the wireless communication systems (Global System of Mobile Communication) to complement the existing wired/land line communication facilities provided by the only existing national carrier Nigeria Telecommunication Limited (NITEL) before (he second national carrier was licensed. Ever since, the operation costs of service delivery to the subscribers has been on the increase because of the need to build more base stations and cell sites and their subsequent maintenance. Though, the situation is not peculiar to Nigeria alone, the overheads of large coverage area is always increasing, hence, this paper focuses on some strategies that can be adopted to maximize coverage for wireless communication systems while maintaining overheads.

## Introduction

Mobile communication is currently the fastest growing area within the telecommunication.- industry. In the last few years there has been an unprecedented growth in subscriber numbers, especially in cellular mobile telephone. Nigeria has now more than ten million cellular mobile telephony users, about twenty times the number of landlines users. In the new' information age. the mobile phone will deliver much more than just voice calls. It has become a multi-media communications device, capable of sending and receiving graphic images and video. With hundreds of new subscribers signing up for cellular service every day throughout the country, cellular operator- are already facing new demands for increased cell sites capacity. To build a base station, it may cost close to forty five million naira (1445, 000,000) or more, this cost is excluding of the cost to run the base station.

However, building new cell sites and base stations may not after all always be the best way to resolve increased network capacity caused by growing subscribers to such network. Careful handling of four network design criterion as stated by John (2001), which include coverage, capacity, carrier to-interference ratio (C/I) and cost can be highly useful for designing effective and efficient wider network coverage vis-a-vis substantial reduction in cost of overheads. By coverage we mean how much area is served (k<sup>rn2</sup>), capacity is the ability to carry traffic, the C/I is the ratio of the signal you want to the signal you do not want, while cost is defined in naira spent in making the network available. In this paper, provisions for expanded coverage without expanding financial obligations of the wireless system operators are x-rayed.

## The Antidote

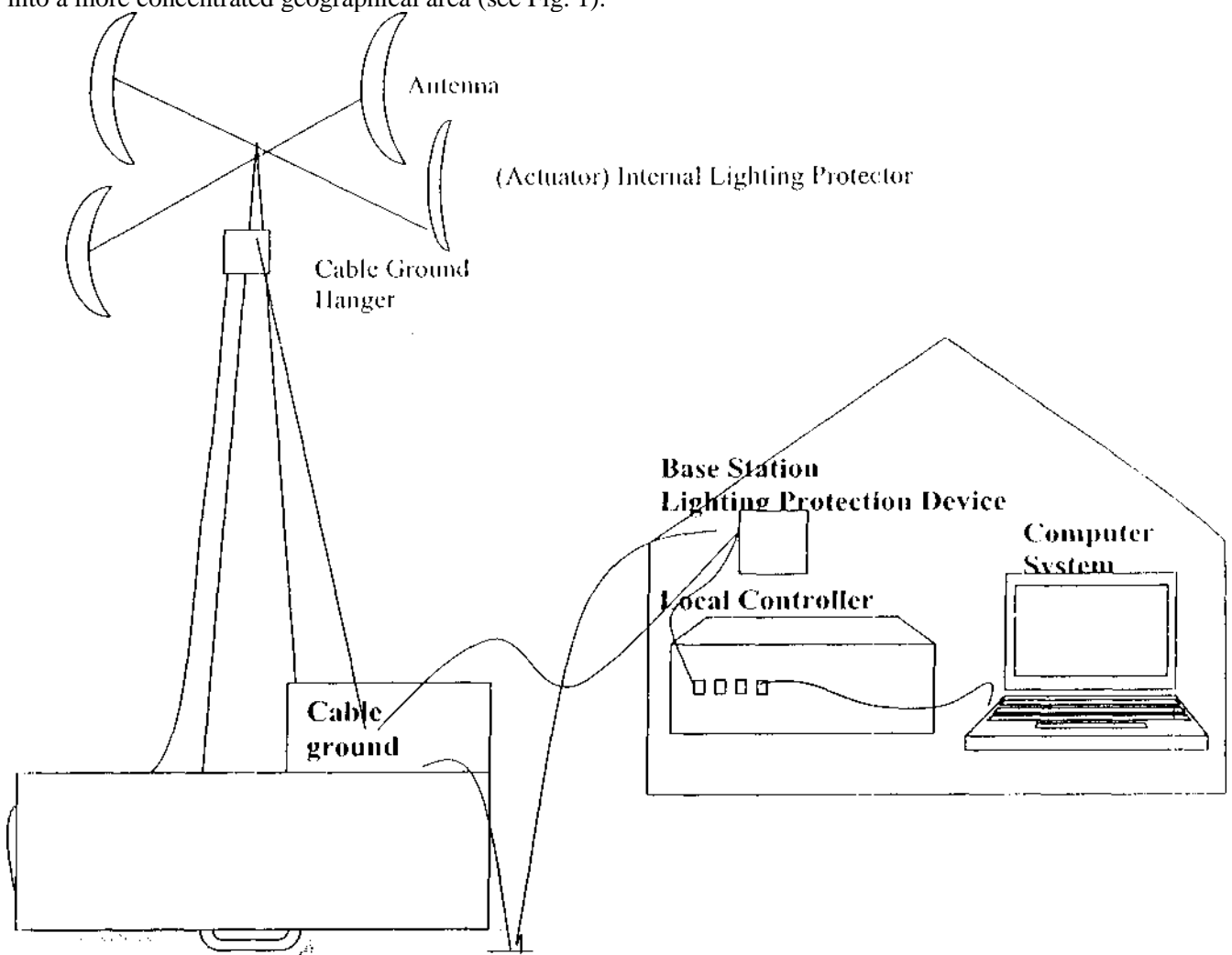
More efficient use of channels and frequencies by cellular carriers and other wireless communications system operators can take them higher levels of success by instituting programs and strategies designed to manage the finite resources of existing base stations. Also, the communication- system operators can support more users without building more base stations hence, drastically reducing the overheads and they in turn function more efficiently while users will be more satisfied with the services and stakeholders are pleased with marginal profit accrued capital invested.

The following are some of the steps to take in maximizing cellular coverage while controlling overheads.

## Antenna Signal Patterns

Cellular carriers' base stations are designed to provide total coverage for metropolitan area- but there have been challenges in providing service access to more users than the channels available To accomplish effective coverage without having to build more base stations and cell sites, carrier- can initiate the antenna *downtilt* techniques. Downtilt, either electrical or mechanical, directs the ratio

frequency (RF) signals toward the ground and focuses the pattern generated by the base station's antenna system into a more concentrated geographical area (see Fig. 1).



**Fig. 1: Teletilt ATC100-1000(Adapted from Teletilt Installation Manual)**

Downtilt brings about reduction in overlapping of channels that are available between base stations that would have occurred, despite the fact that the base stations are mile apart, by aiming the signal pattern towards the ground rather than towards the horizon.

Downtilt results in more frequent reuse of channels because the physical distance traveled by radio frequency signals is reduced.

### **Re-allocations of Frequency**

Re-allocation of available frequency is another major technique that can be used in the battle to provide omni-available service while maintaining minimal overheads level (Peter. 2002). The concept of frequency re-allocation is simple: shift under-used frequencies to base stations that are in use heavily.

The tools that are employed in achieving the shift are automatic tuning combiners by most system managers to accomplish a smooth transition of available channels. The combiners facilitate re-allocation of frequencies from cell sites to provide coverage in, for example, an area that may be busy during the day (e.g. market place) but almost uninhabited at night. The unused frequencies are delivered to locations where there is high demand from cellular subscribers.

### **Remote Site Management**

Site management is one aspect of wireless Communication that takes the resources of all operators because the number of cell sites in a service area always exceeds the number of field technicians employed by wireless operators (Alan, 2003), hence, should there be a problem at a site, the

operator must dispatch a technician to the site to have first hand knowledge of the problem and probably effect repairs. This process may take hours depending on the location of the technician and the elapsed time. Network efficiency suffers because a site is out of commission. Cellular calls can be dropped, short messages services (SMS) will not get through and fleet connections should be severed.

Additional overhead costs also are incurred in the areas of repairing site vehicles, technician hours and replaced equipment.

Remote site monitoring and management can offset the costs associated with field service calls. Twenty four hours surveillance of all base stations in a coverage area from the confines of the operator's local office could be monitored by the Base Station Operations.

There are two major benefits that are available from remote site management:

- (i) The capability to pinpoint exactly which site is not functioning correctly and establishing the type of malfunction without a technician being dispatched to base stations in the coverage area; and
- (ii) The malfunctioning site can be remedied with issuance of commands via computer in the office to the monitoring equipment at the base station. Without leaving the monitoring equipment and the computer on his desk, a technician can locate and repair most problems that occur at a base station. Thousands of naira can be saved every year through the remote site management because there is substantial reduction in the number of field service trips and associated technician's hours.

One of the vital advantages of advanced remote management equipment is that operators can identify site equipment that is slowly degrading in performance levels and then make a plan for the equipment replacement before a malfunction occurs.

### **Equipment and Machinery Sharing Approach**

It was observed that most of the wireless communication operators built their base stations and cell sites close to each other. If the issue of unwarranted and unnecessary rivalry could be eliminated completely among the operators, there are lots of cost saving methods, which could be deployed in their day-to-day operations. Among the cost saving mechanisms is joint purchase of landed property for building of cell sites and base stations. Also, some equipment such as generating set to power the base station in case there is no public power utility could be jointly purchased and maintained. This invariably will reduce the cost of fueling, servicing, and cost of insurance (theft and fire) to each operator to the barest minimum.

Even though, the functionality of sharing the same mast by different operators has not been put to test, we strongly believe that a specially made mast that can accommodate two or more operators' antenna can be constructed. The cost of constructing base station and cell sites will definitely reduce if this method is adopted and numbers of masts springing up each day will drastically reduce and the money saved from such can now be used for something more beneficial to all stakeholders.

### **Recommendations**

In order to maximize wireless communication network coverage with the intention of minimizing overheads, we hereby recommend the followings:

- i. That communication systems operators make efficient use of channels and frequencies reallocation.
- ii. That recent technology deployment to base stations will increase total coverage and reduce cost.
- iii. That downtilting of antenna results in more frequent reuse of channels because the physical distance traveled by radio frequency signals is reduced.
- iv. More sophisticated automatic channel combiners be deployed by systems managers to accomplish a smooth transition of available channels to facilitate reallocation of frequencies from cell sites to provide coverage in areas that may be busy during the day but almost uninhabited at night.
- v. Deployment of more recent remote site monitoring technology for effective site management.
- vi. Construction of multi antenna mast be undertaken by manufacturers of hardware to be able to accommodate two or more operators in a single base station.

### **Conclusion**

Meeting users rising demands of wireless communications services is vital in today's world of increasing dependency on wireless communication. Wireless operators need not lose sleep in finding a way to increase the number of their cell sites and base station to support the demand but rather carefully plan for the efficient management of their base station operations and create more frequencies where and

when it is needed.

Non-exploitative collaborative efforts by operators will go a long way for users of wireless communication to enjoy the benefits of wider coverage. We strongly believe that pooling of resources by wireless communication operators on sites will help increase the potentials of wider coverage, minimizing overheads, providing more quality services to their various network subscribers, increasing service delivery, and creating avenues for finding solutions to technical affecting each other.

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