# Intercell-Interference Management For The Next Generation Wireless Communication System

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***Abstract****: This study focused on inter-cell interference management for the next general wireless communication system in Abakaliki Ebonyi State. The objective of the study was to find out the extent inter-cell interference is managed in Nigeria communication system, four research questions were formulated to guide the study, the design was descriptive survey. The population of the study comprised 1450 out of which samples of 145 staffs were randomly selected. The structural questionnaire. Mean and frequencies were used for data analysis. The findings of the study among other things revealed that inter-cell interference management materials are rare among the network providers in Abakaliki Ebonyi State. Based on the findings of the study some recommendations were made.*
***Keywords****: Interference, Management, Wireless and Next generation.*

## I.    Introduction

Inter-cell interference management is very vital to meet the contemporary needs of the society. It has made the world a small village and it has enhanced communication technology and development and has enabled individuals to excel in communication technological field of life. The importance of inter-cell interference management for next generation wireless communication system in the communication sector cannot be over-emphasized because, it enables technologyto prove the best communication system that will bring to end inter-cell interference in wireless communicationsystem.

Wireless or mobile links-ML are becoming the main form of transmitting information. For this reason, small cells come out as a central solution in some environment in order to get high quality in data and voice services. Many companies that offer telecommunication services like MTN have evaluated options in order to find a more suitable way of meeting their subscribers needs and for 60% of them, small cells appears as a fundamental part in the deploying of 4G networks. In 2020 small cells will cover about 25% of all mobile traffic, and the manufacturers of the related equipment expect to insert into the market about 36.8 million units and make profit around 20.4 billion dollars.

Wireless communication system are in continuous evaluation as a result of the ever increasing demand for higher data rate services. Examples of next generation networks that will bring higher data rates and increase system capacity to end users and network operators are 3GPP long term evolution advanced (LTE-A) and WIMAX 2. These systems are being developed under the scope of IMT-Advanced. Recently, direct device-to-device communication (D2D) as an underlay network to IMT. Advanced cellular network has been proposed as a promising technique that is expected to provide efficient utilization of the available wireless spectrum. Moreover, interference alignment (IA) has shown the potential to boost the overall cellular spectral efficiency.

Inter-cell resource management refers to a collection of operations that intend to achieve a maximized channel efficiency by minimizing the performance degradation caused by the inter-cell interference. The inter-cell interference management has been extensively studied throughout the decade and significant progress has been achieved.

According to Lee *et al.,* (2008) as the next generation wireless communication system emerge,questions arise whether the conventional inter-cell interference management scheme would be applicable to the newly emerging system of wireless communication system (Jatzela and Naghstined, 1996). Indeed there are challenges that do not allow direct application of the conventional schemes as the next generation systems are expected to experience significant changes in terms of technologies, services and network links. Specifically, the main drilling force for the changes involves the data-centric services, new dynamic service scenarios of all-IP based core access networks, new physical layer technologies and heavy upload traffic. In their paper, Kwon *et al.,* (2008) investigated how the interference management should evolve in order to cope with the above changes to occur in the next generation wireless communication system. Kwon *et al.,* (2008) first presented the lessons in the conventional inter-cell interference management schemes, which are fundamentally applicable to next generation system (Lee *et al.,* 2008). The inter-cell interference management is essential for a successful development of the next generation wireless communication system.

Researchers have identified that the merging systems are differentiated from the conventional system in terms of the data services, new dynamic service scenarios of all IP core access networks, new physical layer technologies and heavy upload traffic (Kwon *et al.,* 2008). Based on that, Kwon et al (2008) discussed the inter-cell interference management issues that can maximize the channel reuse which supports the new technologies services and network.

**Interferencein Communication System**

According to EURASIP journal on wireless communication and networking (2011). Interference is a fundamental nature of  wireless communication systems, in which multiple  transaction often take place simultaneously over a common communication  medium. In recent years, here has been a rapid growing interest in developing reliable and spectrally efficient wireless communication system. One primary challenges in such a development is how to deal with the interference, which may substantially limit the reliability and the throughput of the wireless communication system. In most existing wireless communication  system, interference is dealt with by coordinating users to orthogonalize their transmission in time or frequency or by increasing the transmission power and treating each others interference as noise. Over the past twenty years, a number of sophisticated receiver designs for example multiuser detection have been proposed for interference suppression under various settings. Recently, the paradigm has shifted to focus on how to intelligently exploit the knowledge and/or the structure of interference to achieve improved reliability and throughput of the wireless communication system.

**Types of interferencein communication**

There are three basic types of interferences; radio frequency interference (RFI), electrical interference and intermodulation interference. RFI is caused by radio and TV transmitters, communication equipments, cable television system and other types of equipment that generate radio frequency energy as part of their operation. Electrical interference is caused by computers and digital equipment, heavy electrical equipment, etc. Intermodulation is a type of interference caused by the internal combination of strong radio signal in wireless receivers.

A basic understanding of the symptoms and causes of the three types of interference is key to dealing effectively with any problem that might arise. One reason interference problems can be frustrating is that it is often difficult to know where to start. Some times it seems that everything affects the  problem.Simply knowing which type of interference is present helps to avoid wasting time and unproductive approaches and greatly simplifies the process of finding the real source of the problem.

In the first step, we calculate the impact of interference level, $1_m$, of $UE_m$ from neighbouring eNBs. Note that to calculate the interference level, an equal transmitting power is considered for all eNBs on all RBs which stated as

$$I_m = \sum_k^k = {_1} P_m^n H_{m.n}^k$$

In order to calculate the maximum interference, $I_{max}$, the following conditions is taken into account: 1) minimum shadowing, 2) minimum fading, 3) maximum transmit power on the used RB, and 4) minimum  pathloss, that is when a UE is located on the boundary  of two neighouring  cells, the maximum distance from the serving eNB and minimum distance from the neighouring cell is obtained as

$$Distance = \frac{|pos_l - pos_k|}{2}$$

Where $pos_l$and $pos_k$ are locations of serving eNB *l* and neighouring eNB *k*. this assumption will lead to minimum path loss received from the neighouring eNB. By replacing these values into 2, the $I_{max}$ will be obtained.

**Radio frequency interference:** this type of interference is caused by radio frequency (RF) signal on or near the frequency of the affected wireless receiver, the interfering signals might have been transmitted intentionally or unintentionally as the result of some defect or undesired characteristics of the source.

**Electrical interference:** Electrical interference does not benefit anyone and is almost never intentional. With few exceptions, the equipment causing electrical interference problems are not intended to be a source of RP energy. Often, the interference problem in that can be  equipment, simple tend to generate interference in the normal course of operation.

Generally, manufacturers are required to design and  manufacture their products so that they do not cause harmful interference. In many cases, this is a legal requirement because the government has imposed regulations that places strict limits on the unintentional generation of RF interference.

**Intermodulation interference:** Intermodulation or "intermod"  is a type of interference sometimes encountered in wireless microphones system. Intermodulation differs from other forms of interference in that it is created in the wireless system itself, not directly by some external source. Other types of interference are caused by other

transmitter on the wireless operating frequency. TV station carries the harmonic output of transmitters at lower frequencies, spurious emission from various kinds of electrical equipment, and similar external sources. Interference due to intermodulation is caused by strong signals which are generally not near that of the wireless frequencyinstead, these strong signals overload some circuit in the wireless receiver, causing the circuit to internally generate harmonics of the strong signals.

## II. Analysis

In the analysis of the data the mean and frequency were used: the mean was computed in respect of the response mode by multiplying the frequency (f) of response under categories of the assigned values and dividing the sum of products by the number of the respondents to the particular items.

That is $\sum fx$ where x= mean, x=the value of scale F =frequency, N= total number of respondents; A for point scale which require respondent to rate of questions on section one to four. The ranges are strongly agree (SA)=(4) agree (A) (3) disagree (D)=(2) and strongly disagree (SD)=I

Calculative response score of question score of each questionnaire item is calculated and divided by the total number of respondents to obtain the mean thus 4+3+2+1=2.5

2.50 is the mean of the scale point. It was therefore decided that during the item scoring 2.50 and above would be considered accepted items with less than 2.40 was indicated as rejection by the respondents.

Decision – any response with a mean greater or equal (x=2.50) was indicated acceptance, items which means is below or equal to (2.49) will indicate rejection by the respondents.

$$\frac{N}{4}$$

## III. Discussions

**Research Questions 1**; To what extent is inter-cell interference managed in Nigeria communication system using MTN.

**Table 1** means rating staffs on the extent inter-cell interference are managed in MTN in Abakaliki, Ebonyi State.

| No | Item | SA | A | D | SD | N | X | SD | Decision |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Computer are provided to all staff for communication | 15 | 30 | 40 | 60 | 145 | 2 | 2.42 | Disagree |
| 2 | No internet services to manage the problem of intercell interference in communication | 59 | 42 | 28 | 16 | 145 | 2.99 | 2.63 | Agree |
| 3 | Use of wireless materials is rare in MTN | 61 | 42 | 24 | 18 | 145 | 2.97 | 3.85 | Agree |
| 4 | Available technique know-how is always one technique know-how one head office | 50 | 46 | 26 | 23 | 145 | 284 | 3.33 | Agree |
| 5 | MTN Abakaliki has not been having interference in their communication system | 10 | 35 | 42 | 58 | 145 | 1.97 | 3.89 | Disagree |

Ground mean = 2.55

The result of data analysis in table 1 reveals that the respondents in item 1 and 5 rejected that the items on the extent inter-cell interference is managed in Nigeria communication system during working hour. This is confirmed by the mean scores of 2 and 1.97 respectively which is lesser than 2.50. The result of data analysis in table also reveals that the respondents in item 2,3 an 4 agreed that the items on the extent inter-cell interference is managed in Nigeria communication system. The mean scores for items 2, 3 and 4 are 2.99, 2.97 and 2.84 respectively. Therefore since the mean score are greater than 2.50. It was agreed with the mean that are above the cut off point.

**Research question 2;** To what extent does interference management aid/effect wireless communication system?

**Table 2** mean rating staff on the extent inference management aid effect wireless communication system.

| No | Item | SA | A | D | SD | N | X | SD | Decision |
|---|---|---|---|---|---|---|---|---|---|
| 6 | Staff of NTA have the aid for managing interference | 16 | 29 | 41 | 59 | 145 | 2.0 | 2.62 | Disagree |
| 7 | Trained staff of NTA do well in the managing of interference than untrained ones | 70 | 38 | 27 | 10 | 145 | 3.15 | 2.7 | Agree |
| 8 | Introduction of inter-cell interference management has enhanced communication system | 58 | 44 | 32 | 11 | 145 | 3.02 | 3.17 | Agree |
| 9 | Trained staff in inter-cell interference earn more than | 62 | 41 | 36 | 6 | 145 | 3.09 | 3.88 | Agree |

| | untrained ones | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 9 | Trained staff lack internet service manage the problem | 59 | 43 | 26 | 17 | 145 | 2.99 | 3.63 | Agree |

Ground mean = 2.85

The result of the data analysis presented in table (2) above reveals that only respondents in item 6 rejected that the items on the extent interference management aid effect wireless communication system. This is evidenced in the mean scores 2.0 which are below the decision rule of 2.5. The result of data analysis in table 2 also reveals that the respondents in item 7, 8, 9 and 10 a greed that the items on the extent interference management aid effect wireless communication system. This is confirmed by the mean scores of 3.15, 3.02, 3.09 and 3.99 for items 7, 8, 9 and 10 respectively since each of the above mean scores is greater than 2.50. It was therefore accepted with the mean that is above cut off point.

**Research Question 3;** To what extent does government supply power to help maintain constant interference management?

**Table 3** mean rating the extent government supply power to help maintain constant light.

| No | Item | SA | A | D | SD | N | X | SD | Decision |
|---|---|---|---|---|---|---|---|---|---|
| 11 | Inadequate supply of power is a major obstacle in the interference management | 49 | 41 | 39 | 16 | 145 | 2.84 | 2.33 | Disagree |
| 12 | Lack of proper funding on government is also a problem in the sector | 60 | 42 | 31 | 12 | 145 | 3.03 | 3.88 | Agree |
| 13 | Lack of basic skill on the interference management is a obstacle in improving network provision | 58 | 41 | 26 | 20 | 145 | 2.94 | 3.66 | Agree |
| 14 | Government has not taken the campaign of uninterference network to network provides | 70 | 37 | 24 | 14 | 145 | 3.12 | 2.55 | Agree |
| 15 | Government has not been tasking network provides to masses | 50 | 42 | 33 | 20 | 145 | 2.84 | 2.33 | Disagree |

Ground mean = 2.95

The result of data analysis presented in table 3 above reveals that the respondents in items 11, 12, 13, 14 and 15 agreed that the items on the extent government supply power to help maintain constant light. This is confirmed by the mean scores of 2.84, 3.03, 2.94, 3.12 and 2.84 for items 11, 12, 13, 14 and 15 respectively. Since each of the above mean score greater than 2.50. it was therefore acceptable with the mean that is above cut of point.

**Research question** 4; To what extent has the problem of inter-cell interference management affect information dissemination in Nigeria?

**Table 4** mean rating the extent inter-cell interference management has affected communication in Nigeria.

| No | Item | SA | A | D | SD | N | X | SD | Decision |
|---|---|---|---|---|---|---|---|---|---|
| 15 | Communication has been made easy with interference management | 50 | 45 | 30 | 20 | 145 | 2.86 | 2.34 | Agree |
| 16 | Both poor and rich are now enjoying wireless communication | 65 | 41 | 32 | 7 | 145 | 3.13 | 2.56 | Agree |
| 17 | Improved network due to interference management | 45 | 40 | 32 | 28 | 145 | 2.70 | 3.27 | Agree |
| 18 | Network providers make more money than before | 62 | 44 | 32 | 7 | 145 | 3.03 | 3.88 | Agree |
| 19 | Wireless communication is taken over all communication sectors now. | 59 | 43 | 34 | 9 | 145 | 3.02 | 3.17 | Agree |

Ground mean = 2.94

The result of data analysis in table 4 above reveals that the respondents in 16, 17, 18, 19 and 20 agreed that the interference management has affect communication positively. The mean scores for it item 16,17,18,19 and 20 with 2.86, 3.13, 2.02 and 3.02 respectively. Since each of the above mean scores is greater than 2.50, it was therefore accepted with the mean that it above cut-off point.

## IV.    Result

The result of data analysis in table 1 reveals that the respondents in item 1 and 5 rejected that the item on the extent intercell – interference is managed in Nigeria communication system.

This is confirmed by the mean score of 2 and 1.97 respectively which is lesser than 2.50.

The result of data analysis in table 1 also reveals that the respondents in item 2 3 and 4 agreed that the items on the extent intercell-interference is managed in Nigeria communication system; the mean scores for items 2, 3 and 4 are 2.99, 2.97 and 2.84 respectively. Therefore since the mean scores are greater than 2.50. It was agreed with the mean that are above the cut-off point it was established that the intercell- interference is not properly managed in Nigeria communication system.

The result is in consonance with the view of Ndukwe (2001:46) who suggested that the federal government should provide computer to staff to enhance interference management who are to receive training on interference management in line with the above, sulla 1999 said all staffs must be trained in the interference management and other information technologies.

The result of data analysis presented in table 2 above reveals that only respondent in item 6 rejected that the items on the extent does interference management aid effect wireless communication system; this is evidenced in the mean scores of 2.01 which are below the decision rule of 2.5.the result of data analysis also reveals that the respondents in item 7, 8, 9 and 10 agreed that the items are the extent interference management aid has help wireless communication system this is confirmed by the mean score of 3.15,3.02, 3.09 and 3.99 for items 7,8,9 and 10 respective since each of the above mean score is greater than 2.56. It was therefore agreed that inference management aids was of a good help to staffs of N. T. A as a helping aid in communication system.

YUSUF (2005). Was of the view that I C T/internet and uninterence provides quicker and easy access to more extensive and current information communication and can be used to carry out research    YUSUF (2005) also was of the view that the right step in interference management Should be applied in every sector of the natiness communication system and particular in wireless communication, this policy is designed to ensure that Nigeria as a nation recognizes the strategic importance of uninterference for national development.

The result of data analysis presented in tables 3 above, reveals that the respondents in items 11 12 13 14 and 15 agreed that the items on the extent government supply power to help maintain. Constant interference management. This is confirmed by the mean score of 2.84, 3.03, 2.94, 3.12 and 2.84 for items 11 12 13 14 and 15 respectively since each of the above mean score is greater than 2.50 it was therefore establish that the inadequate supply of power is a major obstacle to the implementation on interference communication system in Nigeria and Abakaliki. In line with the above findings M.T.N Nigeria a leading telecommunication company in Nigeria in their bid to say thank you to Nigeria initiated a program they tagged "school connect" this program provided computer to same selected secondary schools in Nigeria with internet facilities, with the aim of linking these secondary school together in order to share ideals, information and other materials. It exposed student to the use of internet ICT in learning and the general use of computer.

The result of data analysis in table 4 above reveals that the respondent in 16, 17, 18, 19, and 20 agreed that intercell- interference management has affected communication system in Nigeria. The mean score for item 16, 17, 18, 19, and 20 are 2.8, 3.13, 2.70, 3.03 and 3.02 respectively. Since each of the above mean score is greater than 2.50. It was therefore established that the problem of intercell- interference affect communication sector in Abakaliki

In line with the above finding Ifegoboje and Okubote (2002)stated that lost of equipment in a state like Nigeria with a battered economic and seriously devalued currency is enormous, in support of the above view. Pavalke (1991) postulated that however, it should be noted that the problem might not be the fund nor the technology, but rather the will on the part of government and the governors in communication system.

## V.    Conclusion

From the ongoing discussions, it is clear that interference management in wireless communication is an indispensable tool in the modern communication system and so its adoption of management will go a long way towards the enhancements of one's communication conditions. This is true because issues such as poor network, delay in information processing, ineffective information communications between masses and network providers. Information communications will be facilitated and enhanced by the use of the wireless communication based technology. However, in order to achieve maximum impact of uninterference communication system in Abakaliki Network providers. The government should do well in providing power/energy, fund for purchases of some management materials and on the part of network providers staffs should be probably trained/ retrained in the area of interference management in communication. It must be realized that the current. Interference management infrastructure in Nigeria communication system cannot enable Nigeria or network providers in Nigeria to be part of the global information society.

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