

# Design and Implementation of a Computerized Frequency Coordination System

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## ABSTRACT

This paper focuses on the design and implementation of a computerized frequency coordination system. In the course of this research, two methods of implementing frequency coordination were adopted. These are the Manual Method and the Computerized Method (incorporating software designed by the researchers).

The first method of frequency coordination was carried out manually for different services (i.e., the FM broadcasting service, fixed and mobile services 1 and 2). The second method was performed using the existing package of Microsoft Excel and a software program developed by the researchers.

Each of these methods were tested on the basis of reliability, flexibility, and compatibility. The results obtained in these tests showed that the manual application and the computerized method produced almost identical results. However, the computer system appears to be preferred considering the speed, reliability, and ease in achieving results and its capability for handling greater volume of data than the manual application.

(Key words: FM broadcasting, mobile communications, wireless, telecommunications testing, RF, frequency coordination).

## INTRODUCTION

Radio frequency coordination is the term given to procedures followed by users of a common band of radio frequencies to minimize and control potential interference between systems [1]. The key aspect of these procedures involves efficient radio frequency planning and coordination.

Radio systems should be designed in such a manner as not to cause any interference with

other planned and authorized operating radio systems. This coordination is facilitated by sharing the coordinated data among users, so that accurate and up-to-date information is available to both planners and users. With appropriate coordination, estimates of potential interference can be made during the system design stage [2].

Frequency coordination and correlation are necessary, especially at the design stage of a new system. This coordination should be involved when one party initiates construction plans or reacts to another party's plans.

The frequency coordination process followed by common microwave carrier system operators involves the exchange of technical data; studies of potential interference effects; correspondence between users regarding new proposals; and, as necessary, re-designs of proposed systems during the coordination notification and response process. This coordination is necessary in order to avoid inter-modulation and spurious interference effects [3].

In this paper, two methods have been adopted in the design of frequency coordination and correlation. The first is a manual coordination effort, which involves the calculation of radio frequencies for different services in the study country (Nigeria) with the intention of investigation and control for existing interference between communication systems. The results obtained serve as primary data.

The secondary data is generated by the computer system used for frequency coordination. A computer system was used in coordination of radio frequencies and considering the volume of frequency data the system handle. A software frequency coordination program was also written in order to ensure compatible radio networking while avoiding harmful interference between different systems.

This computer method attempted to identify existing interference and potential ones caused by mixing such interfering signals with the target signals [4], thus resulting in noise and various inter-modulation and spurious products.

## METHODOLOGY

When coordinating frequencies manually for a particular service, it is essential to consider the operating frequency range and channel spacing required for that service.

Based on the given data, the first frequency is coordinated by choosing an appropriate frequency within the applicable range. Then, the second frequency is obtained by adding the given channel spacing to the first coordinated frequency. Continuing the addition of the desired channel spacing to each successive frequency, results in subsequent frequency coordination [5]. These frequencies are coordinated sequentially for accuracy.

The principle of frequency coordination requires that the last coordinated frequency should not be greater than the maximum frequency range and this requirement is well observed in this work [6].

The next step in this work is to identify channel numbers that will correspond to the coordinated frequencies. The channel numbers are given to coordinated frequencies starting from the first coordinated frequency to the last [7], as shown in Table 1.

**Table 1:** Manual Coordination of Frequency in a Fixed/Mobile Service.

<i>Channel Number</i>	<i>Frequency (MHz)</i>
1	148.000
2	148.025
3	148.050
4	148.075
5	148.100
6	148.125
7	148.150
8	148.175
9	148.200
10	148.225

## COMPUTERIZED FREQUENCY COORDINATION

Once the software program has been written for frequency coordination, the inputs must be inserted into the program so that the computer can carry out the coded instructions and execute the output. In this software program, the degree of accuracy is higher than the existing package of Microsoft Excel when coordinating frequencies.

In the software program, it is quite simple for a programmer to coordinate frequency in different services and also to ensure fast retrieval of storage information without following some procedures as contained in the existing package of Microsoft Excel. Improved speed of operation is ensured when coordinating frequencies in the developed software program in order to minimize and control potential interference compared to when coordinating frequencies in the existing package of Microsoft Excel.

The key to computerized interference studies is the existence of up-to-date databases of radio stations that use the frequency bands of interest. Two major databases are typical for common carrier radio coordination purposes [8]: one catalogs all existing and planned terrestrial systems using the common carrier radio frequency bands; the other database lists all existing or planned satellite earth stations which have been frequency-coordinated in the bands shared with common carrier microwave systems. Table 2 shows such computerized frequency coordinated effort for the broadcasting service.

**Table 2:** Computerized Frequency Coordination in a Broadcasting Service.

<i>Channel Number</i>	<i>Frequency (MHz)</i>
1	88.1
2	88.3
3	88.5
4	88.7
5	88.9
6	89.1
7	89.3
8	89.5
9	89.7
10	89.8

## COMPARISON OF THE RESULTS

As can be seen from Tables 1 and 2, the results obtained from the developed software program and the existing package of Microsoft Excel are almost the same with those obtained by manual coordination. The only exception is that the computerized system is very fast with a higher degree of accuracy and frequency capacity handling.

## DISCUSSION AND RESULTS

The results obtained by both the manual method and computerized frequency coordination application are almost identical. The frequency coordination exercise was made for the FM broadcasting service, fixed/mobile service 1, and fixed/mobile service 2.

In the broadcasting service, the results show that the first coordinated frequency is 88.1MHz within the applicable range, the last coordinated frequency is 107.8MHz and the total number of channels that corresponds to the coordinated frequencies is 100.

In the fixed/Mobile Service, the results show that the first coordinated frequency is 148.000MHz within the applicable range, the last coordinated frequency is 299.975 MHz and the total number of channels that corresponds to the coordinated frequencies is 6,080.

It is observed from the above results that the smaller the number of channel spacings in each service, the larger the number of coordinated frequencies and vice versa [9].

## CONCLUSIONS

The results obtained in both the manual and automated frequency coordination are nearly identical. This indicates that both methods can be used to effectively coordinate frequencies. The greatest advantages in the application of computers to coordinate radio frequencies are efficiency-related, which makes this method a preferred choice.

Obviously, the overall cost of computerized frequency coordination is less than the costs associated with a manual process when considering the variety of tasks it performs (e.g. the volume of frequency that it can process, the

speed, accuracy and the ease with which this can be achieved) [10].

## REFERENCES

- [1] CCIR. 1964. "World Distribution and Characteristics of Atmospheric Radio Noise". International Telecommunications Union: Geneva, Switzerland. Rep. 322.
- [2] Perkins, C.E. 2001. *Ad Hoc Networking*. Addison-Wesley: New York.
- [3] Cuccia, C.L. and C. Hellman. 1991. "Status Report: Microwave Communications Update – 1991". *Microwave System News*. (Feb/Mar): pp 20-53.
- [4] Ashley, J.R., T.A. Barley, and G. J. Rast, Jr. 1999. "Transmission Line Discriminators for FM Noise Measurement". *Proc. IEEE (Letters)*. 65:578-580.
- [5] Gaskel, P.S. 1992. "Developing Technology for Personal Communication Networks". *Electronics and Communication Engineering Journal*. (April):53- 64.
- [6] Salgado – Galicia, H., M. Sirbu, and J. M. Peha. 1995. "Spectrum Sharing Through Dynamic Channel Assignment for Open Access to Personal Communications Services". *Proc. IEEE International Conference on Communication (ICC)*. (June):41722.
- [7] Pawlikowski, K. et al. 2002. "On Credibility of Simulation Studies of Telecommunication Networks". *IEEE Communication Magazine*. (January):132-139.
- [8] Baker, F. 2002. "An Outsider's View of MANET," Internet Engineering Task Force. , 3/17/02. <http://w3.antd.nist.gov/wctg/manet/draft-baker-manet-review-01.txt>.
- [9] Ondria, J.G. 1998. "A Microwave System for Measurements of AM and FM noise Spectra", *IEEE Trans. Microwave Theory Tech*. Vol. MTT-16, (September):767-781.
- [10] Kobb, B.Z. 1993. "Personal Wireless". *IEEE Spectrum*. (June):20-25.

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