Lab Assignment #4

Frequency Allocation Plan and Spectrum Utilization

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Purpose

This experiment examines spectrum utilization and its compliance with the FCC Frequency Allocation Plan. It will determine the characteristics of several strong broadcast signals and their compliance with the Federal Communications Commission's Rules and Regulations.

Equipment

- Spectrum Analyzer Agilent ESA–L1500A: 9 kHz-1.5 GHz
- Antennas made in the second experiment

Introduction

Under the provisions of the revised Communications Act of 1934, authority for managing the use of the radio frequency spectrum within the United States is shared between the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC). Hence to establish radio services that will be allowed to operate in the United States for a given frequency band requires that the spectrum management policy decisions be agreed upon both by the NTIA and the FCC.

Under the provisions of the International Telecommunication Union (ITU) treaty the US is obligated to comply with the spectrum allocations specified in the ITU Radio Regulations' Article 8 (International Table of Frequency Allocations). However, US domestic spectrum utilization may differ from the international allocations provided these domestic applications do not conflict with the neighboring spectrum which comply with international regulations or arrangements.

Therefore, more than thirty different US radio services have been allocated portions of the spectrum in over 450 separate frequency bands. With the aim to promote more efficient use of the spectrum, the FCC and NTIA have made the *Frequency Allocation Plan*, (known as FCC Rules and Regulations – Part 2) which is based on The International Table of Frequency Allocations. By respecting designated frequencies, modulation techniques, and maximum effective radiated powers, different systems work in assigned frequency bands with given priorities and with minimum overlap and interference.

All the frequency sub-bands are divided and allocated for Government and non-Government sectors, either on an exclusive or a shared basis (for use by one or more radio services). In case of shared operation the types of services permitted need not be the same.

Cases where allocations have been made to more than one service are listed below in order of priority:

1. primary services,
2. permitted services, and
3. secondary services.

Primary and permitted services have equal rights, except that, in the preparation of frequency plans the primary services have the first choice to frequencies. Stations of the secondary services shall not cause

harmful interference to stations of primary or permitted services, and cannot claim protection from harmful interference from stations of the same or higher order stations.

Most wireless applications need to be approved and licensed by the FCC, but industrial, scientific, and medical equipment designed to work in one of the ISM bands can work *without FCC approval*, but *must comply* with the strict rules.

PRE-STUDY

Exercise 1

See the web site references at the end of this Lab.

Exercise 2

Study Part 2 of the FCC Rules and regulations describing the frequency allocations and radio treaty matters.

Exercise 3

Download the frequency allocations for broadcasting stations in the Denver area.

Exercise 4

By knowing the Frequency Allocation Plan, the geographic layout of Boulder and Denver, strategic interests, and broadcasting frequencies; try to predict the 10 strongest frequencies that can be received in the vicinity of CU Campus.

LAB PROCEDURES

Exploring the Spectrum

The Agilent ESA-L1500A portable spectrum analyzer and antenna have to be taken outside to investigate the frequency range 250 kHz – 1.5 GHz. Using an omnidirectional antenna attached to the input of a spectrum analyzer determine all significant signals. Then find the 10 strongest, characteristic signals and measure their signal levels, center frequencies, and 3 dB bandwidths. If a directional antenna is available, try to determine approximate directions of their transmitters. Also identify the modulation techniques of the observed signals.

Do not forget that when changing the frequency range, wavelength is changing, too, so the length of a measuring antenna has to be changed (the frequency characteristic of a monopole antenna over the reflecting plain was investigated in the first experiment). It is recommended to change antennas attached to the ground plane (antennas of different lengths are needed). Otherwise, the antenna attenuation factor for a certain frequency has to be taken in consideration.

Set the span to about 5Mhz between 902-928MHz. Set the trace to the maximum value and record your observations.

Tune the spectrum analyzer to an AM channel and observe the received signal.

POST-LAB (GROUP) EXERCISE

Exercise 5

Characterize the 10 strongest signals by listing their center frequencies, 3dB bandwidth, and application (TV, radio, mobile, private, etc.) If you can not determine the application easily, try to match their center frequency and bandwidth with FCC rules and regulations for specific signal types.

Exercise 6

Discuss in which bands is only noise received, and in which exist the highest number of transmitters.

Exercise 7

Using knowledge of the Band and your observations identify the application in the 902-928MHz measurements.

REFERENCES

Books

1. T.Rappaport Wireless Communications: Principles and Practice, Prentice Hall, 1996

Web sites

1. FCC Rules and Regulations are listed at http://www.fcc.gov/wtb/rules.html. Start Part 2 of Rules and Regulations to get the explanation about services, priorities, and The Frequency Allocation Plan.
2. The Frequency Allocation Chart is placed at http://www.ntia.doc.gov/osmhome/allochrt.html.