

**RESIDENTIAL MICROWAVE OVEN INTERFERENCE ON BLUETOOTH
DATA PERFORMANCE**

by

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ABSTRACT

This thesis investigates the interference potential of microwave ovens to Bluetooth data communication. Interference experiments are conducted on a Bluetooth piconet in the Center for Wireless Telecommunication's (CWT) Bluetooth lab.

A novel, "quasi-real time" spectral measurement concept is developed to take radio frequency measurements. A LabView program enables a spectrum analyzer to download oven spectral data onto a computer. From this data, three-dimensional plots of microwave radiated power levels versus ISM band frequencies over time periods are produced for different microwave ovens. These plots are compared with the results of interference experiments to explain Bluetooth packet errors.

In addition to causing packet errors, emitted oven power levels at certain frequencies are sometimes strong enough to cause data packets to be lost (dropped) as they are transmitted over the air. This is a major problem since the Protocol Analyzer does not "see" these packets and cannot record the transmissions during an experiment. Knowledge of the transmission's Bluetooth Frequency Hopping Scheme (FHS) enables these lost packets to be counted. The FHS is coded in Matlab to predict a data transmission's hopping sequence. The lost packets on each Bluetooth channel are counted by subtracting the Analyzer's recorded number of data transmissions per channel from the total number of transmissions per channel predicted by Matlab.

A Bluetooth receiver and the spectrum analyzer is used to measure the received power level of Bluetooth signals on a particular frequency (channel). The number of packet errors on a channel is determined from the channel's C/I (carrier-to-interference ratio). If a channel's C/I level falls below the calculated C/I threshold at any instant of time due to oven operation, the packet transmitted at that instant is likely in error. A Matlab program estimates the number of packet errors per channel by counting the number of times the C/I of a channel falls below its threshold value. The predicted number of packet errors is compared with the measured packet errors from experiments to yield extremely good results.

Oven-interference experiments are conducted in a small building, a large office environment and outdoors. For each experiment, the number of occurrences of transmitted data is plotted in Microsoft Excel for each Bluetooth channel. These plots are compared with the oven spectral plots to describe an oven's effect on Bluetooth transmission.

It is determined that different ovens cause packet errors on specifically different channels, in addition to channels 52-54 around the oven's 2450 MHz center operating frequency. The interference experiments suggest that placing an oven a radius of 10 m away from Class I (devices in a piconet will not affect data transmission).