The Effects of Radio Propagation in the Workplace

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https://wiki.ornl.gov/sites/rams/c_shields/Pages/poster.aspx

Abstract

This research project consisted of experimenting with Radio Frequency Propagation (RFP) at the Oak Ridge National Laboratory (ORNL). The Information Technology Services Division utilized the research data to determine which buildings were high-priority, based on building occupancy. Due to the increase of cellular devices on site, there is a need to understand how RFP works and its effects on emergency and nonemergency equipment reception.

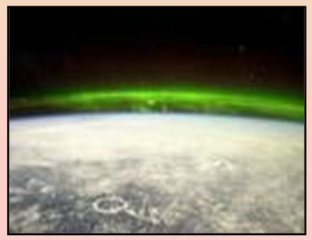
BACKGROUND

RF propagation

- Transmission of radio waves and cellular reception

Ionosphere

- Impact on Radio Frequency (RF) propagation
- Upper portion of the atmosphere
- RF waves utilize the ionosphere to reflect transmitted signals
- Geomagnetic storms cause fading and scattering
- Storms occur as a result of temporary disturbances in space weather

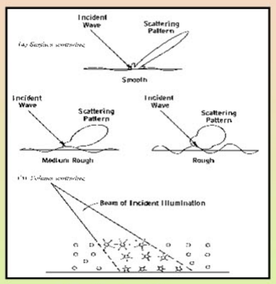


Earth's Ionosphere

Geomagnetic storm

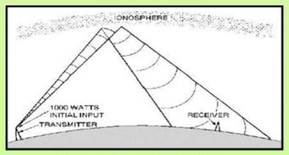
Multipath signals

- Attenuation- absorption of radio waves
- Scattering - propagated wave front breaking apart into many directions
- Diffraction- signals hindered by sharp edges of objects
- Reflection - propagated signal or wave striking an obstacle

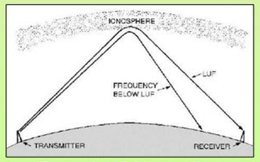


Scattering Diagram

Example of Diffraction



Example of Reflection



Example of Attenuation

Multipath effects

- Path loss within a building is difficult to predict
- Multiple floor path loss occurs with increase in floor separation, causing decrease in propagation loss
- Multipath and fading occurs when a signal undergoes any interruption

METHODS

Cellular survey

- Searched facility database for building floor plans
- Surveyed approximately 90 buildings
- Survey time required between 5 and 30 minutes depending on building size
- Survey locations included ORNL and surrounding worksites
- Observed readings in engineering mode on each cell phone
- Input data into spreadsheet
- Developed survey key to identify each specific reading of each floor plan
- Compiled data for current project and future use

ANALYSIS

Repeater technology

- Determined solution to our dilemma at ORNL
- Repeater eliminates all (absorbing) and undesirable noise

Repeater

CONCULSION

- Implementation of repeater technology has mitigated impediments to good reception
- Application of repeaters within buildings will improve cellular service
- Reception was improved by scientific analysis and research of the problems

IN THE FUTURE

- Enhanced widespread communication on ORNL campus is expected with repeater installation
- Sprint, now on a removable tower, is expected to occupy the main tower as well as AT&T and Verizon which will increase sprint coverage on site
- T-Mobile will be implemented, resulting in better coverage for T-mobile customers on site

The Research Alliance in Math and Science program is sponsored by the Office of Advanced Scientific Computing Research, U.S. Department of Energy. The work was performed at the Oak Ridge National Laboratory, which is managed by UT-Battelle, LLC under Contract No. De-AC05-00OR22725.