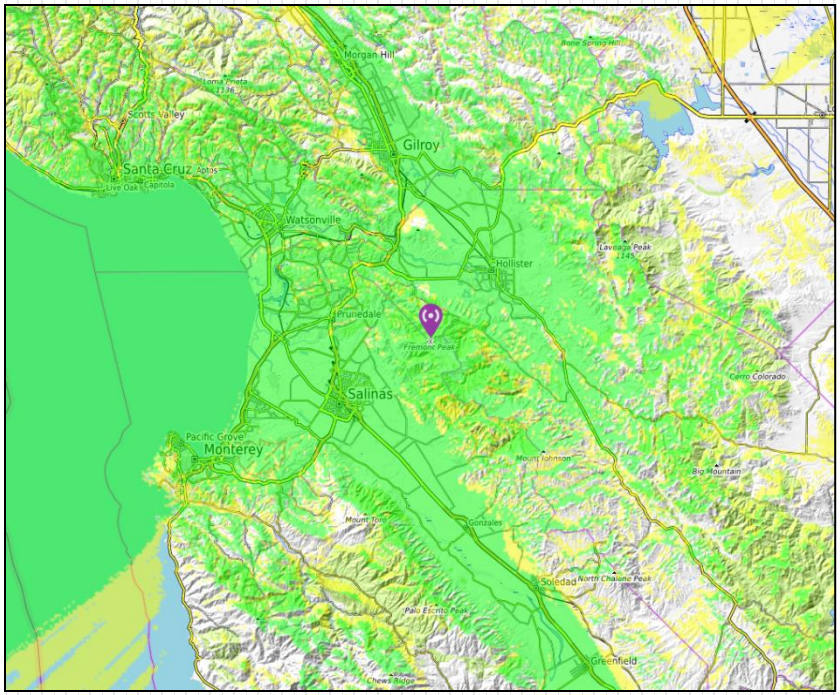
Radio Propagation Mapping



Presented by

Marcel Stieber

AI6MS

Presented at BayCon 2022

Virtual Conference – Saturday, February 5th, 2022

Who is this guy?

- Marcel Stieber, AI6MS
- Licensed in 2008 as KI6QDJ
- Master's in Electrical Engineering

- Cal Poly Amateur Radio Club
- Cupertino ARES Repeater Trustee
- Salinas Valley Repeater Group

- Volunteer RF Consultant and Tower Climber

- Slides and video available at:
  - www.qrz.com/db/ai6ms
  - https://twitter.com/ai6ms
  - https://www.youtube.com/marcelstieber

Overview

In this presentation, we will introduce the basics of radio propagation mapping for VHF, UHF, and up! We'll cover some common programs including Radio Mobile Online by VE2DBE and Ubiquiti's airLink and ISP Design Center and demonstrate some case studies for each!

Radio Mobile

Freeware by VE2DBE

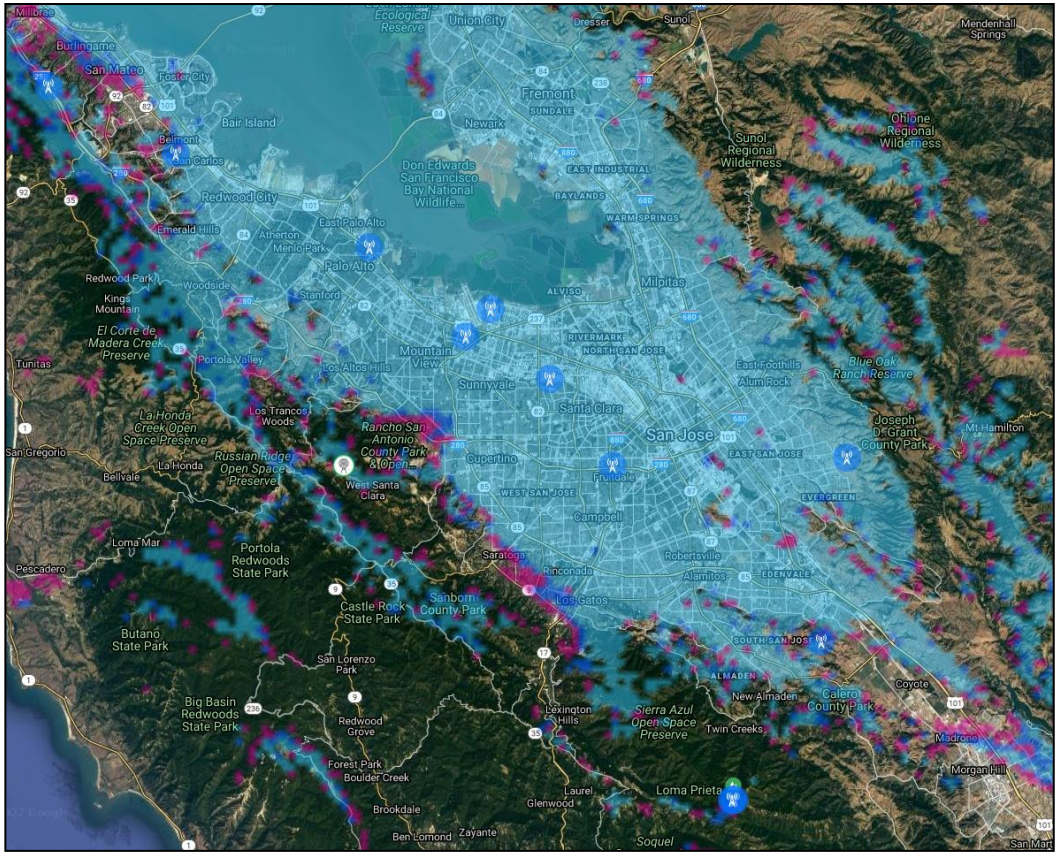
Since 1988

airLink™

ISP Design Center

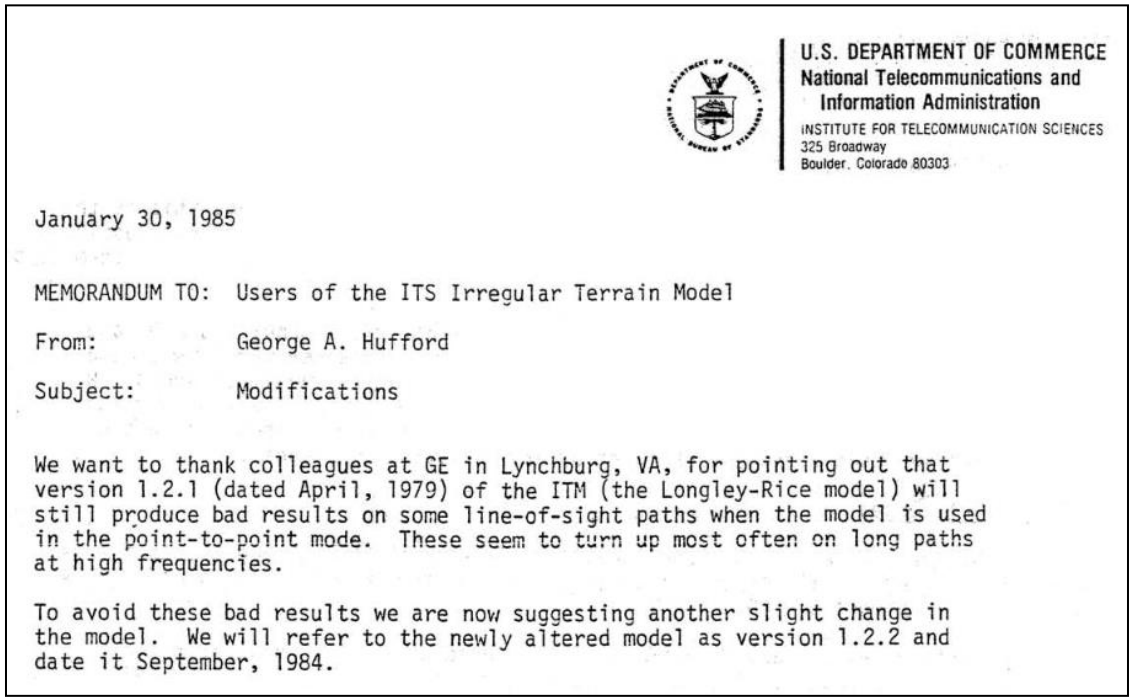
Radio Propagation Mapping

- Visual representations of radio coverage
- Used for:
  - Infrastructure planning
  - Event radio coverage
  - Network topology
  - Coverage studies
  - Point-to-point links
  - Interference analysis



Intro Radio Propagation

- Longley-Rice model (aka. Irregular Terrain Model)
  - Developed by Anita Longley and Phil Rice in 1968
  - Institute for Telecommunication Sciences
  - Open-Source and downloadable



U.S. DEPARTMENT OF COMMERCE
National Telecommunications and
Information Administration
INSTITUTE FOR TELECOMMUNICATION SCIENCES
325 Broadway
Boulder, Colorado 80303

January 30, 1985

MEMORANDUM TO: Users of the ITS Irregular Terrain Model

From: George A. Hufford

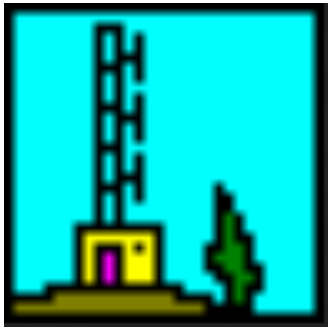
Subject: Modifications

We want to thank colleagues at GE in Lynchburg, VA, for pointing out that version 1.2.1 (dated April, 1979) of the ITM (the Longley-Rice model) will still produce bad results on some line-of-sight paths when the model is used in the point-to-point mode. These seem to turn up most often on long paths at high frequencies.

To avoid these bad results we are now suggesting another slight change in the model. We will refer to the newly altered model as version 1.2.2 and date it September, 1984.

The Longley-Rice Model (or ITM)

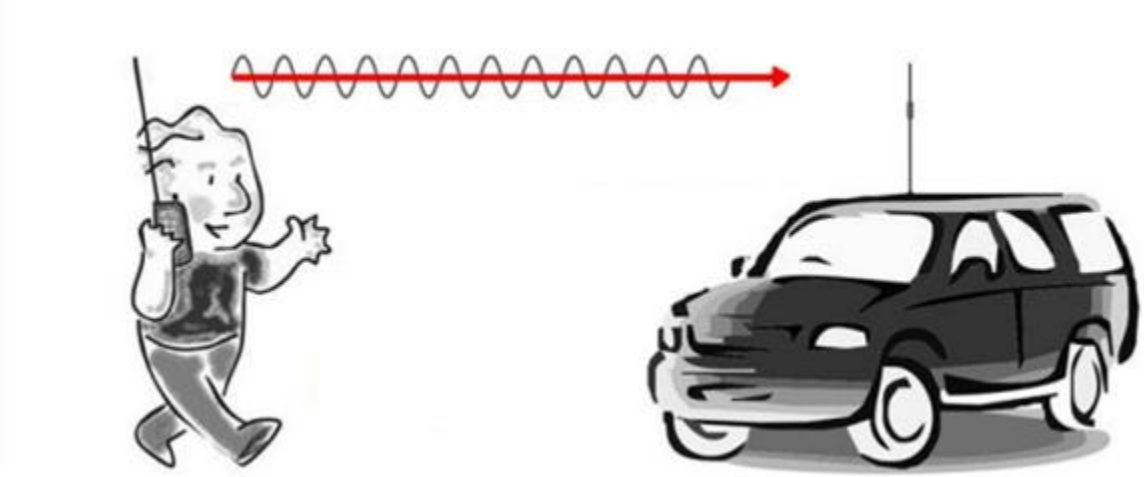
- The basic algorithm takes in a bunch of inputs:
  - Distance
  - Antenna heights
  - Frequency
  - Terrain irregularity
  - Surface refractivity
  - Earth's effective curvature
  - And more!



- And generates an output: Reference attenuation
- This lets you calculate the path loss!
  - Receive Power = Transmit Power + Gains - Losses

Simplified Path Loss

- Transmitter is a 1W radio = **30dBm**
- Reference attenuation = **100dB**
- Transmit Power + Gains – Losses = Receive Power
- **30dBm** – **100dB** = **-70dBm** (~71uV)



Radio Mobile

- Link Demo!

Radio Mobile

- Mapping Demo!

Radio Mobile

- Pros
  - Free!
  - Available online or as Windows download
  - Very powerful and configurable
  - 20Mhz to 20GHz coverage
  - Link calculations and propagation studies
- Cons:
  - Some learning curve, lots of parameters
  - Results often optimistic, so need to adjust inputs
  - Slower to generate results

Ubiquiti airLink™ and ISP Design Center

- Pros
  - Free!
  - Available online
  - Super fast to do quick studies in almost real-time!
  - Sharable links (viewable with a free account)
- Cons:
  - Designed for 900Mhz and up
  - Limited in Ubiquiti device selection

- The newer ISP Design Center has a bunch of improvements and is likely the tool to learn, though it is still in development.

Ubiquiti airLink™ and ISP Design Center

- Mapping Demo!

Free Mapping Tools

- Radio Mobile Online by Roger Coudé VE2DBE
  - https://www.ve2dbe.com/rmonline_s.asp
- Ubiquiti airLink
  - https://link.ui.com/
- Ubiquiti ISP Design Center (alpha released in 2021)
  - https://ispdesign.ui.com/

- And several others we won't cover here

Quick Summary

	Radio Mobile	airLink/ISP Design Center
Cost	Free!	Free!
Frequencies	20-2000MHz	900Mhz, 2.4GHz, 5GHz, 11GHz, 24GHz, and 60GHz
Platform	Online or Windows program	Online only with sharable links*

*A free Ubiquiti account is required to view shared maps

Q&A

Presentation is available at: www.QRZ.com/db/AI6MS

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Want to get or upgrade your license? Fully-Remote Amateur Radio Exams are offered daily!
Check out: https://hamstudy.org/sessions/online

*Special thanks to **George, Jon, Rod, and Vince** for helping put on this virtual conference!*

References

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