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NABSHOW
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HD Radio Measurements and Coverage Studies

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Introduction

- HD Radio is now a fact in North America (Canada and Mexico now investing)
- Major investments have been made over the past 15 years
- Promises of HD Radio:
  - Improved Quality
  - Additional Channels
  - Additional Revenues
- But how do we assess the reception quality for main channel, HD 2+ and additional data channels?
- How can we improve the reception?

Typical Coverage Improvement Cycle

- Receiving coverage complaints from listeners
- Asking engineering what they did wrong
- Verifying the hardware (transmitter, antenna, audio compression)
- Verifying the coverage
- Looking at possible improvements:
  - Very difficult in analog (SFN repeaters are limited)
  - Asking for additional spectrum (which does not exists anymore)
  - Looking for HD Radio SFN
- Requesting for a budget
- Implementing, and rinse and repeat…

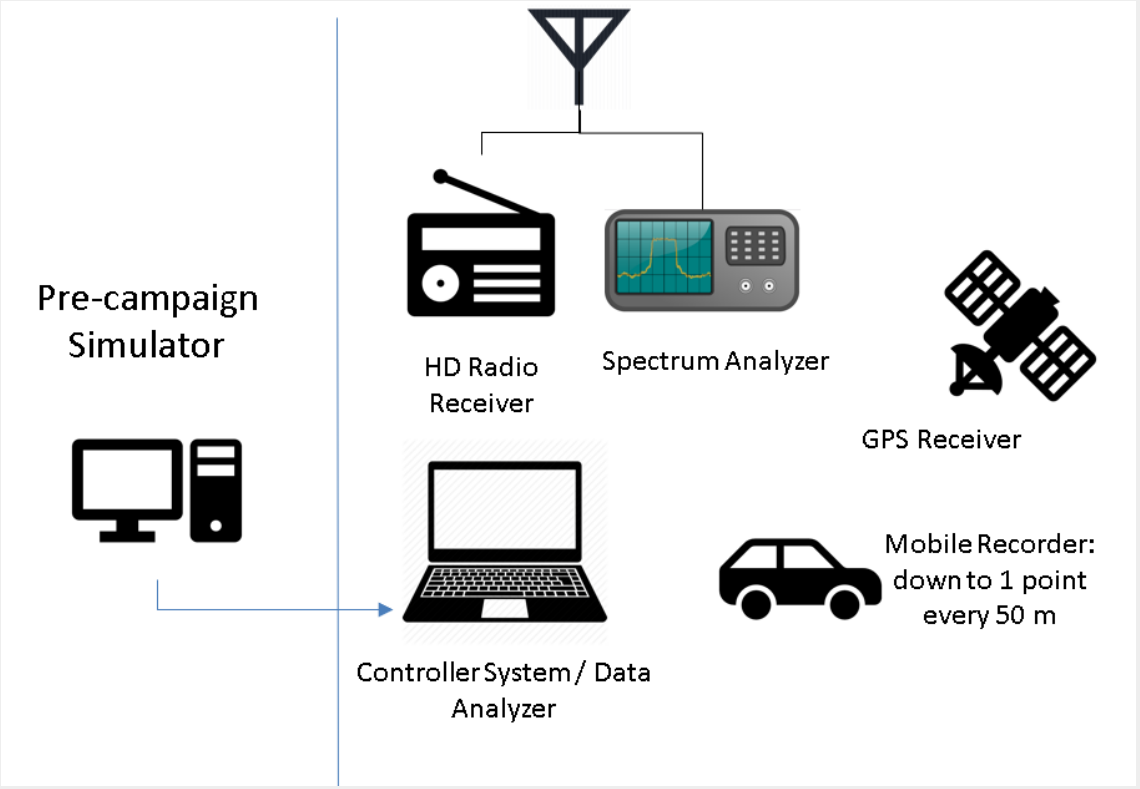
Skipping some steps…

- Possibilities to merge the following steps together:
  - Simulating the expected coverage
  - Performing the measurements
  - Testing the measurements against the expected coverage
  - Evaluating the hardware performance (antenna radiation pattern)
  - Evaluating terrain difficulties
  - Creating real coverage maps for HD2+ services (advertisement)

System Description

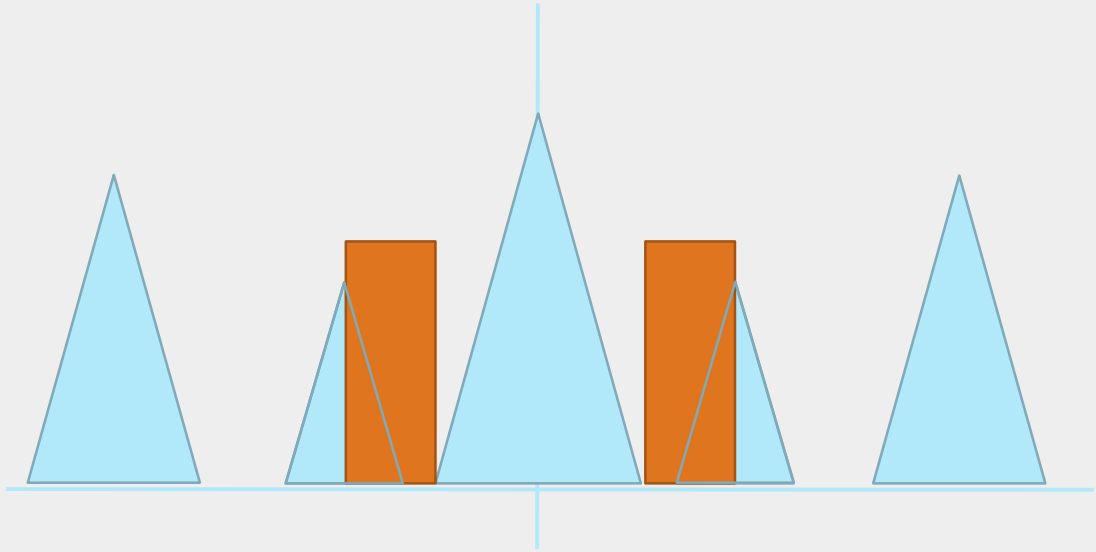
Full Campaign Cycle:

- Simulating the existing transmitter system using Longley-Rice, CRC-Predict, ITU-1546
- Performing the measurements: real-time comparison with simulated data
- Analysing the data: in field report capability with direct output to Google Earth or Open Street Map.
- Taking more relevant data: while in the field, verifying key areas
- Avoiding bad news: when all points are bad, something must be bad (measurement or transmitter problems)



Key Metrics

- Channel(s) Power
  - Main channel
  - Individual HD Sidebands
  - 1st and 2nd adjacent
- Analog Metrics:
  - Multipath
  - SNR, RDS quality, Stereo, etc.
- Digital Metrics:
  - HD and Digital audio acquired
  - Cd/No



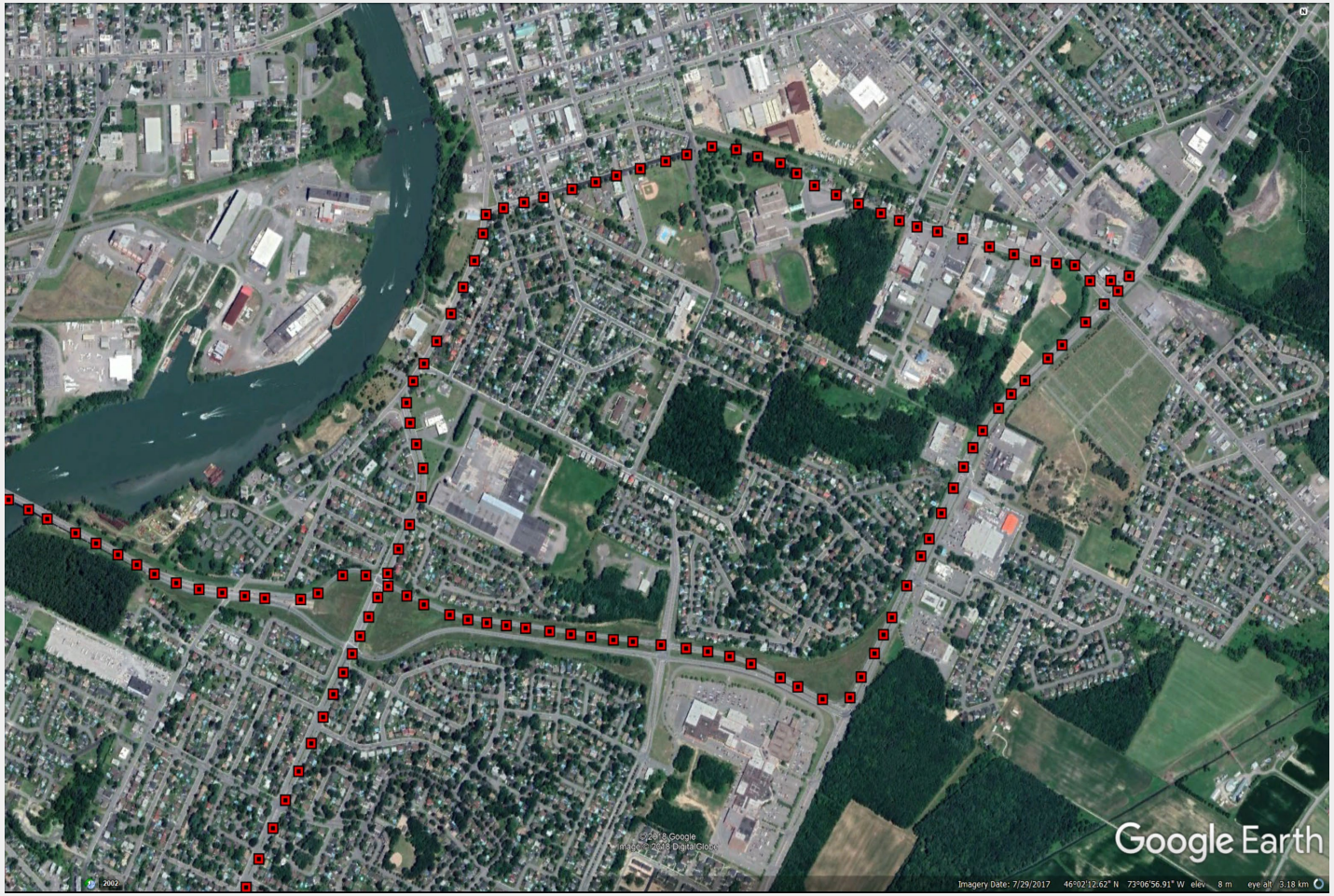
Early Warnings

- To maximize the time spent in the field, the system provides the following real-time analysis:
  - Differences from propagation model and measurements
    - Identifying if the transmitter system behaves has expected
    - Identifying problems with the measurement system (loose cable…)
    - Identifying unknown interference sources
  - Expected reception quality
    - HD Radio signal quality assessment
    - RBDS quality
    - Stereo, Multipath, etc.

Constant Data Distribution

The GPS distance-based measurement insures a constant interpretation of the statistical spread of the points, which results in a more accurate prediction / analysis of the data.

We usually record one point at every 50 yards.



Case Study #1: VPR Burlington (VT)

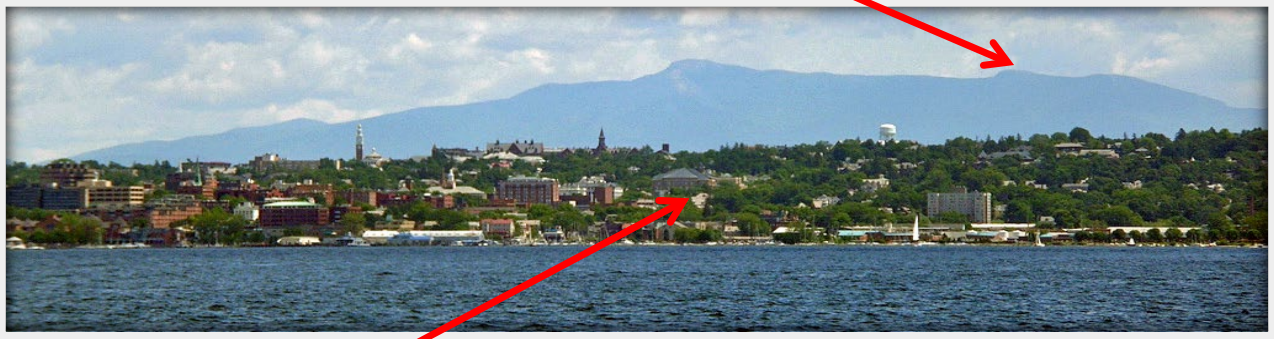
Problem: Downtown Burlington is located on the shore of Lake Champlain, which is in shadow from the main transmitter behind.

A lot of multipath is present from echoes across the lake.

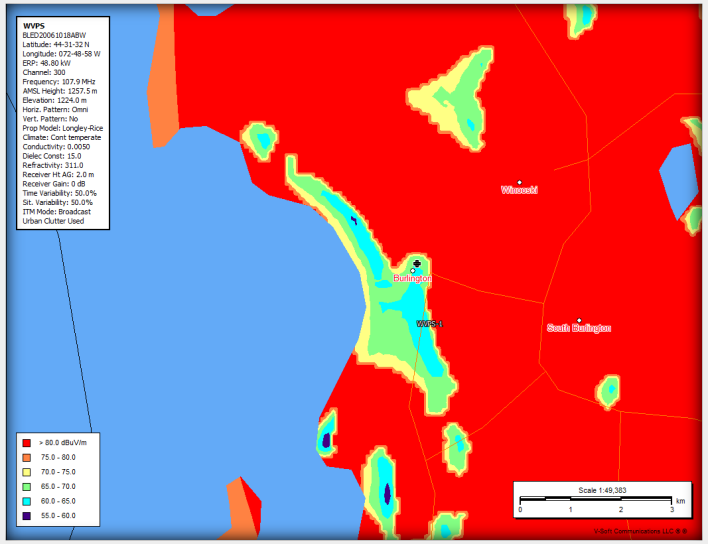
VPR are receiving many reception complaints.

The predicted signal analysis demonstrates signal levels exceeding 60 dBu, which should be sufficient for an adequate reception.

WVPS Transmitter

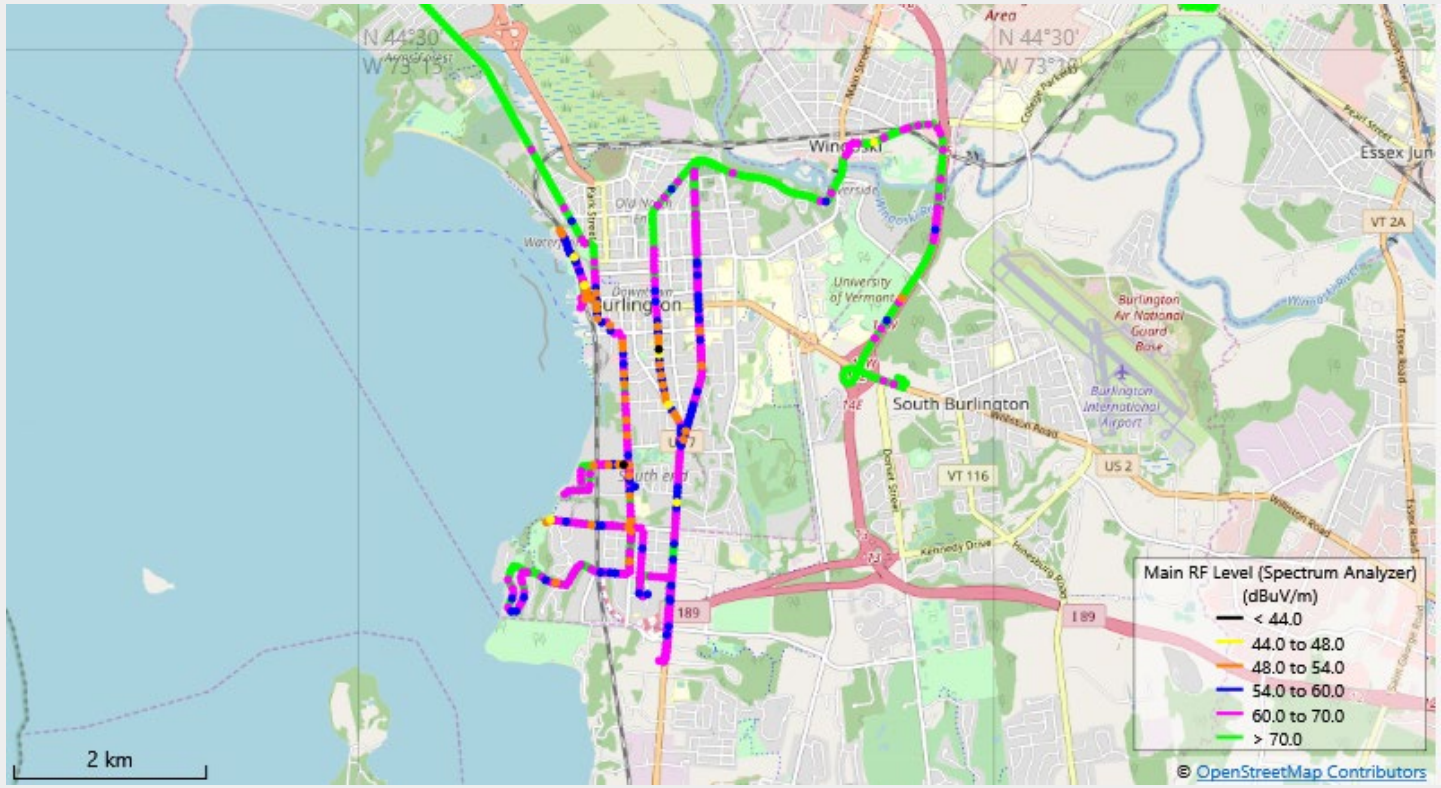


The "Hill" Section



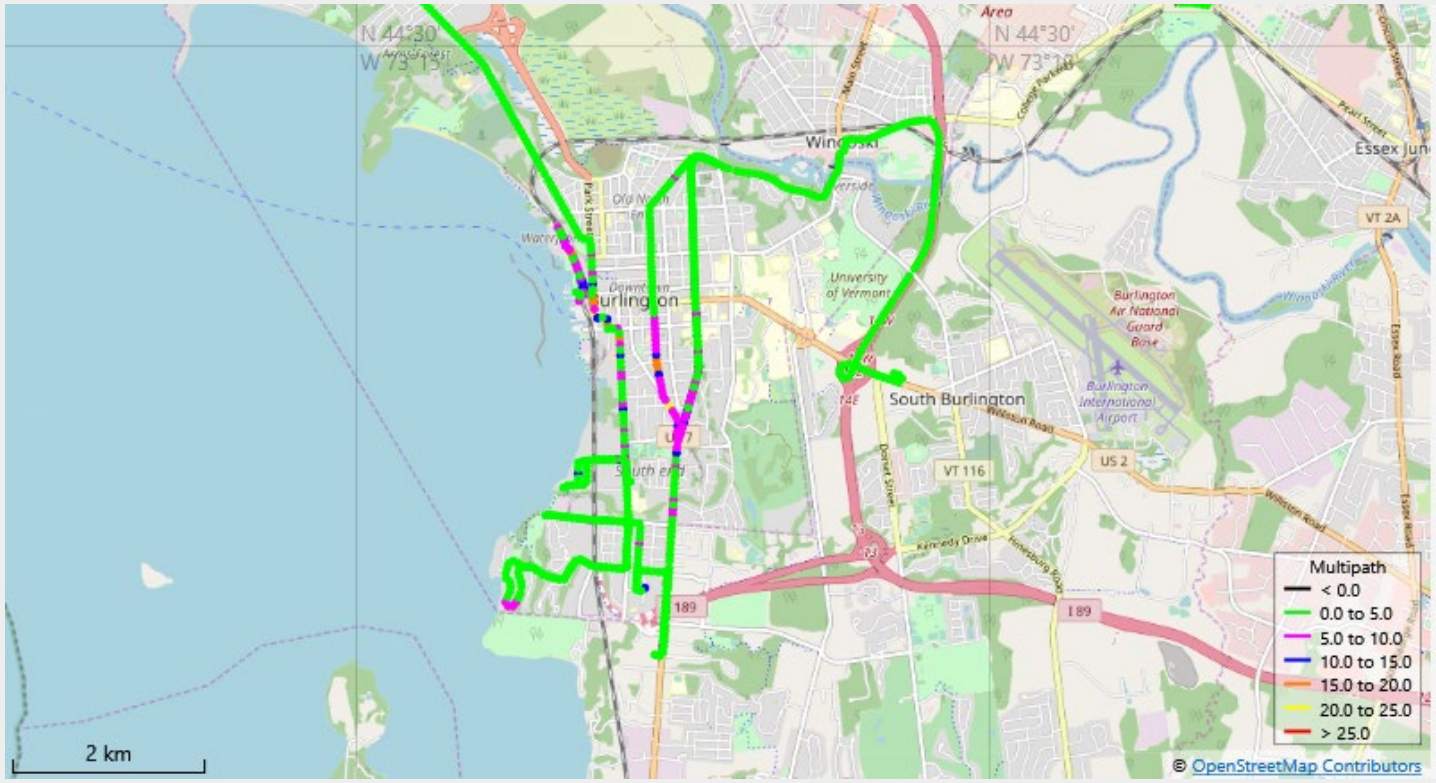
Measurements: RF Levels

From a pure field strength analysis, the signal level in downtown Burlington should be sufficient for an adequate reception (mostly above 54 dBuV/m)



Multipath Analysis

We can rapidly find the problematic areas for analog reception.

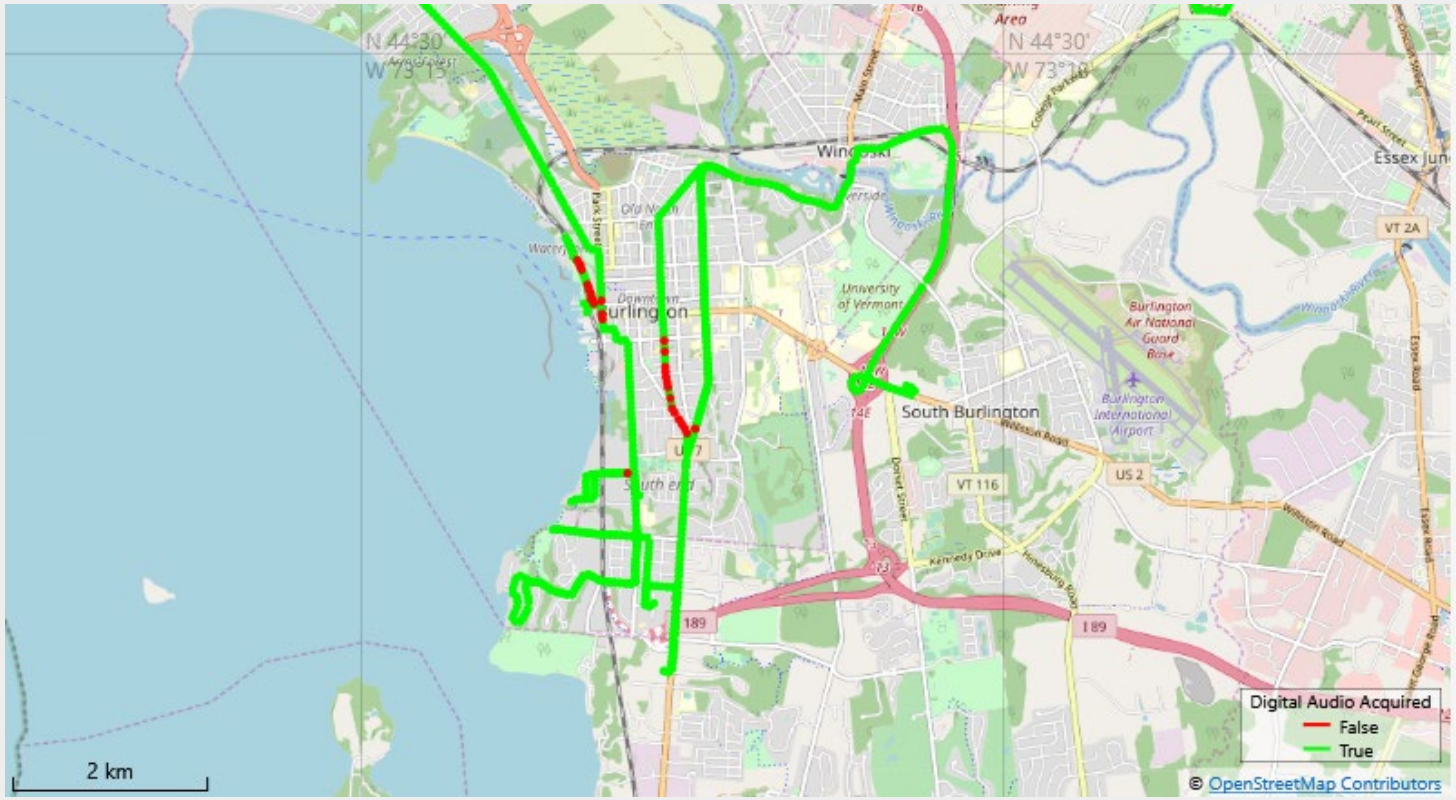


HD Radio Reception

The problematic zone is also confirmed on the HD Radio reception.

Solution exists:

- Possible usage of SFN repeater, analog, or digital, or both.
- Using a low power fill-in translator

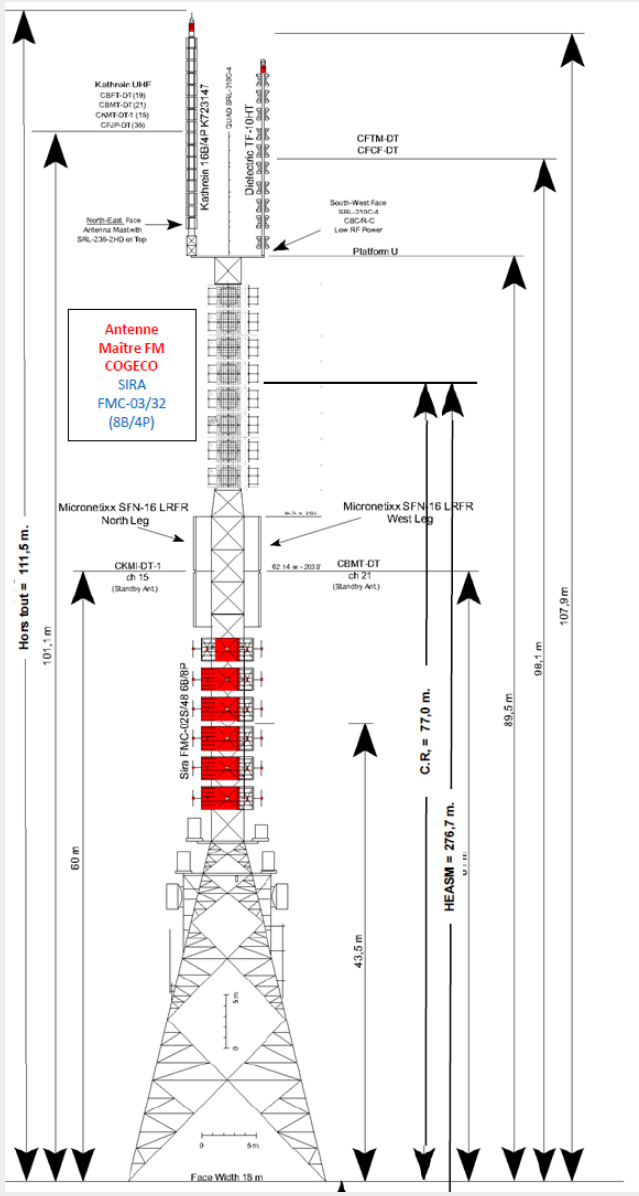


Case Study #2: Cogeco Media Inc

Cogeco Media Inc (Montreal, QC), decided to combine their 4 FM services in a single antenna below the top platform of the Mont-Royal tower.

This space became available after the removal of the old channel 2 and channel 6 low-VHF TV antennas.

The system was used to compare the antenna pattern and coverage before and after the work, to ensure that the coverage was as predicted and that the antenna was performing as specified.



Antenna Verification

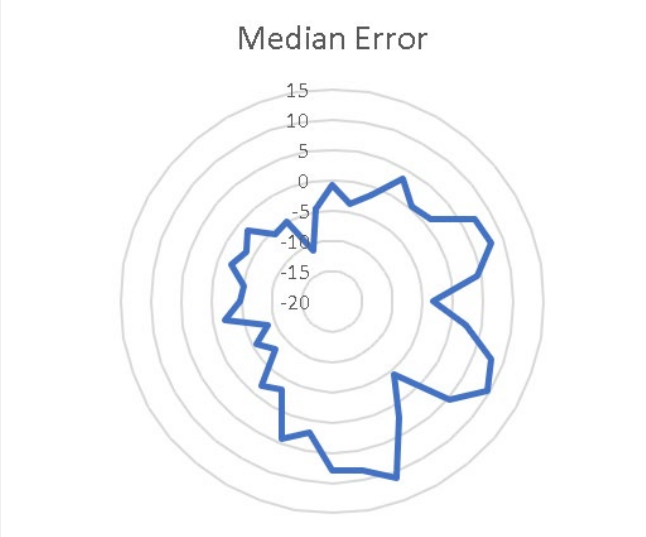
The system compares each measurement point with its predicted value from the model file.

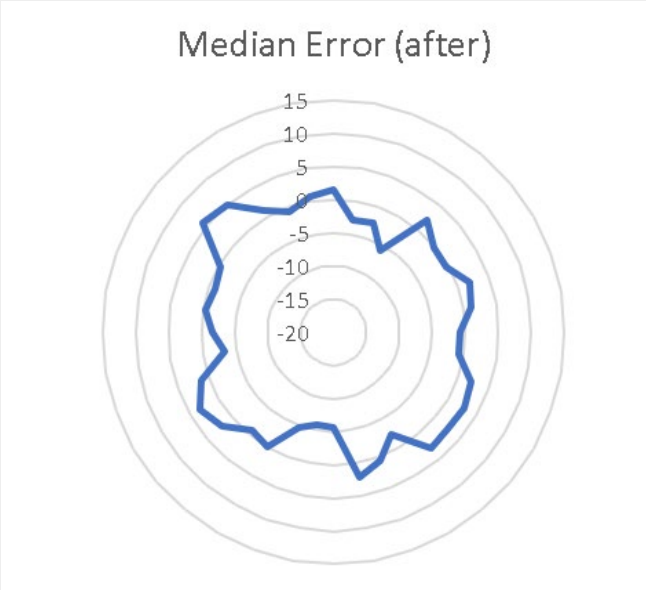
It then evaluates the median error (or can evaluate the 90th or any other percentile error value) for a user defined sector (usually, at every step of 10 degrees) for a specific radial range (typically from 5 to 40 km).

For a perfect reception, from a perfect omni antenna, we should see 0 everywhere (we can also project the pattern for directional antenna).

The graphs show the results before and after the antenna replacement.

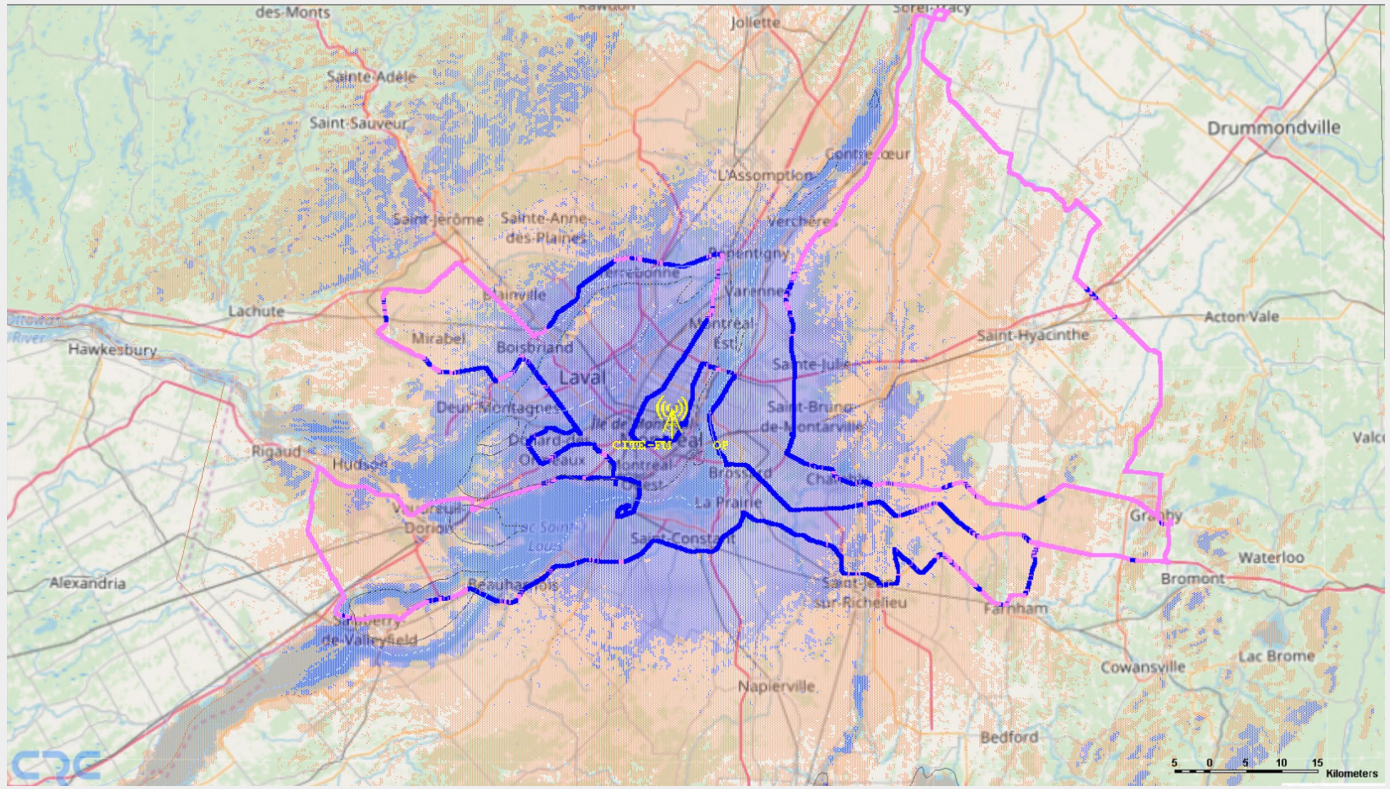
The top graph shows nearby reflections and obstructions due to the former top position of the antenna on the platform





Coverage Assessment

While verifying the antenna behavior, the system was recording 5 stations (plus their surrounding potential interferers), providing the information on all key metrics previously discussed.



Conclusions

- Major systems (antenna replacement, new sites, etc.) are being built and are not thoroughly verified. Protect your investment.
- Systems have been in operation for many years with non-optimal coverage.
- Directional antennas are prone to installation problems (wrong harnesses used, power dividers connected upside down) which does not show on a network analyser sweep, but result in a bad antenna pattern.
- Coverage optimization (analog or digital repeater) can be assessed and better designed.
- Measuring costs money: you want to make the most of it and have an intelligent system in the field that tells you rapidly what is right or wrong.

Questions ?
Come see a live demo at C346

Thanks to:

Joe Tymecki, VPR Burlington

Jean Arcand, Cogeco Media Inc