Project Proposals from VodafoneThree

Signal Strength Sync: Modelling and Verifying Ofcom 4G Field Measurements Against Predictive Radio Network Data

Summary

This project aims to evaluate the accuracy of VodafoneThree's 4G coverage predictions by comparing them to Ofcom's independently collected drive-test measurements. By aligning predicted and measured signal strengths in 100m x 100m geographic bins, we will compute a Mean Error for each frequency band and assess compliance with Ofcom's regulatory threshold of ±3 dBm. The outcome will be a reusable data analysis framework that supports internal validation and anomaly detection in mobile network predictions.

Background

Ofcom is the UK's telecommunications regulator, responsible for ensuring that mobile network operators meet minimum coverage accuracy standards. Every year, Ofcom conducts multi-band nationwide drive tests using calibrated scanners to record 4G and 5G signal strengths across all operators and frequency bands. These measurements are published openly.

VodafoneThree uses the Atoll planning tool to generate predicted signal levels across multiple licensed frequency bands. Predictions are submitted to Ofcom as 100m x 100m UK grid rasters, each indicating signal strength and the best serving cell's Physical Channel Indicator (PCI). However, operators are not given access to Ofcom's data processing or filtering procedures.

The aim is to independently recreate Ofcom's signal validation method, enabling VodafoneThree to verify (or contest) the official pass/fail outcomes and identify potential discrepancies in measurement, processing, or network state assumptions.

Key Research Question

How can we rigorously assess the accuracy of large-scale mobile network predictions using independent field measurements, and what are the most critical factors contributing to discrepancies between predicted and observed signal strength?

Challenges

- **Data Volume**: Ofcom's 2024 dataset contains over 25 million measurement points, exceeding the capacity of standard tools like Excel and requiring scalable, high-performance data processing environments.

- **Coordinate Mismatch**: Ofcom data uses GPS (Lat/Lon) coordinates, while VodafoneThree predictions are based on UK National Grid References (NGR), requiring conversion and binning.
- **Signal Identification**: Correctly matching scanner-observed received signal PCIs to predicted best server PCIs is non-trivial, particularly in Single Frequency Networks where multiple cells share the same frequency band.
- **Temporal Misalignment**: Ofcom provides only broad time windows (e.g. monthly) for when drive tests occurred, making it difficult to recreate the exact network state at measurement time. Bear in mind that sites and cells are being brought on air or decommissioned on a weekly basis.
- **Anomalous and Corrupted Data**: Operator-side database inconsistencies ("Friday afternoon" sites/cells), unplanned outages, or unrecorded site deployments can all introduce discrepancies between predictions and measurements.
- **Ofcom's Methodology**: The lack of transparency in how Ofcom filters and averages its data introduces uncertainty when reproducing its compliance calculations.

Datasets

- **Ofcom Connected Nations 2023 4G and 2024 4G/5G Scanner Measurements**
  - Format: Lat/Lon-based measurements with dBm signal levels by band and operator
  - Access: Publicly available
  - Limitations: Timestamps encrypted; no PCI filtering
- **VodafoneThree 4G Signal Predictions**
  - Format: UK-wide rasters (100m x 100m) with signal level and best server PCI per band. 800MHz 4G prediction and Excel data analysis model created for 2023 comparison. For 2024, where no analysis has been done nor data model yet been created, VodafoneThree will provide 800MHz (4G), 2100MHz (4G) and 3400MHz (5G) band predictions, for comparison with Ofcom's 2024 scanner datasets on these bands.
  - Tool: Forsk Atoll planning software
  - Access: Internal (supplied by VodafoneThree). Pre-computed best server signal matrices on each of the bands should suffice i.e. live Atoll session not necessarily required but available nevertheless
  - Limitations: Static snapshot; subject to discrepancies with real-time network status