



Automation of Spectrum Analyzer Operations for Satellite Communication Link Characterization

Sahal Mohammed M N* ⁽¹⁾, and Bhukya Ramesh ⁽¹⁾

(1) ISRO Telemetry Tracking and Command Network (ISTRAC), Bengaluru, Karnataka, India, 560058
e-mail: sahal@istrac.gov.in; bhukyaramesh@istrac.gov.in

The SATCOM division of ISTRAC-ISRO manages satellite communication links using geostationary satellites, connecting ISTRAC ground stations across India and globally. SATCOM also supports the IRNSS Data Communication Network (IRDCN) for India's NavIC program, employing FDMA-SCPC technology to access satellite bandwidth. Each ground station uses Spectrum Analyzers in the downlink chain for tasks like continuous spectrum monitoring, logging C/N (Carrier to Noise power ratio) of carriers, antenna alignment, and interference detection. Currently, SATCOM maintains over fifty full-duplex links through various satellites, each with two carriers. Monitoring C/N of each carrier periodically is critical to detect issues like interference, rain fading, or equipment degradation that could disrupt communication. Manually recording C/N for over a hundred carriers across multiple stations is labor-intensive. To streamline this, a GUI-based MATLAB application was developed to automate operations on *Rhode & Schwarz* Spectrum Analyzers. SCPI commands using VISA interface over Ethernet connection is used for remotely controlling these analyzers, facilitating centralized management from the SATCOM Control Center. The application automatically scans frequencies to retrieve carrier power levels and determines noise levels by identifying local power minima around each carrier. This method ensures accurate C/N calculations, even when interference affects only one side of a carrier. Using antenna size data from each station, the application estimates the C/N received at remote stations by factoring in theoretical G/T differences. E_b/N_0 estimate for remote stations are then derived from carrier data rates and RBW settings. Known E_b/N_0 requirements for achieving a BER of 10^{-6} are compared with estimated values based on modulation and channel coding used to assess available link margin. Additional features include continuous spectrum data retrieval based on user-defined intervals, screenshot capture and storage, constellation diagram plotting, C/N table export to Excel sheet, customizable spectrum analyzer settings, and automated satellite telemetry measurements for antenna alignment. This setup enhances efficiency and accuracy in managing satellite communication links, ensuring proactive issue detection across the network.