FoxTLM

A Software Demodulator and Telemetry Display Program for the Fox-1 Satellite

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Fox-1 Telemetry Background

- Fox-1 will send low speed always-on telemetry at the same time and same frequency as voice FM transponder whenever uplink signals are heard.
- Voice and telemetry all of the time (win-win).
- Telemetry data sent as audio below 300 Hertz.
- “Sub-audible telemetry” where repeater sub-audible tones would normally be found.
- GMSK modulation at about 80-100 baud.
- After five minutes with no uplink signals, Fox-1 will transmit one telemetry frame.
Goals and Objectives

- Easy to install and easy to use software
- Maximize participation from ground stations
- Open Source / GNU Public License (GPL)
- Leverage “lessons learned” from telemetry collection with ARISSat-1 and software development with ARISSatTLM
  - Written in C with Qt framework
  - Support multiple sound cards
Goals and Objectives

- Support both NBFM and SDR receivers
- Runs on Windows XP and Windows 7 platforms
- Separate coding effort by Gilbert Mackall for Mac
- Qt *should* allow easy porting to Linux systems including devices like the Raspberry Pi
- Software that runs on a 1 GHz class computer
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Initial Concept Artwork Ideas
FoxTLM on Windows
FoxTLM Look and Feel

- Waterfall diagrams for FM receive audio (left side) and SDR RF receive signal at 145Mhz (right side)
- Raw telemetry hex dump and decoded telemetry displays
- Telemetry as Text screen (not shown)
- “Visual” telemetry with pictures - it should look *interesting* to a fifth grader
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- Forward error correction scheme: still TBD
- High speed experiment telemetry: still TBD
- Another lesson learned: Reuse open source C code from previous projects wherever possible (waterfall/FFT code from AO40Rcv/ARISSatTLM or FFTW, native Qt audio routines or reuse ARISSatTLM C source code)
Telemetry Web pages

- FoxTLM.org (or AMSAT) web pages similar to the ARISSatTLM telemetry web pages
  - desktop (large screen)
  - mobile devices (small screen)
- Webpages updated about once a minute when telemetry is being received and submitted by ground stations
- Leaderboard telemetry statistics
  - Encourage competition → more telemetry collected
  - All time “high score” telemetry submitters
  - Last 30 days statistics
  - Top schools submitting telemetry
- “Raw” and “cooked” telemetry data to be archived on amsat.org (includes telemetry .CSV files)
Ideas and Stretch goals

- Measure the downlink RF frequency, time of closest approach and Doppler shift of the downlink using an SDR receiver.
- Report the UTC time, ground station location and Doppler measurements to the Internet telemetry server for later orbital analysis → do-it-yourself orbital elements.
- Possibly a college level educational project (grade 13-16).
Ideas and Stretch goals II

- Multiple language translations using Qt tr() translate functions
- Assumes the existence of volunteer translators to provide the translations)
Ideas and Stretch goals III

An automated unattended telemetry ground station using a Raspberry Pi and a FUNcube dongle with QtonPi (a Linux distribution optimized for running Qt applications)
But wait...there’s more

More ground stations + more coverage = more telemetry

Deploy this to a remote location with an Internet connection in Alaska or Hawaii or McMurdo Station (which has over a dozen passes per day! Updated telemetry every ninety minutes.)
What questions do you have?

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