Software Factors for Satellite Communications

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Why Computer Control?

• Manual vs. Automatic operation
• Should a computer “replace” our radio?
  - Antennas: AZ, EL rotators; Polarization
  - Radio: what and how?
• What should we be controlling?
  - Everything?
• No, Only add specific missing features:
  - Should operate *with* my radio
  - Background TX & RX Doppler correction
  - Correct for systematic or experimental link offsets
  - Should remember published and recent operating parameters
Technical Requirements

• Computer
  - Real-time calculations using orbital elements
  - Range rate used to find Doppler shift
  - Satellite position: Azimuth and Elevation
  - Intuitive and consistent GUI

• Radio
  - Well-designed packet interface
  - High-speed connection to computer
  - Non-predatory controls
  - Satellite modes
Technical Requirements

• **Yaesu FT-736R**
  - Simplex packet interface
  - Predatory remote control only
  - Set modes and control VFO’s

• **Yaesu FT-847**
  - Well-designed packet interface
  - High-speed connection to computer
  - Non-predatory controls
  - Satellite modes

• **Icom IC-821H**
  - Poorly designed full-duplex packet interface
  - Non-predatory remote control interface is difficult
  - Panel “modes”
Operational Requirements

• The One True Rule
  - re.: “The One True Rule for Doppler Tuning”, by Paul Williamson, KB6MU; re: Amsat Archives, Jan 1994
  - Holds frequencies constant at the satellite
  - Replaces drift at the satellite for drift at the ground station
  - Operational interference issues
  - Link offset variations
  - How to use it correctly when others don’t

• Background Doppler Correction
  - Tuning is done both by the computer and operator
  - Requires stringent interrupt-driven programming techniques
Operational Requirements

• Radio satellite tracking modes
  - Non-inverting transponder
  - Inverting transponder

• Add dynamic Doppler correction to the tracking modes
AC6P Ground Station Controller

- Why I wrote it
- Radios it works with now
- What it does and doesn’t do
  - works with your radio; non-predatory interface
  - Won’t make you a better operator
  - Can quickly be enabled or disabled using the mouse or hot-keys
  - Includes a satellite database to keep track of mundane operational satellite parameters
Conclusions

• Software tracking control is not a panacea

• Proper architecture and algorithm design must be thoughtfully done before coding (programming)

• Operational feedback is needed for improvements