The Applications of a Software Defined Radio In Space

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CAPE 2 - Software Defined Radio Subsystem
Overview – What is an SDR?

- A Software Defined Radio (SDR) utilizes software routines to accomplish necessary functions.
Overview – Software Radios vs Hardware Radios

- **Software Defined Radio**
  - Implementation of radio functionality in software.
  - Minimized hardware footprint.

- **Hardware Defined Radio**
  - Composed of mixers, filters, amplifiers, detectors, modulators, demodulators, etc.
  - Superior power efficiency.
Overview – Hardware Radios on a CubeSat Platform

- Hardware Radio Limitations
  - Limited broadcast and receive flexibility.
  - Multiple broadcast schemes require a large mass budget on CubeSats.
  - Functionality change requires new hardware design.
Advantages – Why use an SDR?

• Allows for multiple types of radio modulation schemes internal to single system.
  – AM, FM, CW, FSK, PSK, ASK, QAM, etc.
  – Each modulation executed in software.
Advantages – Why use an SDR?

- Reprogram software in flight.
  - Functionality changes.
    - Addition of alternative modulation schemes.
    - Encryption/Decryption routines.
    - Efficiency improvements in software.

- Ability to update design post-launch.
Advantages – Why use an SDR?

- Terminal Node Controller (TNC)
  - Handles protocol wrapping (AX.25, KISS, etc.)

- May be implemented internal to an SDR.
  - External circuit not required.
  - Update via software for new data protocols
Advantages – Why use an SDR?

• Allows for a smaller hardware design.
  – Complex systems are greatly simplified.
  – Single operational circuit.

• Replace multiple radios with single system.
Limitations – Common Disadvantages

• Ideal SDR design employs non-existent technology.

• Fairly new technology to CubeSat platform.

• Longer Development Time.
Limitations – Common Disadvantages

- Expensive power requirements.
  - FPGA's and x86 processors.
- New technology enables low-power devices.
  - New generation of DSPs and FPGAs.
Limitations – Common Disadvantages

• Software Radios are a fairly new technology.
  – Community documentation is rare in relation to hardware radios.
  – Existing hardware radio designs are readily available.

• Research in SDRs is rapidly advancing with enabling technologies.