

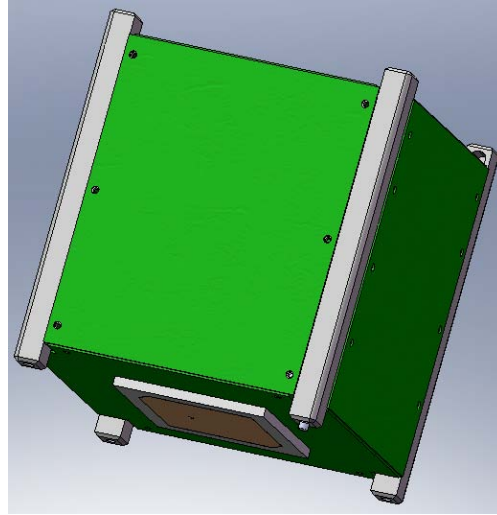
A Miniaturized Communication System for Cubesats

AstroDev

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www.astrodev.com

The 1U Mission: The Problem

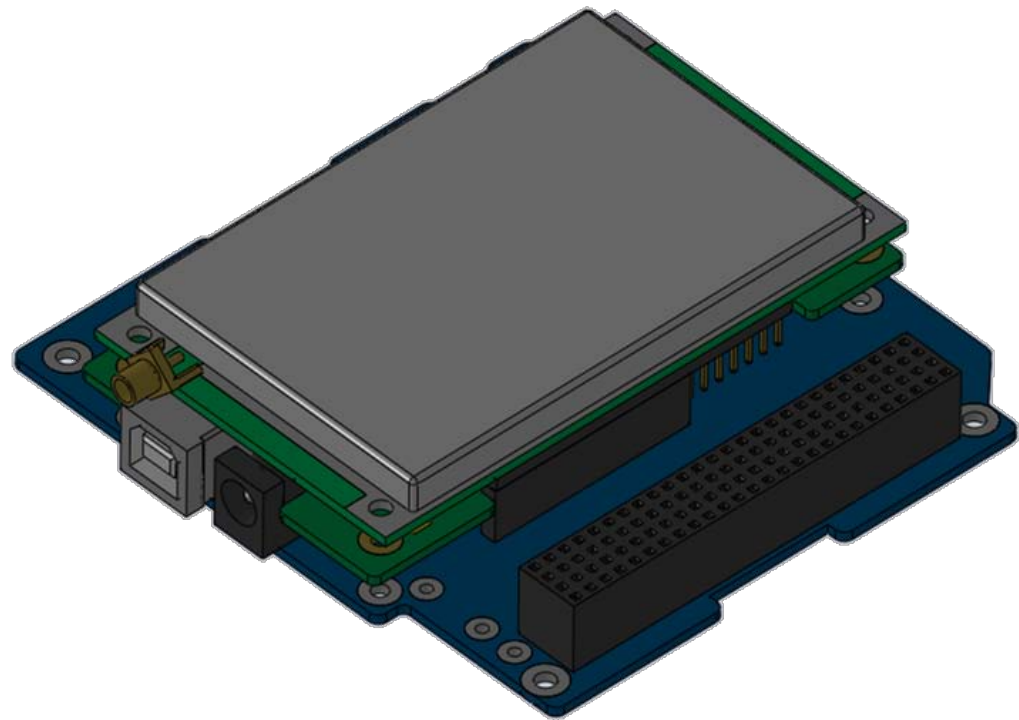


A 1U mission can not sacrifice volume and mass to accommodate large subsystems.

The 1U Mission: Example

- Pumpkin CubeSat Kit

*Can you integrate your **entire** UHF communications subsystem into the same volume as a MHX2400?*



<http://www.cubesatkit.com/>

The Radios: Method

- **Move to radios which can be highly integrated onto PCB and existing subsystems.**
- **Use modern electronics manufacturing**
- **Integrate RF cables into radio connect at antenna**

The Radios: Operations

- **Beacon**
 - **Satellite tracking, health and status, spacecraft reset**
- **VHF/UHF High Reliability Access**
 - **Command and Data**
- **L Band Secondary Up/Downlink**
 - **Data**

The Radios: Capabilities

- **HAM Compliant or Other**
 - *AX.25 (GFSK)*
 - *802.11 (DBPSK)*
- **Power Levels**
 - *27 to 33 dBm*
- **Data Rates**
 - *1.2 to 38.4 kbps (low bands)*
 - *115.2 kbps and greater (high bands)*

The Radios: New in 2010/11

- **CII Radio**

- *40 x 50 x 6 mm*

- *VHF/UHF/L*

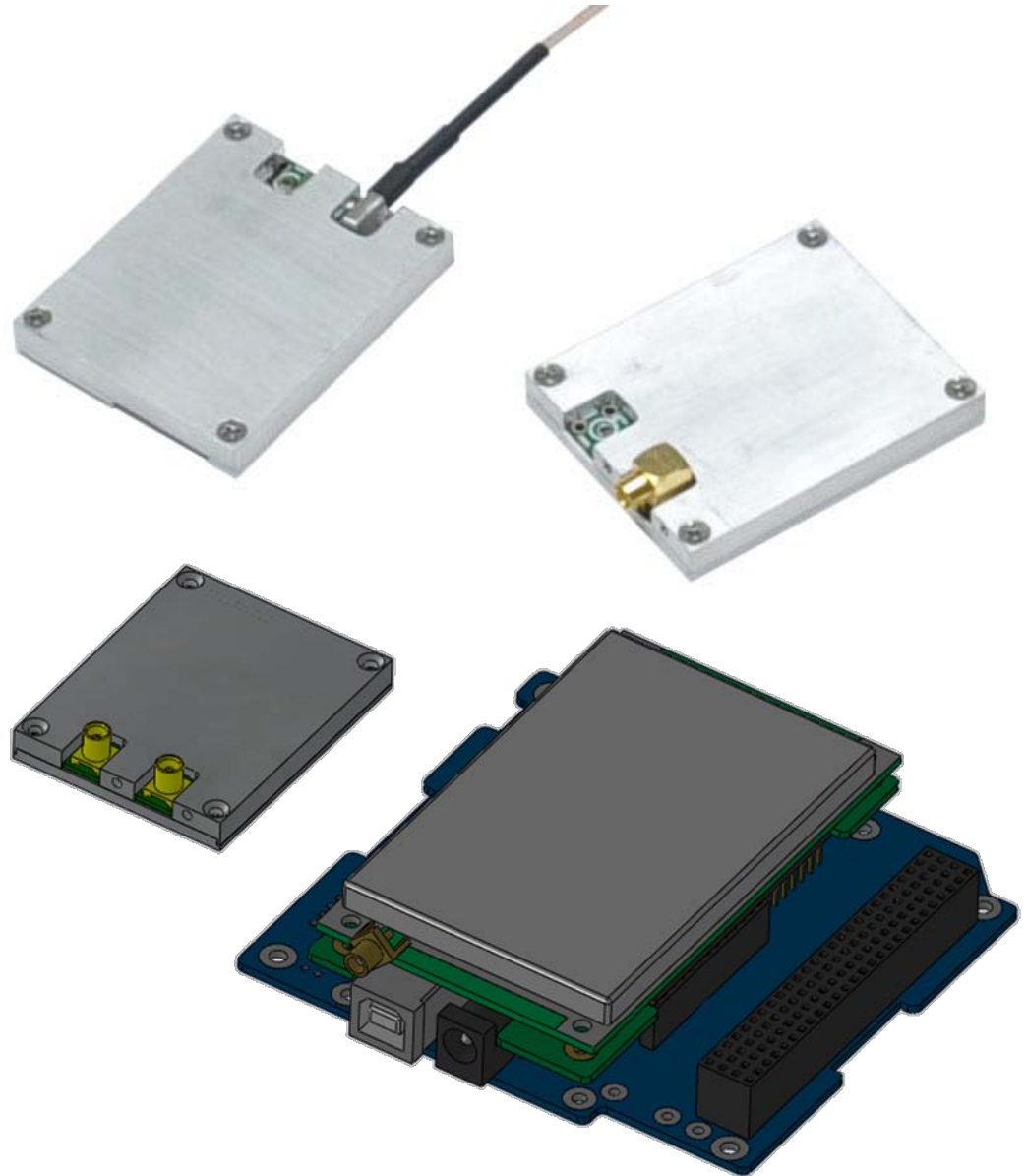
- *< 200 kbps*

- *< 36 dBm*

- *Full Duplex*

- *CLP Plug*

- *USD \$5000*



The Radios: New in 2010/11

- **Ne-2 Beacon**
 - ***15 x 25 x 3 mm***
 - ***UHF***
 - ***< 38.4 kbps***
 - ***< 33 dBm***

 - ***Highly Integratable***

 - ***Intern: Tyler Burba***



Beacon Design Goals

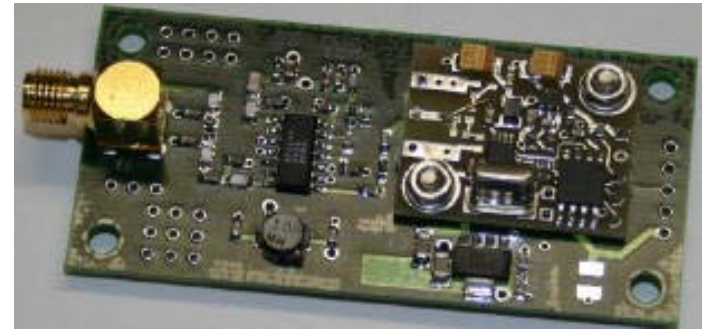
To create a remotely reconfigurable UHF beacon that can change:

- protocol
- frequency
- power

with no physical access required

Current Beacons Available

- Stensat Radio Beacon
 - 430MHz to 440MHz
 - 1 watt max
 - 3.1 inches x 1.75 inches
 - Data Rates: 1200 baud AFSK and 9600 baud FSK
- ISIS
 - 400MHz to 450MHz
 - 300mW PEP, 150mW average
 - 3.5 inches x 3.7inches
 - 1200-4800 baud
- Next generation will continue to shrink in size



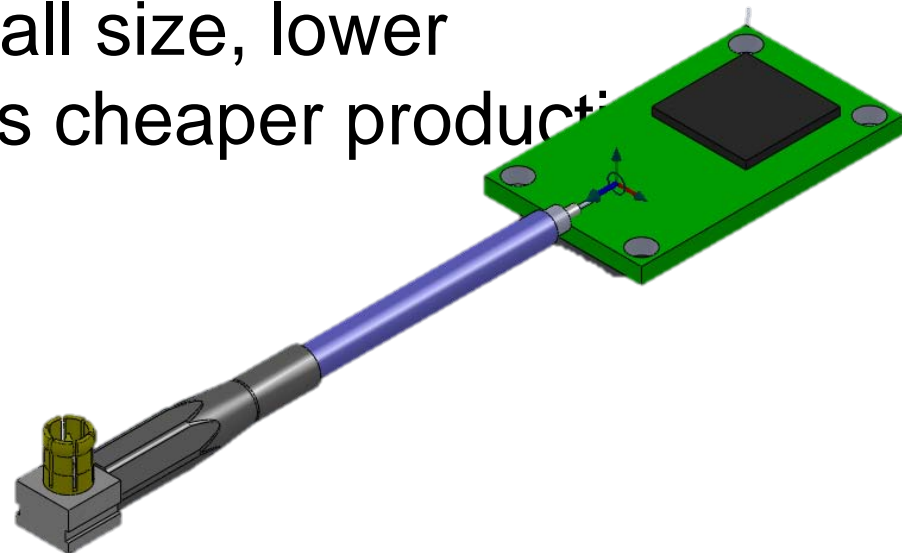
Concept for Design

- By using modern SoC a smaller, more capable beacon can be created that has numerous advantages over traditional beacons, while meeting the design goals
- A SoC brings tightly coupled RF, processor, and flash



Advantages

- A SoC:
 - Allows transmit power, frequency and protocol to be changed at any time
 - No dependence on C&DH processor for reconfiguration
 - Single SoC allows small size, lower component count, thus cheaper production cost



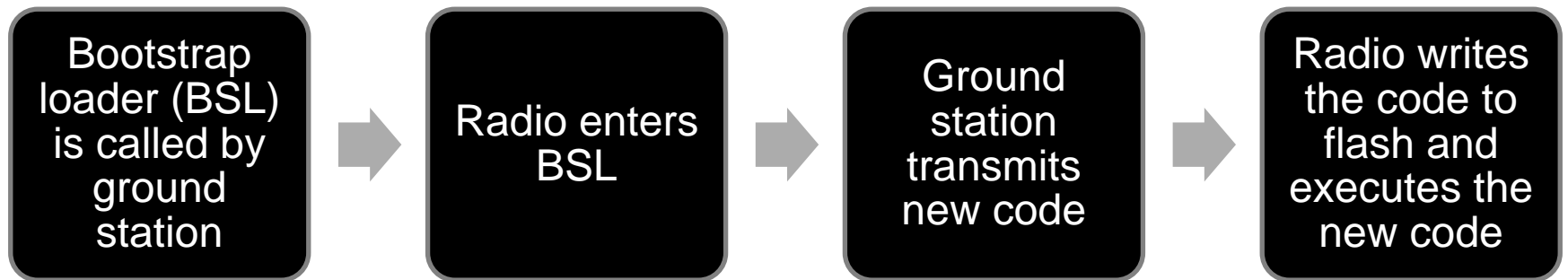
User Advantages

- Reprogrammable thru RF
 - No physical access required
 - Post integration reconfiguration
 - On orbit reconfiguration
 - Allows final integration into satellite before IARU frequency allocation is complete, etc.

Capabilities

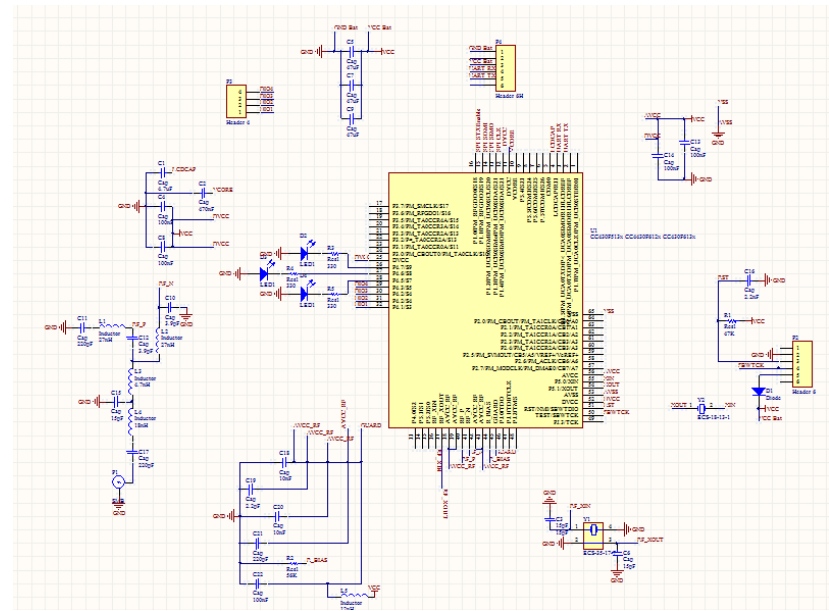
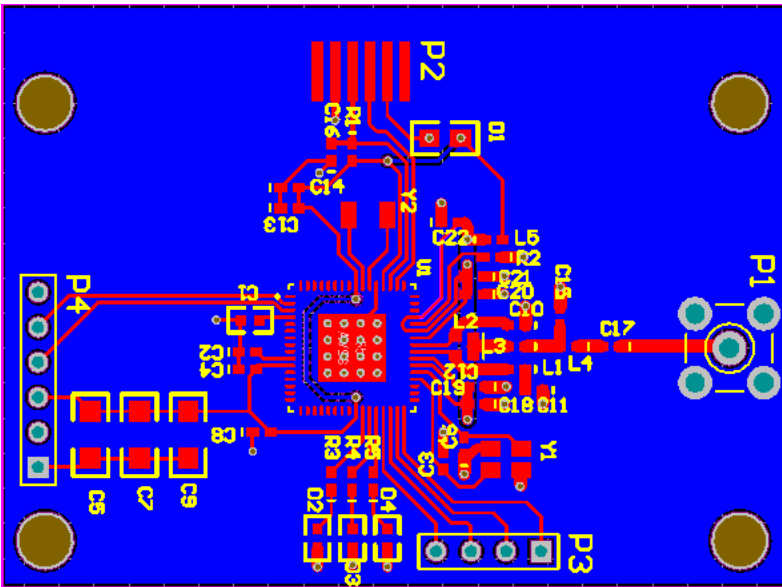
- UHF - 390MHz to 460MHz
- 3.0V-4.0V up to 1.0Amp
- 1W max output expected
- Data rate effectively limited by link budget and licensing, hardware range from .6kBaud to 500kBaud
- Small- approx. 1in x .75in
- Currently supports GFSK, FSK

RF Update Process



Status

- Have populated prototype PCBs and software development is in progress



Conclusions

- A complete UHF communications solution can fit within a MX2400 volume
- Requires no electrical changes to host system in example CubeSat Kit
- Users can replace low efficiency, low performance, and difficult software with easy to use, high efficiency and acceptable performance