Applying Codec2 To Amateur Satellite Operations

Bruce Robertson, VE9QRP
Amsat Symposium, 2012
QSO with ZL3IN in Early 2011

About 45 min. conversation
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The complete recording of both sides of the conversation could fit on a 1.4MB floppy disk
Codec2

- A very low-bitrate sound encoder / decoder
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- Attuned to the human voice
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- Open-source
Codec2

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- Attuned to the human voice
- Open-source
- Under active development
History

Bruce Perens, K6BP, noted the absence of a free and open-source low-bitrate voice codec
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Encouraged David Rowe, VK5DGR, to repurpose the work in his Ph.D. thesis to this end

- Built community and code base
- Won ARRL technical innovation award in 2012
Software

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Modems:
- 1400 bit/s FDMDV
- 4800 and 2400 (early) GMSK
FDMDV2 Teaser
Hardware

- Easily cross-compiled to ARM
  - Nokia N800: 330 MHz ARM11
Hardware

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  - Pandaboard: ARM Cortex-9
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- But many satellite stations have a computer attached
Comment pending on "Conversation Using Codec2"

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to me

Oct 6

sonick808 has made a comment on Conversation Using Codec2

This comment requires your approval. You can approve or reject it by visiting the comments page.

suck it D-Star!!

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Philosophy

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Philosophy

- Not about
  - Hijacking D-Star
Philosophy

- *Not* about
  - Hijacking D-Star
- Current emphasis on HF voice
Philosophy

The best part about Codec2 is that it allows us to experiment!

Kristoff Bonne, ON1ARF
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Kristoff Bonne, ON1ARF

For example?
I. Experiment With Today’s Satellites

- FDMDV through FM birds
I. Experiment With Today’s Satellites

- FDMDV through FM birds
- TWO FDMDV channels (x 1050 Hz) through one FM bird
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  - Who’s going to call that an Easy-Sat? 😊
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- TWO FDMDV channels (x 1050 Hz) through one FM bird
  - Who’s going to call that an Easy-Sat? 😊
- FDMDV signal acquisition and doppler correction
2. A Codec2 Demo. Mode

- Codec2 can bridge the voice / digital gulf
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  - Allows a functionally digital mission to assist in improving voice communications or
2. A Codec2 Demo. Mode

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  - Allows a primarily digital mission also to assist in improving voice communications
  - No more ‘beep boxes’
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- Digital comms. should be arranged with this possibility in mind
2. A Codec2 Demo. Mode

- Codec2 can bridge the voice / digital gulf
  - Allows a functionally digital mission
    - To assist in improving voice communications
    - To provide voice communications
  - No more ‘beep boxes’
- Digital comms. should be arranged with this possibility in mind
  - 1200 AFSK won’t cut it
  - 2000-2400 BPSK/QPSK?
3. Digital Bent-Pipe Mode

- Requires an appropriate uplink bandwidth, as well
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- Offers interesting research problems for undergraduate cubesat programs:
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- Offers interesting research problems for undergraduate cubesat programs:
  - E.g., what sort of modulation technique and how much error correction would be helpful in LEO?
4. An In-flight Modulation Mode

- Analog voice uplink and Codec2 voice down
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- Advantages:
  - More simple station set-up
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  - Transmission efficiency for satellite
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**Advantages:**
- More simple station set-up
- Transmission efficiency for satellite

**Challenge:**
- Including efficient codec2 modulation code in on-board computing system
5. Radio-less Experimentation

- Many ears make light work
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- Ideas for unix-monkeys:
  - Pipe a mp3 stream through Codec2, listen for a hour or so and characterize the result:
5. Radio-less Experimentation

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- Ideas for unix-monkeys:
  - Pipe a mp3 stream through Codec2, listen for a hour or so and characterize the result:
  
    (Twit’s live stream to shoutcast)

    ```bash
    gst-launch souphttpsrc location=http://twit.am:80/listen ! 
    Mad ! Audio oconvert ! Audio o resample ! Audio o/x-raw-int, 
    rate=8000, depth=16, signed=true ! Fdsink fd=1 | c2enc 1200 
    - - | src/c2dec 1200 - - | gst-launch fdsrc fd=1 ! 
    Audi oconvert ! Vorbis enc ! Oggm u x ! Shout2send 
    mount=/stream.ogg port=8000 password=password ip=localhost
    ```
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- Introduce random errors into FEC-encoded Codec2 to evaluate interleaving approaches
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- Ideas for unix-monkeys:
  - Pipe a mp3 stream through Codec2, listen for a hour or so and characterize the result:
    - (Twit’s live stream to shoutcast)
      - `gst-launch soupphpsrc location=http://twit.am:80/listen ! Mad ! Audio oconvert ! Audio o example ! Audio o x- raw int, rate=8000, depth=16, signed=true ! Fdsink fd=1 | c2enc 1200 - - | src/c2dec 1200 - - | gst-launch fdsrc fd=1 ! Audio o convert ! Vorbisenc ! Oggmux ! Shout2send mount=/stream.ogg port=8000 password=password ip=localhost`
  - Introduce random errors into FEC-encoded Codec2 to evaluate interleaving approaches
    - Extra points: make a website that crowd-sources the scoring of various approaches
Last Word to the Codec

- 2.1 kB message at 1200 bits/s
- Come see me for a record/playback session with my laptop