SARSAT Beacon Manufacturer's Workshop September 28, 2012

Second Generation Beacons

Presented by:

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Background

- Cospas-Sarsat (C/S) has defined operational requirements based on use of a second generation of beacons

  - Operational Requirements for Cospas-Sarsat Second Generation 406 MHz Beacons, C/S G.008

  - Second Generation Beacon Implementation Plan (BIP), C/S R.017

Operational Requirements from G.008

▸ **Compatible with Cospas-Sarsat System**

▸ **Minimum Requirements**
  ▸ Independent location accuracy
  ▸ First burst transmission timeliness [3] seconds
  ▸ Increased performance in first 30 seconds
  ▸ Cancellation function
  ▸ Verification of Beacon Registration

▸ **Objective Requirements**
  ▸ Better encoded location
    ▸ 30 m, 95% of the time within 5 minutes of activation
  ▸ Return Link Service (RLS)
  ▸ Additional data encoded in beacon message
  ▸ Automatic ELT activation on indication of emergency

Timeline (contained in BIP)

- According to C/S Operational Requirements, C/S G.008
  - LEOSAR SARP processing constraints limit the possible evolution of first generation beacon specifications
  - 2nd gen beacons **after** MEOSAR FOC **not required** to be LEOSAR SARP interoperable
  - 2nd gen beacons **prior** to MEOSAR FOC **required** to be LEOSAR SARP interoperable
  - MEOSAR D&E not dependent on availability of 2nd gen beacons

- BIP timeline created at C/S EWG-2 in September 2010
  - At the time, MEOSAR FOC was scheduled for January 2015.
    (ref. C/S R.012, MEOSAR Implementation Plan, Issue 1, Rev 5, Annex I)
  - BIP timeline derived to insure 2nd generation beacons approved by first C/S Open Council after MEOSAR FOC, October 2015
  - C/S Council meeting in October 2010 moved MEOSAR FOC to 2018
    (ref. C/S R.012, MEOSAR Implementation Plan, Issue 1, Rev 6, Annex I)
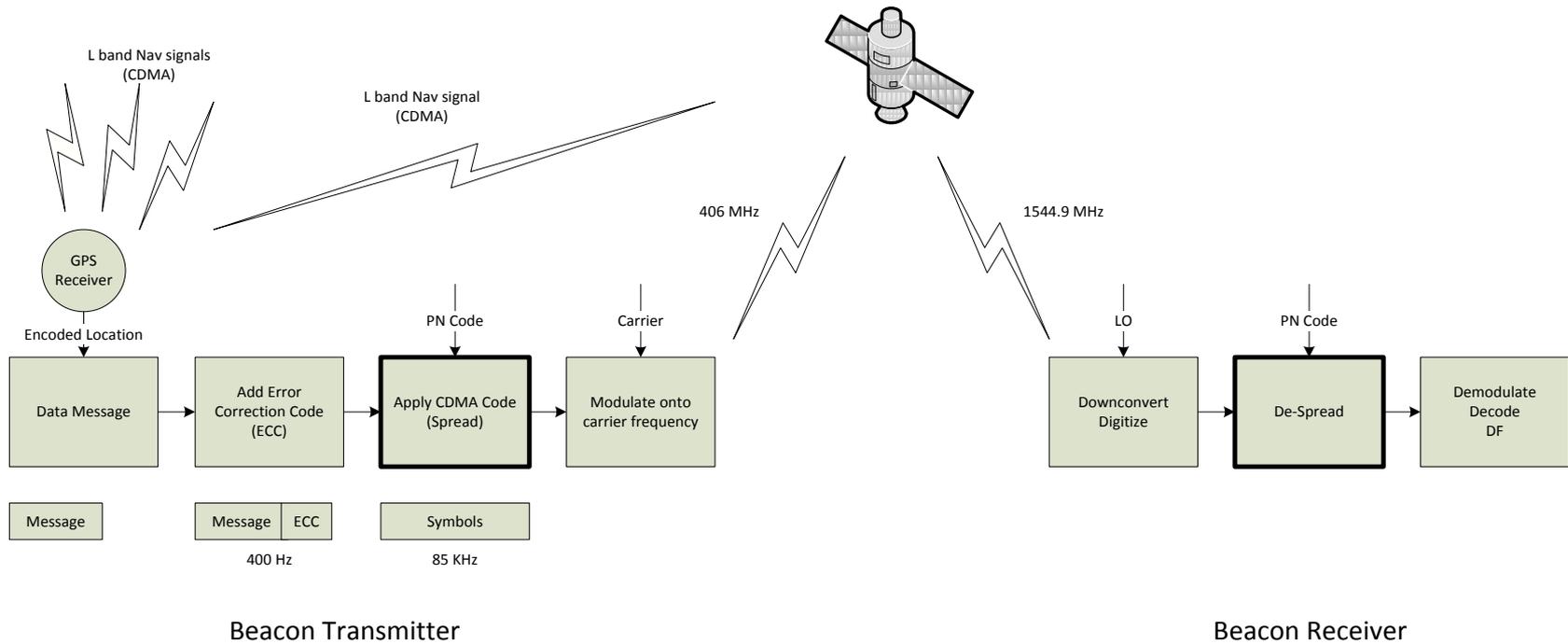 - BIP timeline not adjusted accordingly, creating 2 year gap

U.S. and French Goals

- Improve system performance to meet or exceed C/S requirements

    - including detection probability, location accuracy and system capacity

- Modernize beacon signal for MEOSAR system

- Relax beacon requirements to reduce cost and complexity

- Collaborate with manufacturers to obtain the most competitive end product

Fully realize ability of Cospas-Sarsat to provide the gold standard of emergency distress location
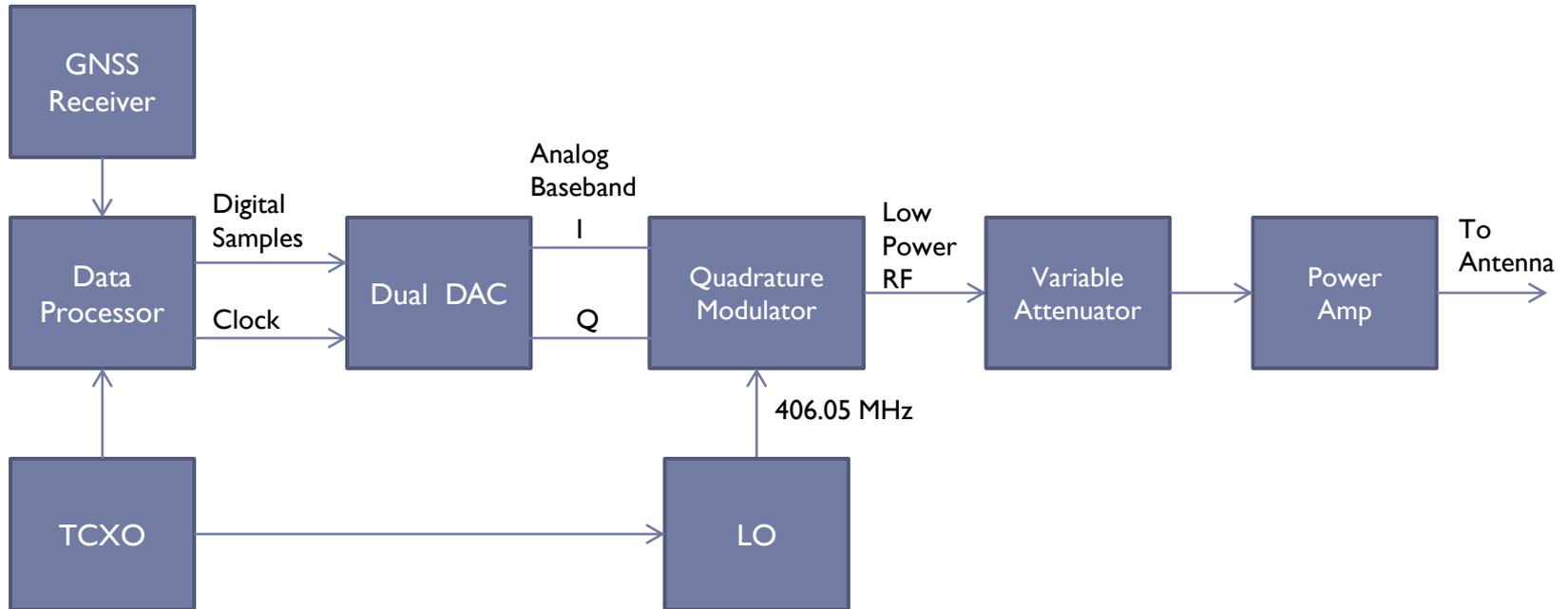
Beacon Model : Functional

L band Nav signals (CDMA)

L band Nav signal (CDMA)

GPS Receiver

Encoded Location

406 MHz

1544.9 MHz

PN Code

Carrier

LO

PN Code

Data Message	Add Error Correction Code (ECC)	Apply CDMA Code (Spread)	Modulate onto carrier frequency

Downconvert Digitize	De-Spread	Demodulate Decode DF

Message

Message	ECC

400 Hz

Symbols

85 KHz

Beacon Transmitter

Beacon Receiver

Beacon Model : Physical

Message Format

- ## Simple and efficient

  - Single message structure with multiple protocols

  - Investigating use of a modified Type Approval Certification (TAC) data base to provide some required data that is currently carried in the message

  - Use of various schemes to encode some alpha-numeric data fields

  - Message length to meet requirements with some margin

  - Protected with a single BCH Forward Error Correction code to exceed Bit Error Rate requirement with minimal cost to beacon

RF Modulation

- **Offset Quadrature Phase Shift Keying (OQPSK)**

  - Industry standard

  - Many commercially available chip sets available

  - Relaxes requirements on amplifier

  - Increases system performance and efficiency of data transmission

Direct Sequence Spread Spectrum Code Division Multiple Access

- ▸ Industry standard basis for major performance improvements in detection, location and capacity

- ▸ Easy to implement – code applied to digital data in software

- ▸ Relaxes beacon requirements

    - ▸ Oscillator frequency stability of 5-10 ppmillion – orders of magnitude improvement over current 1-2 pp_billion_

    - ▸ All beacons transmit at same center frequency

        - ▸ never have to change oscillator

        - ▸ different codes applied in software.

Local Detection and Homing Signal

- **406 MHz signal designed for local detection and homing**

  - Replace 121.5 MHz homing signal – simpler, single frequency beacon design

  - Collaborating with DF equipment manufacturers on signal design

  - Purpose built design will improve performance over current systems

  - Software configurable so beacon utilizes existing 406 MHz transmit chain

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