Beacon Manufacturers Workshop
September 28, 2012
Orlando, FL

MEETING MINUTES

NOTE: This document highlights the Workshop presentations and panel discussion; detailed PowerPoint presentations and other information of interest are posted on the NOAA SARSAT website (www.sarsat.noaa.gov) under SARSAT Meetings tab on the left.

1. Introduction and Opening Remarks

Mr. Chris O'Connors (BMW Chair and NOAA SARSAT Program Manager) convened the meeting, welcomed the participants (enclosure (1)), and expressed appreciation to RTCM for hosting the workshop.

The Chair introduced LTJG Tim Sinquefield, the new NOAA SARSAT Operations Officer, Dr. Lisa Mazzuca, the new NASA Deputy SAR Mission Manager, and CAPT Peter Martin, the new Coast Guard Chief of Search and Rescue.

The Chair reviewed the Action Items from the prior meetings, most of which were able to be closed. The remaining open items are included with the list of Action Items from this meeting (see Agenda Item 13 below).

2. RTCM Special Committees

a. Special Committee 110 (SC-110)

Mr. Chris Hoffman (RTCM/ACR) briefly reviewed RTCM's functions and activities; RTCM's main role is standards development for maritime communications and electronics.

SC-110 develops standards for emergency position-indicating radio beacons (EPIRBs), personal locator beacons (PLBs) and ship security alerting systems (SSASs). SC-110 also interacts with other RTCM Special Committees, e.g., SC-119 on marine survivor locator devices, SC-128 on satellite emergency notification devices (SENDs), and SC-101 on handheld VHF DSC radios with integral GPS receivers. SC-110 accounts for technological developments and liaises with other national and international bodies, including the Radio Technical Commission for Aeronautics (RTCA), the International Maritime Organization and Cospas-Sarsat.

SC-110 had been recently working on matters such as second generation beacons (SGBs), EPIRB AIS standards, rechargeable PLBs, registration issues, and homing.

RTCM Standard 11010.2 on PLBs had been published in July 2008 and amended in August 2010 and June 2012. The Federal Communications Commission (FCC) was considering adoption of this standard into its rules.

RTCM Standard 11000.3 on EPIRBs, which addresses differences from the related International Electrotechnical Commission (IEC) standard (61097-2), had been updated and published in June 2012. This version mandates inclusion and testing of GNSS capabilities and includes improvements related to reduce false alert reduction, beacon mounting, and human interfaces.

RTCM had begun work on an EPIRB standard to accommodate use of the automatic identification system (AIS); it provides that EPIRB homing could be 406/121.5 MHz; 406/121.5 MHz plus AIS; or 406 MHz/AIS without 121.5 MHz.

Mr. Ghassan Khalek (FCC) pointed out that the FCC will request public comments on these standards as they are considered for incorporation into regulations.

b. Special Committee 128 (SC-128)

SC-128 had developed RTCM Standard 12800.0 on distress alerting functionality for one-way and two-way satellite emergency notification devices (SENDs). The Standard, which had been published in August 2011, includes provisions for non-beacon devices comparable to those in beacon standards. A SEND either is required to float (Category 1), not required to float (Category 2), or intended for fixed installations on vehicles (Category 3).

3. Beacon Use and Issues

Mr. Sam Baker (NOAA/SSAI) reviewed false alert statistics, noting that ELTs are of particular concern and that ELT false alerts are often associated with maintenance, testing and installations. ELTs account for 17% of registered beacons, but 54% of false alerts.

The top 24 beacon models that contribute to false alerts were noted; dongles are used with many of the ELT models with a high false alert rate. NOAA can provide details on each of these models for the associated manufacturer.

NOAA had attended an aviation maintenance, repair and overhaul (MRO) conference to contact ELT installers about reducing false alerts related to ELT maintenance and installation.

Manufacturers gave mixed responses when the Chair asked whether they would mind if the names of ELT manufacturers of models associated with false alerts were published.

4. Beacon Testing Policy

Mr. Al Knox (USAF) addressed a prior Workshop action item that related to updating the policy for testing and exercising using 406-406.1 MHz beacons. The updated policy, which covers definitions and types of transmissions that are for other than actual SAR response, is posted on the NOAA SARSAT website. Laboratories, maintainers, users, and others who train, test or exercise with beacons are addressed; some types of activations require coordination with SARSAT. Confidence testing is prohibited.

The coordination requirements, which are important for avoiding false alerts, are covered in the policy. The USAF, USCG and NOAA are involved in processing test requests, and the relevant points of contact are covered in the policy. NOAA is the final approval authority for any beacon test conducted within the United States.

Mr. Hoffman pointed out that testing is an international issue, and test coordination can be difficult.

During the following discussion, the value of a beacon test channel for non-public system tests was considered; such a channel would reduce the chance of a test interrupting an actual distress alert. This could be further considered in relation to second generation beacons (SGBs), but it would require changes to spacecraft instruments.

5. Beacon Malfunctions and Coding Issues

Mr. Baker discussed a problem that seems to be associated with how the SARP-3 satellite instrument processes data; it looks for operational coding anywhere within the beacon ID rather than just at the beginning or the data string and blocks bits before the operational coding. Four beacon models that transmit rapidly in the self-test mode had been susceptible to their codes being read incorrectly. Since NOAA and SAR authorities have become aware of this problem, the faulty transmissions are usually detected.

Mr. Baker cautioned manufacturers to be aware of the problem and consider designing to preclude rapid self-test repetition rates.

Sometimes holding the self-test button triggers rapid transmissions associated with this issue. Rapid transmissions can also deplete the battery pre-maturely.

Mr. Hoffman noted that manufacturers have no way to determine whether their beacons are a problem, and suggested that RTCM or Cospas-Sarsat standards might be amended to provide for manufacturers performing tests to detect the problem.

Mr. Andryey Zhitenev (Cospas-Sarsat Secretariat) clarified that Cospas-Sarsat document T.007 (beacon type approval standard) includes self-test provisions; manufacturers have to provide details of how these provisions are satisfied for the beacon approval. Some beacon features are undocumented and need to be discussed with the Secretariat. Manufacturers might describe how to conduct self-tests for type approval, but might not check the outcome of users incorrectly following prescribed procedures.

ACTION: RTCM and Cospas-Sarsat to investigate the need to add a test to Cospas-Sarsat document T.007 to identify beacons that could transmit with rapid repetitions that prevent proper processing by SARP-3 satellite instruments.

6. Canadian Beacon Registry Update

CAPT Keith Wohlgemuth (CMCC) addressed Canadian topics focusing mainly on the Canadian Beacon Registry (CBR), which included data for about 27,000 beacons and features a recently improved associated website (www.cbr-rcb.ca). The CMCC had been working aggressively to improve the data quality and registration rate over the past 18 months. Some miscoding had resulted from manufacturers mislabeling location-protocol beacons, and some inaccuracies were due to failure to update data when beacons had changed owners or been replaced. A mass mailing had been used to verify data not recently updated. The registration website is now accepting checksums, and new forms will soon provide for use of checksums.

The CBR had improved its in-house procedures and training on information exchanges, tracking unregistered beacons, registration verification, and use of statistics to detect trends. An automatic beacon registry checker will provide registration rate reports and automate data reviews and owner contacts; this improves user confidence. Follow up action is taken for every unregistered Canadian that is activated.

Two beacon anomalies had surfaced. Some beacons switched between a test protocol and operational protocol, causing needless search and rescue (SAR) resource launches or failures to launch in real cases; causes are under investigation. Other beacons had transmitted inverted frame sync data not initiated by users; this seemed random and the manufacturer was made aware. Manufacturers were asked to note these issues and were invited to help by sending a list of their Canadian hex-IDs and vendor or other information that might be used to improve the registration data or rates.

Some manufacturers would like to follow up with users with, for example, battery change-out reminders, but do not have owner contact information; the CBR might be able to help with this issue.

The CBR sends emails to registered owners when alerts are received, but not more than one per day.

7. Regulations and Type Approvals

a. MMSI, Checksum, and EPIRB Serialized ID

Mr. Jesse Reich (NOAA) discussed pending FCC regulatory updates to Title 47 of the Code of Federal Regulations (CFR) Parts 80, 87 and 95. NOAA's new mailing address will be included in each of these changes; collectively they affect EPIRBs, ELTs and PLBs.

47 CFR Part 80 and Part 95 will mandate use of checksums, require changes to registration forms for EPIRBs and PLBs, respectively, and will end use of MMSI numbers for EPIRBs.

47 CFR Part 87 will make similar changes for ELTs, except for a checksum exemption where IDs will change.

The above changes will incorporate the relevant new RTCM standards.

The EPIRB Standard RTCM 11000.3, requires integral navigation, provides for serialized coding only, improves tests and ergonomics, and incorporates relevant Cospas-Sarsat, IEC and ITU standards by reference. The updated PLB Standard, RTCM 11010.2, corrects global navigation satellite system (GNSS) test scenario tables.

One participant suggested allowing submission of a picture of the beacon label to help reduce registration errors.

b. Antenna Test Facility Inaccuracy

Mr. Jim Christo (NASA) noted that beacons with inadequate power could possibly receive type approval due to inadequate accuracy of antennas used at test facilities. This is enabled by combined allowances within Cospas-Sarsat T.007 and T.008 standards, and could adversely affect beacon detection probability. The Cospas-Sarsat Joint Committee would like to gather information on antenna accuracies at various type approval sites and possibly tighten the accuracy requirements of T.007 and T.008. No test or test equipment exists for checking EIRP and antenna gain at test sites, which raises the possible need for Cospas-Sarsat to develop a test antenna. Mr. Zhitenev added that the Cospas-Sarsat Secretariat checks labs for T.008 compliance, but that antenna accuracy and uncertainty is currently handled at the national level.

c. Rechargeable Batteries

Mr. Christo advised that Cospas-Sarsat had approved an interim specification for Li-Ion rechargeable batteries in 2009 and began issuing 'letters of compatibility' in lieu of type approvals for use of these batteries in 2010.

Battery issues are quite complex. The Joint Committee is investigating assessment of battery capacity using realistic pulsed currents vs. equivalent constant current, and RTCA has proposed a method to determine irreversible storage and standby losses. The United States has identified concerns about use of rechargeable batteries in beacons, including:

- Higher storage fade (sum of reversible and irreversible battery losses over time) of Li-Ion rechargeable batteries (greater than fade of non-rechargeable batteries);
- Inadequate diligence in maintaining rechargeable batteries;
- Potential reduced beacon reliability and operating times;
- Possible difficult recharging of mounted ELTs and EPIRBs;
- Insufficient means to determine time of last charge and number of charge cycles; and
- Use of a Cospas-Sarsat safety factor that does not account for temperature.

Breitling had presented plans to RTCM to develop a hybrid 406 MHz beacon-wrist watch that would depend on a rechargeable battery, and intended to request a Cospas-Sarsat letter of compatibility. This briefing had prompted RTCM to consider whether to develop a standard for a new class of beacons suitable for wearing on the wrist, but RTCM later decided not to take this action.

Mr. Christo emphasized that SAR applications are unique in their demand on batteries, and so far not enough testing had been done to clearly understand how the batteries work. He encouraged any testing that could be done to better define rechargeable battery behavior.

8. MEOSAR Demonstration and Evaluation (D&E) and Space and Ground Status

The Chair reviewed the MEOSAR status and planned implementation timeline. The space segment will include the Galileo (ESA), GLONASS (Russia) and GPS (United States) systems. MEOLUTs worldwide will receive data from bent-pipe spacecraft receivers to forward to SAR forces via mission control centers (MCCs). Galileo plans to provide a return link service (RLS). MEOSAR will optimize detection of beacons, and will provide near instantaneous notifications and locations worldwide, 100% availability, and better accuracy. Twenty-four (24) of the seventy-two (72) total MEOSAR satellites will be GPS platforms provided by the United States.

The optimum MEOSAR satellite altitudes enable each satellite to cover up to about one-third of the Earth, so that the fully operational system could provide up to six satellites in view of a beacon at any time. MEOSAR will use time difference of arrival (TDOA) and frequency difference of arrival (FDOA) involving at least three satellites and be able to locate a beacon from a single beacon burst. [The current system requires multiple bursts and uses Doppler processing.]

MEOSAR satellites are available for testing and demonstration using S-band downlinks; new satellites will provide both S and L-band downlinks. GPS satellites were used for a proof-of-concept that showed that MEOSAR will be able to locate beacons using three satellites with greater accuracy than the current Cospas-Sarsat system. Ten GPS satellites were already available for ongoing tests.

The ground infrastructure is being developed in parallel with the system being used for LEOSAR and GEOSAR, and the MEOLUTs will be networked with each other to enable selection of the best available satellite data for a quality solution. NASA operates a prototype MEOLUT that might become operational in the future. NOAA has a 6-channel MEOLUT in Hawaii that became operational in December 2011 and had awarded a contract for a MEOLUT in Miami.

Cospas-Sarsat expects initial operating capability (IOC) for MEOSAR to begin in 2015, with full operating capability (FOC) by 2018. The demonstration and evaluation (D&E) phase, which will begin in January 2013, will help develop recommendations for integration of MEOSAR into Cospas-Sarsat. The D&E will include operational and technical tests. The U.S. will begin networking with Canada before the D&E begins. The first launch of the fully operational SAR-GPS satellites is scheduled for 4th quarter of 2018, but other satellite systems will provide operational satellites earlier.

Ground coverage will be adequate for the D&E, and will be sufficient to conduct IOC with stand-alone MEOLUTs; MEOLUTs networking will improve coverage, and by January 2018 most of the globe is expected to be covered.

The Chair advised the United States will need about 20 beacons for the D&E technical test T-5 of 2-D location capability; the beacons will also be used later for operational tests. 121.5 MHz homing will have to be disabled in these test beacons. The beacons must be test-coded and function on a standard beacon frequency in the 406 MHz band. Other countries will deploy 16 additional beacons for the test. NOAA promised to clarify the specific requirements for the beacons and post them on the NOAA SARSAT website as soon as possible. Testing will run for about 72 hours at staffed locations, so the beacons will have to be either switched out or have their batteries replaced during the tests. The Chair solicited contributions of beacons from various manufacturers for the D&E.

> ***ACTION: NOAA to post, as soon as possible in the Beacon Manufacturers Workshop section of its SARSAT website, detailed requirements for beacons for manufacturers that are interested in supplying beacons to support the Cospas-Sarsat D&E Technical Test 5.***

9. Second Generation Beacons

George Theodorakos (NASA/MEI) pointed out that MEOSAR opens opportunities to improve Cospas-Sarsat in various ways, including the ability to use ‘bent-pipe’ space segment processors (due to global coverage). MEOSAR would also enable development of improved and simplified SGBs. SGB operational requirements are documented in Cospas-Sarsat document G.008, and the SGB beacon implementation plan (BIP) is covered in document R.017.

Cospas-Sarsat minimum (critical) and objective (desired) SGB requirements, which might be supplemented by national requirements, cover the functions listed below:

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

The requirement for first burst within 3 seconds is tentative pending determination of feasibility.

The BIP provides that:

LEOSAR SARP processing constraints limit the possible evolution of first generation beacon specifications;

SGBs after MEOSAR FOC are not required to be LEOSAR SARP interoperable;

SGBs prior to MEOSAR FOC are required to be LEOSAR SARP interoperable; and

The MEOSAR D&E and the eventual operational system will be independent of SGB availability.

The BIP provides for introduction of SGBs well before the MEOSAR FOC. Manufacturers will need to decide whether to develop beacons operable through both MEOSAR and the current systems during this gap, or wait to provide beacons dedicated to operation through MEOSAR.

The United States and France, desiring to meet or exceed all SGB operational requirements, would like to modernize the beacon signal with use of spread spectrum and provide smaller and cheaper beacons. Use of spread spectrum will enable substantial relaxation of oscillator frequency stability and should be relatively easy to implement. 406.025 MHz would be the center frequency for all spread spectrum beacons.

The beacon message will be simplified and use a single structure for multiple protocols. Potentially, a modified type approval certification (TAC) and a single BCH Forward Error Correction code could be used to provide some required data. The OQPSK RF modulation will improve system performance while relaxing amplifier requirements.

The 121.5 MHz homing signal will likely be replaced with homing on 406 MHz; NASA, USCG and USAF are working with the DF equipment manufacturers to see what signal characteristics are needed for homing on 406 MHz.

10. Panel on Second Generation Beacon Requirements and Other Beacon Issues

The Chair introduced Dr. Lisa Mazzuca, Deputy Search and Rescue Program Manager, NASA Goddard Space Flight Center, to moderate a Q&A session between the participants and a SARSAT panel. Dr. Mazzuca's background is in engineering and astro-physics, and she conducts SAR operations part time as an air crew member and investigator with the Baltimore County police.

The panel members were as follows:

Mr. Al Knox (USAF) who handles certain civil SAR and personnel recovery matters for Air Combat Command, including beacon matters, command and control software, and coordination between the SARSAT agencies and the GPS Directorate.

CDR Mark Turner (USCG) who serves as SARSAT Liaison Office in the Coast Guard Office of Search and Rescue at Coast Guard Headquarters, focusing on interagency and international SARSAT matters.

Mr. George Theodorakos (NASA/MEI) who provides contract engineering support for the NASA Goddard SAR Mission for R&D, particularly in support of SARSAT and SGBs, and provides technical support for integration of the Canadian MEOSAR payloads aboard GPS satellites.

Mr. Jim Christo, a staff engineer for the NASA Goddard SAR Mission who supports checkouts of launched spacecraft, provides technical support to help resolve selected SARSAT-related problems and questions dealt with by RTCM and Cospas-Sarsat, and serves as a subject matter expert on batteries.

Mr. Jesse Reich (NOAA) who currently manages SARSAT-related LUT contracts and communications networks, supports RTCM, and handles a variety of other assigned projects.

Dr. Mazzuca introduced questions to the panel that had been submitted ahead or that were brought up during the panel discussion. The questions, panel responses and comments from participants are summarized in Enclosure (2).

11. U.S. Beacon Registration Database Statistics: NOAA RGDB Statistical Analysis and Population

Mr. Apurve Mathur (NOAA/SSAI) reviewed the United States year-to-date registration statistics. About 25% of new registrations and updates are received by mail, fax, etc., and entered into the database by NOAA; others are entered directly online. Registration data is validated biennially by contacting beacon owners.

The number of first-time civilian registrations peaked in 2009. Registrations were up this year and could exceed the number for 2009 by the end of the year. Mr. Hoffman suggested that consumer confidence and new beacon models had contributed to this growth.

Most new registrations were for PLBs. EPIRB and ELT registrations were about equal in number and trending down. Florida, California, North Caroline, Washington and Alaska accounted for the highest numbers of registrations. The largest use of PLBs is for boating. PLBs comprise about 30% of the total registered population, with 18% for ELTs and 52% EPIRBs. NOAA plans to add registration statistics to its SARSAT website.

The mailing address for registration forms had changed to:

SARSAT Beacon Registration
NOAA
NSOF E/SPO53
1315 East West Highway
Silver Spring, MD 20910-9684

Manufactures <u>must</u> update their forms and websites with the new NOAA address for registration.

Mr. Hoffman suggested adding a 'Sold or Scraped' check box on the registration form.

ACTION: NOAA to review whether a change is warranted to registration forms to provide for a box to check for beacons that have been sold or scraped.

Checksum use will be introduced into the CFRs as a requirement for all types of beacons with the exception of ELTs that have UINs that will change after production. Registration forms should include the preprinted beacon ID and checksum value. When submissions online have discrepancies, NOAA will determine whether a mismatch is due to an ID error or checksum error.

Mr. Hoffman believed that the CFR language on checksums should be changed to account for United States beacons that might be sold overseas and possibly also for military sales.

ACTION: NOAA to review the pending regulations on use of checksums to see whether any changes might be needed to account for discussion at the Workshop.

NOAA encourages voluntary use of the checksum pending finalized rules.

12. Cospas-Sarsat

a. System and Program Update

Mr. Dany St. Pierre (Cospas-Sarsat Secretariat) noted that the number of Cospas-Sarsat Participants had remained at 43.

Six LEO satellites were in operation, with one under test, and three more launches planned. Extra satellites have reduced the alert latency, which now average about 45 minutes at mid-latitudes.

A new Russian GEO satellite has been added to the system, bringing the total GEO satellites to six, with two in testing and many more expected in the future. 22 GEOLUTs are commissioned. In some locations up to four GEO satellites could be within simultaneous view of a beacon, and soon every location will have at least two satellites in view.

In 2011 there were 637 SAR events with 2,208 persons rescued. Lives saved had been steadily increasing to the current average of 5.1 per day.

MEOSAR might have 20 payloads in orbit by FOC in 2018. IOC will have sufficient satellites for excellent coverage even though some areas might be covered by only two satellites. At FOC, there will be at least 6 satellites always in view, and at times there could be 18-24 satellites in view.

About 11 MEOLUTs would be available during the D&E.

The International Beacon Registration Database (IBRD) had been enhanced to improve usability and reliability, and redundant servers had been installed to improve reliability.

For 2013, Cospas-Sarsat planned to hold an Expert Working Group meeting on SGBs and a Task Group meeting on the MEOSAR D&E.

Mr. St Pierre showed a global plot of where 406 MHz interference had been detected.

b. Beacon Manufacturer Statistics

Mr. Zhitenev highlighted some outcomes of the 2011 survey of 49 beacon manufacturers; 39% of these were in Europe, 37% were in United States and Canada, and 24% were in Asia and Australia.

Beacon production had dropped about 9.4% in 2011 following a greater decrease that had occurred during 2010. Sales increased for half of the manufacturers during 2011, but decreased overall for all types of beacons. About 157, 000 beacons were sold all together in 2011, bringing the world population to about 1.2 million, of which about 40% use the location protocol. 56% of beacons sold during 2011 used location protocol.

The global production slowdown seemed to be due to factors including the economy, reduced government spending, delays in finalizing new carriage requirements, and slower introduction of new models.

Manufacturers had projected a 35% increase in production in 2012 over 2011; such projections in past years have tended to be overly optimistic.

Any survey data that might be sensitive for a particular manufacturer is treated as commercial proprietary and is not shared outside the Secretariat.

13. Review of Action Items

Enclosure (4) lists the open action items from this and prior Workshops.

14. Closing Remarks (Surveys)

The Chair thanks all who participated in the BMW; he believed that it had been very valuable for the SARSAT agencies.

The Chair expressed appreciation to Mr. Bob Markle for RTCM hosting the meeting, to Ms. Lisa Hessler (NOAA/CSC) for administrative support, and to Mr. Bob Pearson of Rakon America's sponsorship of lunch.

The Chair also reminded the meeting that the detailed presentations and other information of interest would be posted on the NOAA SARSAT website.

Enclosures:

1. List of Participants
2. Panel Discussion Summary
3. Action Items

Enclosure (1)

2012 Beacon Manufacturers Workshop

List of Participants

	Name	Organization
1.	Andreadis, Peter	Communications Research Centre (CRC) Canada
2.	Avidor, Dalia	Astronics DME Corporation
3.	Baker, Sam	NOAA/SSAI
4.	Blackhurst, Peter	Inmarsat
5.	Bourgoin, Major Gilles	Dept. of Nat'l. Defence: Canadian Mission Control Center
6.	Brady, Edmond J.	Odyssey for USCG
7.	Brisson, Denis	Cospas-Sarsat Secretariat
8.	Cantave, Herve J.	Astronics DME Corporation
9.	Chén, Daniel R.	Microwave Monolithics Incorporated
10.	Christo, James	NASA Goddard Space Flight Center
11.	Cornish, Angie	Dept. of Nat'l. Defence: Canadian Beacon Registry
12.	Cox, Bill	ACR Electronics
13.	Eastwood, Bill	Orolia Ltd.
14.	Eggen, Oyvind	Jotron
15.	Forey, Peter	Sartech Engineering Ltd.
16.	French, Bryan	ACR Electronics
17.	Fuechsel, CAPT Jack	GMDSS Task Force
18.	Fuhrmann, Dave	AFRCC
19.	Goodman, Joan	Emergency Beacon Corporation
20.	Griffin, Sean	GME
21.	Hampton, Robert	TUV SUD Product Service Ltd.
22.	Hessler, Lisa	NOAA/CSC
23.	Hiner, Eric	Astronics DME Corporation
24.	Hoffman, Christopher	ACR Electronics
25.	Holmes, Kevin	WS Technologies Inc.
26.	Jobey, Laurent	SYRLINKS
27.	Jones, Sarah	TUV SUD Product Service Ltd.
28.	Jordan, Neil	Orolia Ltd.
29.	Khalek, Ghassan	Federal Communications Commission
30.	Knox, Allan C.	USAF/Air Combat Command
31.	Lariviere, George E.	Whiffletree Corporation Inc.
32.	Lariviere, Mark	Whiffletree Corporation Inc.
33.	Lemon, Dan	NOAA, 2020
34.	Markle, Robert	RTCM
35.	Martin, CAPT Peter	USCG
36.	Mathur, Apurve	NOAA/SSAI
37.	Mazzuca, Dr. Lisa	NASA Goddard Space Flight Center
38.	Mirza, Saddique	Sartech Engineering Ltd.

	Name	Organization
39.	Morgan, Dr. Scott P.	Emerging Lifesaving Technologies
40.	O'Connors, Chris	NOAA
41.	Pack, Thomas	ACR Electronics
42.	Pearson, Bob	Rakon America
43.	Pro, Bob	ACR Electronics
44.	Pulgarin, Felipe	Rakon America
45.	Quiring, Duane	ACR Electronics
46.	Reich, Jesse	NOAA
47.	Rigel, Ventura	Rhotheta USA, Inc.
48.	Ritter, Doug	Equipped To Survive Foundation
49.	Robinson, Michael	Specmat Technologies, Inc.
50.	Sheekey, David	Ocean Signal Ltd.
51.	Sinquefield, Tim	NOAA
52.	Steir, Kimberly	NOAA/CSC
53.	St-Pierre, Dany	Cospas-Sarsat Secretariat
54.	Street, Bill	WS Technologies Inc.
55.	Strickland, Tim	USCG
56.	Takahashi, Masaaki	ICOM America Inc.
57.	Taylor, Stuart	Techtest Ltd.
58.	Theodorakos, George	NASA Goddard Space Flight Center
59.	Thompson, John N.	Signal Engineering, Inc.
60.	Turner, CDR Mark	USCG
61.	Waesche, Earl M.	National Boating Federation
62.	Wahler, Chris	ACR Electronics, Inc.
63.	Weisser, Carl	Honeywell
64.	Wilkinson, Ross	Orolia Ltd.
65.	Wilson-Elswood, Kevan	GME
66.	Wohlgemuth, CAPT Keith	Dept. of Nat'l. Defence: Canadian Mission Control Center
67.	Woodman, Patrick	Jotron USA Inc.
68.	Yaker, Mokrane	SYRLINKS
69.	Yarbrough, Larry	US Coast Guard District 7
70.	Zhitenev, Andryey	Cospas-Sarsat Secretariat

Enclosure (2)

BMW 2012 Panel Discussion Summary

What are some pros and cons of spread spectrum and narrow band beacon signals?

The panel noted that Cospas-Sarsat will likely decide during 2013 which of these signals will be used for second generation beacons (SGBs). SGB requirements are challenging, as are the non-ideal environments often encountered in distress situations where beacons must be detected and located. Spread spectrum (also known as code division multiple access, or CDMA) is widely used, and enables signal detection within noise by means of excellent time measurements; this reduces reliance on costly tight beacon frequency stability requirements. While CDMA receivers are complex, their capability to discern code within noise has been refined over the years; performance has been tested and verified. Canada added that the current method of transmission, narrow band, has been used for years, and that Canada is working with Russia to enhance its potential use with MEOSAR. Narrow band is simpler, and would be compatible with the current system until LEOSAR is phased out.

How would variations in received power affect the performance of spread spectrum?

The panel stated that problems such as the presence of a strong signal along with a weak signal had all been dealt with successfully; the relatively weak signal can still be received. Mr. Hoffman (RTCM) asked for clarification on potential to use more than one code. The panel replied that testing so far had involved use of a single code since it presents the worst case. Use of multiple codes would entail more processing power on the ground.

Since the current system uses narrow band, why start over with a new type of signal?

The panel advised that even though over a million beacons now use narrow band signals, spread spectrum signals should be used for SGBs because they will perform better. Spread beacons would meet all the requirements of G.008, be less susceptible to interference, and allow a reduction in the cost of the beacons due to less stringent requirements. More testing will be conducted in real-world conditions to further confirm the spread spectrum advantages. MEOSAR will process both types of signals.

How can SGBs best be marketed as superior and reasonably priced in comparison with other alerting technologies?

The panel advocated marketing the system, not just the beacon. Beacons as part of MEOSAR will have advantages over other devices operating through their respective systems. SGBs are being developed from the ground up for the first time based solely on operational requirements that will enhance lifesaving, and are being designed to take full advantage of MEOSAR's superiority to the current Cospas-Sarsat system and other satellite-ground systems. Use of SGBs will maximize SAR effectiveness, and therefore lifesaving, with the fastest and most reliable distress alerting available. Complex digital processors can make beacons perform better, cost less, and be simpler to operate. Mr. Hoffman proposed that the SARSAT agencies partner with beacon manufacturers in marketing SGBs.

How well will SGBs keep up with user expectations?

The panel replied that the SGBs are mainly intended to comply with or exceed performance requirements that were developed to maximize lifesaving by optimizing the balance of cost and performance. Users want accurate locations. Cospas-Sarsat independent locations will not have the accuracies that GNSS receivers in beacons or other devices provide; however, potential buyers need to understand that SGBs will often outperform other devices in sub-optimal environments. SGBs operate through a robust government-owned system that will provide locations when systems that depend solely on GPS locations will not work. Further, SGB messages will have more bits dedicated to latitude and longitude so that the beacons can also transmit GNSS locations with accuracies that people have come to expect. The SAR-GPS instruments are completely independent of the satellite GPS position navigation and timing packages. Mr. Hoffman believed that the general population will struggle to understand why satellite SAR instruments on navigation satellites cannot process GNSS locations and why independent locations can be determined when GNSS locations cannot. Mr. Doug Ritter (Equipped to Survive) stated that the cost and device size of SGBs must remain competitive with other systems that offer alerting functions.

How resistant is spread spectrum to jamming?

The panel acknowledged that interference will always be a problem. However, compared to narrow band, spread spectrum is less susceptible to interference because the noise is spread. Simulations have indicated that system capacity will increase, i.e., more beacons will be able to use the same frequency.

Could CDMA intellectual properties and patents a problem?

The panel pointed out that SGB use of CDMA is a 'textbook' or science application rather than a use similar to those covered by patents. Many international satellite programs use CDMA. The SGB application would be an open technology based on published standards.

How will CDMA affect battery demands?

The panel noted that current beacons operate at five watts; SGBs with error correction could reduce that power demand substantially. This could improve beacon size and weight as well as battery cost. Further, current beacons depend on a 50 second burst interval to support Doppler processing; with SGBs, the burst rate can potentially be different and variable because locations can be determined from a single signal burst. Mr. Hoffman pointed out that longer pulses might be needed to transmit the desired amount of data, and that this power demand could be offset by increased burst intervals.

How would conversion to spread spectrum signals affect the cost of receivers other than those within the Cospas-Sarsat System, such as receivers used to test beacons?

The panel acknowledged that beacon testers used now will not work with SGBs, and stated that the cost of new testers had not yet been considered. More sophisticated testers are available that measure numerous parameters and that are often software programmable.

Have message structures that use rotating data fields been considered?

The panel explained that focus so far had been on identifying data that must be transmitted and on alternatives for sending more data using fewer bits. For example, beacons could use more than one message length or use one length with zeros filling unneeded bits. Another possibility would be to not transmit every field in every burst. More bits require more energy. NASA has been considering messages of about 200 bits. Mr. Hoffman pointed out that too few spare bits had been a problem with current beacon coding and recommended that sufficient bits be available to accommodate future uses that are currently unanticipated.

What is the U.S. policy on use of beacons aboard unmanned aviation systems?

The panel explained that such use of beacons for other than protection of life, such as for tracking, is illegal. Use of 406 MHz beacons on board UAV/UAS/RPA or other unmanned systems can needlessly jeopardize SAR response crews since no lives are in distress. Also, such use aboard military assets presents serious operational security issues and risks. SARSAT agencies had been working with the FAA and DOD to clarify this policy. The panel asked that manufacturers try to inform entities that interact with potential buyers about this policy, realizing that suppliers are not always aware of how purchase beacons will be used.

How will SGBs meet the requirement to confirm beacon registration?

The panel pointed out that registration verification had been established as a minimum requirement, while the return link service (RLS) that might be used in some way to provide verification is an objective requirement. Consequently, RLS cannot necessarily be counted on as a means of satisfying the registration requirement. Registration verification seems to be the most challenging of the operational requirements, with possible solutions all having cost-benefit tradeoffs. Information on the status of registration can be entered into a beacon and displayed to the user, but the challenge is interaction with a registration database. Inclusion of all registration data in the beacon message is not practical. Many countries have apparently not provided for registration of their beacons; such issues cannot be allowed to disable the beacon. Preferably the user will learn whether the beacon is registered when he or she conducts a self-test, but the U.S. has not agreed to limit the self-test if the beacon is not registered or if the registration has not been verified within the past two years. There might not be a way for technology alone to meet the registration verification requirement.

How will alert cancellations work?

The panel commented that switching off the beacon should not be the means of sending a cancellation notification. Cancellation will need to be initiated by the beacon owner with a separate button or other control designed to prevent any inadvertent cancellation. Mr. Hoffman added that cancellations are as critical as activations; an un-received cancellation message is better than an inadvertent cancellation for an actual distress.

Is it more valuable to use a tail number or other identification than to use serial numbers?

The panel explained that access to the beacon registration data is more important than having information such as tail numbers in the message. Codes like tail numbers are often out of date due to beacon relocations to different craft or vessels. Identities can be included in messages, but should not replace a serial number that provides a link to beacon registration data. Mr. Hoffman pointed out that relatively few countries have registration databases, in which case total reliance is on information in a message and on any other database that might be associated with data in the message.

Enclosure (3)

SARSAT Beacon Manufacturer's Workshop
Status of Open Action Items from 2012 and Prior Meetings

Action Item #	Description	Status
BMW-2012-AI.I	RTCM and Cospas-Sarsat to investigate the need to add a test to Cospas-Sarsat document T.007 to identify beacons that could transmit with rapid repetitions that prevent proper processing by SARP-3 satellite instruments.	
BMW-2012-AI.2	NOAA to post, as soon as possible in the Beacon Manufacturers Workshop section of its SARSAT website, detailed requirements for beacons for manufacturers that are interested in supplying beacons to support the Cospas-Sarsat D&E Technical Test 5.	
BMW-2012-AI.3	NOAA to review whether a change is warranted to registration forms to provide for a box to check for beacons that have been sold or scraped.	
BMW-2012-AI.4	NOAA to review the pending regulations on use of checksums to see whether any changes might be needed to account for discussion at the Workshop.	