International Cospas-Sarsat Programme

World Statistics Day
at ICAO
Montreal

20 October 2010

Cheryl Bertoia
Cospas-Sarsat Secretariat
www.cospas-sarsat.org

Source: CNES – D. Ducros

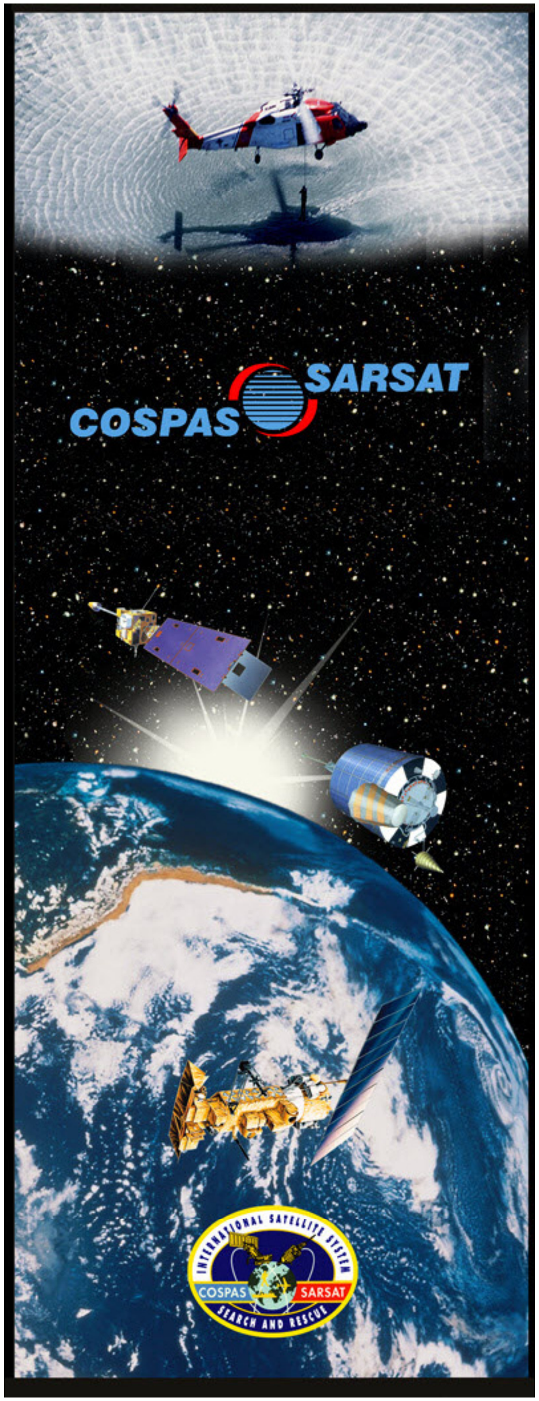
Cospas-Sarsat

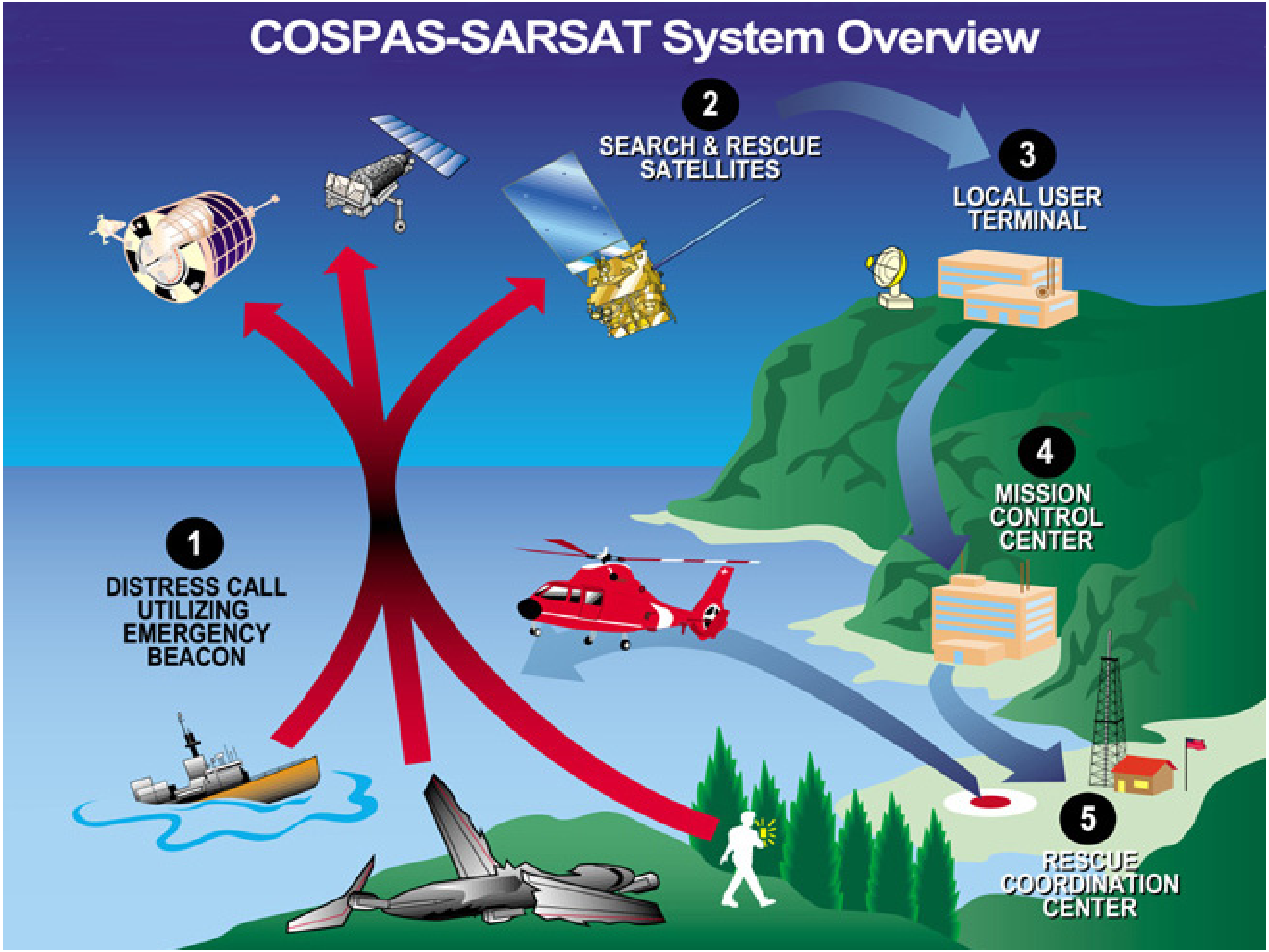
Mission Statement

The International Cospas-Sarsat Programme provides accurate, timely and reliable distress alert and location data to help search and rescue authorities assist persons in distress.

Objective

The objective of the Cospas-Sarsat system is to reduce, as far as possible, delays in the provision of distress alerts to SAR services, and the time required to locate a distress and provide assistance, which have a direct impact on the probability of survival of the person in distress at sea or on land.




COSPAS-SARSAT System Overview
1
DISTRESS CALL UTILIZING EMERGENCY BEACON
2
SEARCH & RESCUE SATELLITES
3
LOCAL USER TERMINAL
4
MISSION CONTROL CENTER
5
RESCUE COORDINATION CENTER

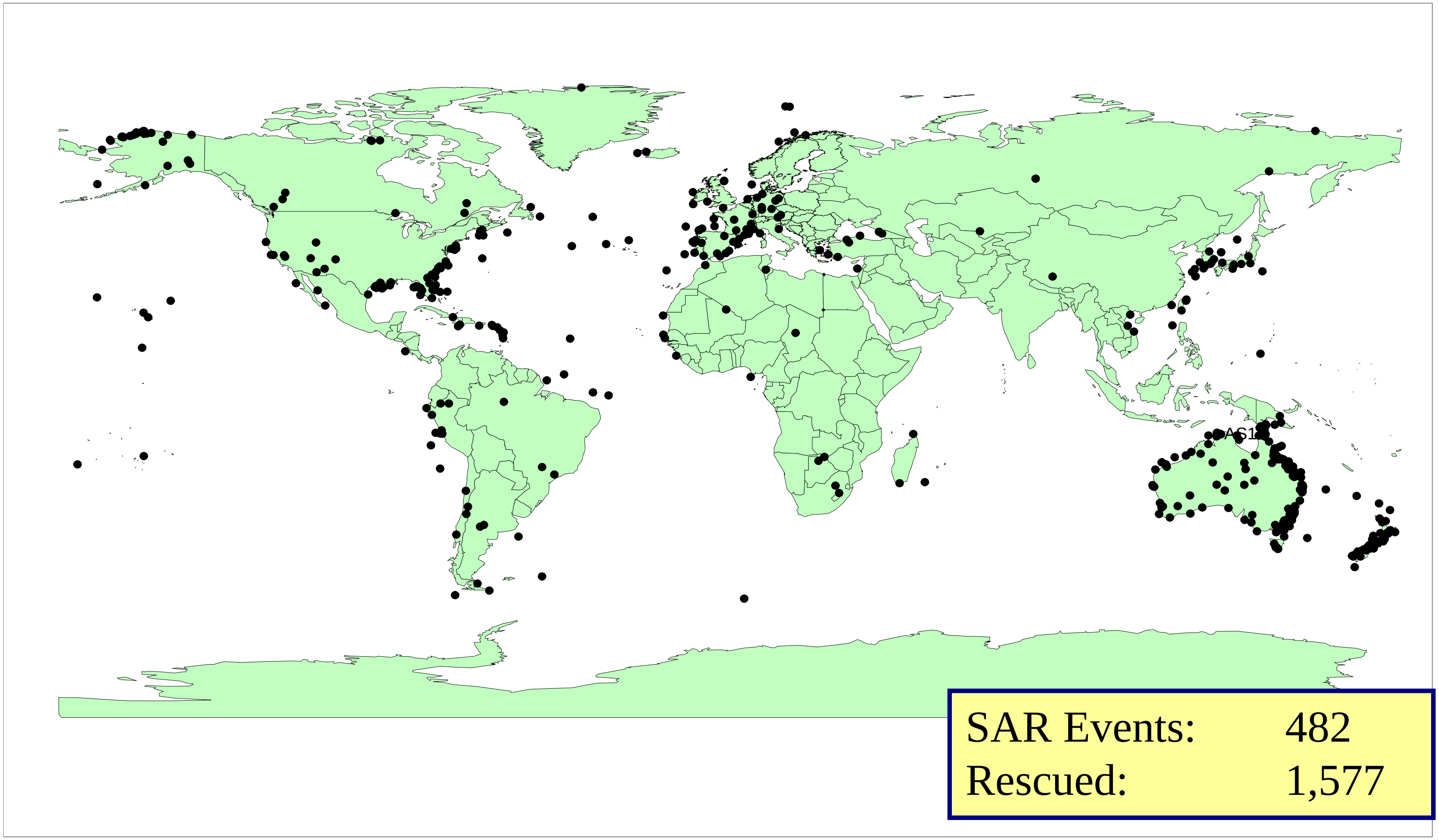
Cospas-Sarsat Programme

Cospas-Sarsat Participants

Algeria
Argentina
Australia
Brazil
Canada
Chile
China (P.R.)
Cyprus
Denmark
Finland
France
Germany
Greece
Hong Kong
India
Indonesia
Italy
ITDC
Japan
Korea (R. of)
Madagascar

Netherlands
New Zealand
Nigeria
Norway
Pakistan
Peru
Poland
Russia
Saudi Arabia
Serbia
Singapore
South Africa
Spain
Sweden
Switzerland
Thailand
Tunisia
Turkey
UAE
UK
USA
Vietnam

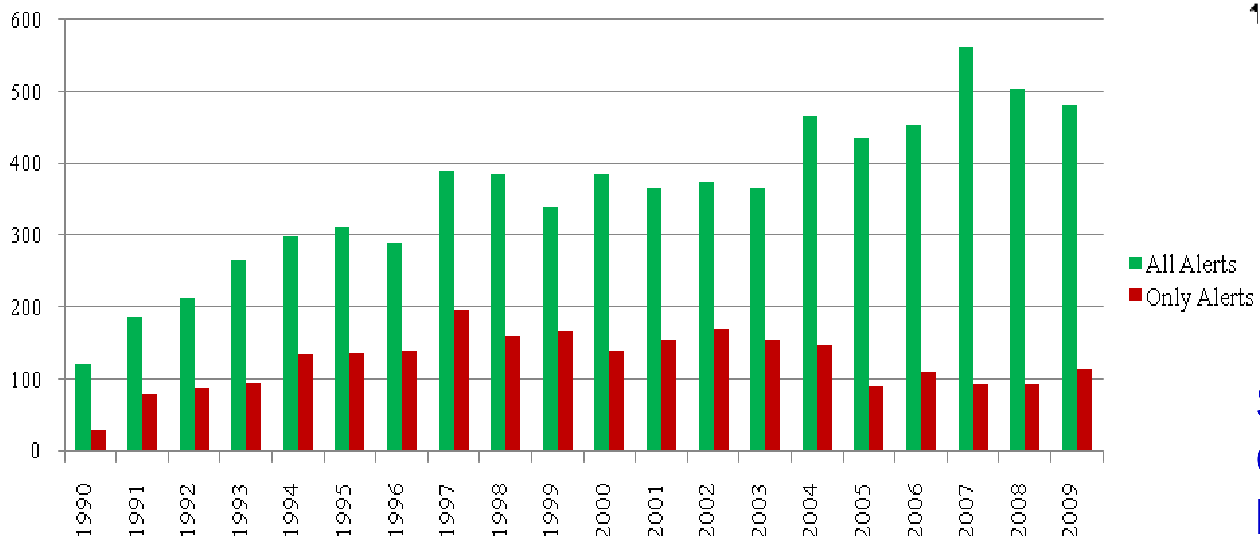
2009 Alert Locations

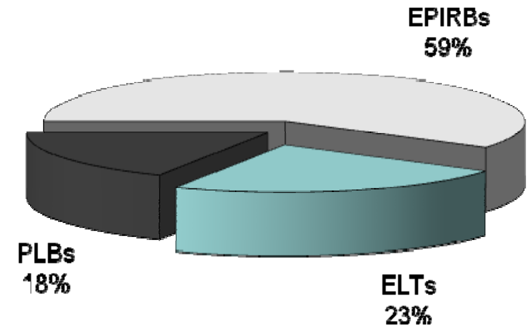


SAR Events:	482
Rescued:	1,577

System Operations

Number of SAR Events Annually where Cospas-Sarsat Assisted and Provided the Only Alert





Since September 1982, Cospas-Sarsat data helped rescue more than 28,000 persons in about 7,800 SAR events.

COSPAS SARSAT

System Monitoring

Year	Rate
2005	96.0%
2006	97.1%
2007	95.0%
2008	95.9%
2009	96.7%

SAR False Alert Rate

Beacon Type	EPIRBs	ELTs	PLBs
2005	1.8%	6.6%	0.5%
2006	1.9%	10.2%	0.7%
2007	1.5%	8.2%	0.6%
2008	1.2%	8.0%	0.9%
2009	1.2%	8.5%	0.6%

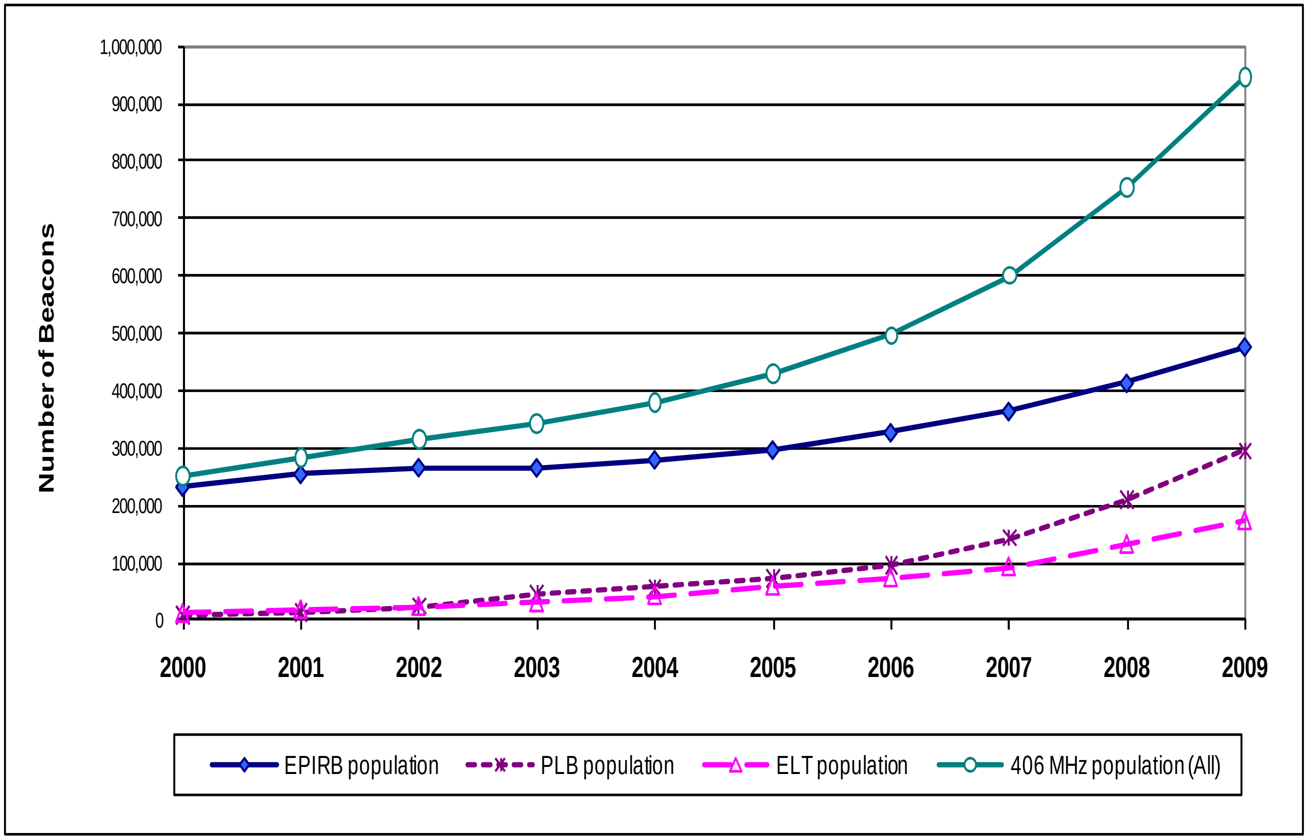
406 MHz Beacon False Alert Rate

EPIRB		ELT		PLB		Totals	
Number of beacons registered / Number of detections	%	Number of beacons registered / Number of detections	%	Number of beacons registered / Number of detections	%	Number of beacons registered / Number of detections	%
4221 / 5619	75.2	5244 / 8724	60.1	604 / 751	74.8	10321 / 15478	66.7

Percentage of Detected Beacons that are Registered (2009)

Beacon Population

Estimated Beacon Population at the end of 2009



Beacon Type Approval

Series of laboratory technical tests and an outdoor functional test of the beacon transmitting to the satellite conducted by an accepted test facility

Medium-Term Stability

The medium-term frequency stability shall be derived from measurements of $f_i^{(2)}$ made over 18 successive transmissions at instants t_i (see Figure A.4). For a set of n measurements(1), the medium-term frequency stability is defined by the mean slope of the least-squares straight line and the residual frequency variation about that line. The mean slope is given by:

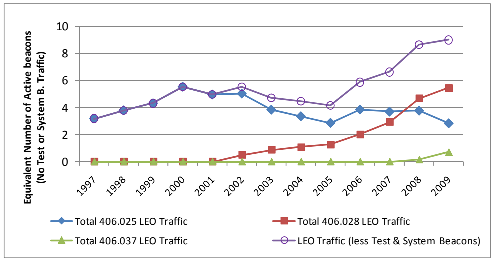
$$A(t_n) = \frac{n\sum_{i=1}^{n} t_i f_i - \sum_{i=1}^{n} t_i \sum_{i=1}^{n} f_i}{n\sum_{i=1}^{n} t_i^{\,2} - \left(\sum_{i=1}^{n} t_i\right)^2}$$

where n=18. The ordinate at the origin of the least-squares straight line is given by: $B = \frac{\sum_{i=1}^{n} f_i \sum_{i=1}^{n} t_i^{\,2} - \sum_{i=1}^{n} t_i \sum_{i=1}^{n} t_i f_i}{n\sum_{i=1}^{n} t_i^{\,2} - \left(\sum_{i=1}^{n} t_i\right)^2}$

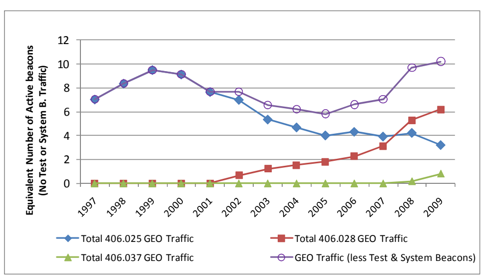
where n=18. The residual frequency variation is given by: $\sigma(t_n) = \left\{ \frac{1}{n} \sum_{i=1}^{n} \left(f_i - At_i - B \right)^2 \right\}^{1/2}$

406 MHz Beacon Message Traffic

Estimated LEOSAR Channel Traffic Evolution – 1997 – 2009



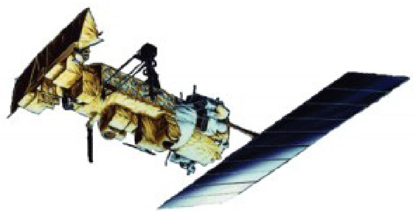
Estimated GEOSAR Channel Traffic Evolution – 1997 – 2009



Forecast of Beacon Message Traffic to 2019

2009 DATA			ELT	EPIRB	PLB	ALL	ELT	EPIRB	PLB	ALL	ELT	EPIRB	PLB	ALL
			2009	2009	2009	2009	2014	2014	2014	2014	2019	2019	2019	2019
Beacon Population (end of year)	P		173,293	477,340	295,144	945,777	261,386	742,672	753,475	1,757,533	285,366	795,099	906,359	1,986,823
Annual Rate of Activation	Ra		0.0720	0.0138	0.0083		0.0720	0.0138	0.0083		0.0720	0.0138	0.0083	
Average Duration of Transmissions	D		54	327	216		54	327	216		54	327	216	
			7.33682E-06	*8.5477E-06*	*3.43351E-06*		*7.3368E-06*	*8.5477E-06*	*3.4335E-06*		*7.3368E-06*	*8.5477E-06*	*3.4335E-06*	
Number of Active Beacons	**NAB = P x (Ra/365) x (D/1440)**		1.27	4.08	1.01	6.36	1.92	6.35	2.59	10.85	2.09	6.80	3.11	12.00
LEOSAR System														
Ratio of coverage	**R leo**		0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Density Factor	**Df (leo)**		4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Peak-Time Factor	**Rt**		4	4	4	4	4	4	4	4	4	4	4	4
Peak Number of Active Beacons	PNAB / P = (Ra/365) x (D/1440) x Rleo x Df(leo) x Rt		*8.83354E-06*	*10291E-05*	*4.13395E-06*		*8.8335E-06*	*10291E-05*	*4.134E-06*		*8.8335E-06*	*10291E-05*	*4.134E-06*	
in LEO Visibility Area	**PNAB = P x (Ra/365) x (D/1440) x Rleo x Df(leo) x Rt**		1.53	4.91	1.22	7.66	2.31	7.64	3.11	13.07	2.52	8.18	3.75	14.45
Population for Self-Test Tr. Observed		745,451												
Observed Self-Test Traffic (2008 / LEO / USA) = OSTT		0.260												
Average Self Test Traffic	ASTT = OSTT / Rleo / Df(leo)	0.9												
Self-Test Peak-Time Factor	STPT	4.0												
Self Test Ratio	STR = ASTT x STPT / P	4.635E-06												
Self-Test Peak Traffic (leo)	**STT = P x STR x Rleo x Df(leo)**					1.32				2.45				2.77
Test Beacons	**TB (leo)**					2				2				2
System Beacons	**SB (leo)**					3				3				3
TOTAL LEOSAR TRAFFIC	**LEO Traffic = TB (leo) + SB (leo) + STT + PNAB**					**13.98**				**20.52**				**22.22**
GEOSAR System														
Ratio of coverage	Rgeo		0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Density Factor	Dfgeo		1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Peak-Time Factor	Rt		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Peak Number of Active Beacons	PNAB / P = (Ra/365) x (D/1440) x Rgeo x Dfgeo x Rt		*9.47551E-06*	*11039E-05*	*4.43438E-06*		*9.4755E-06*	*11039E-05*	*4.4344E-06*		*9.4755E-06*	*11039E-05*	*4.4344E-06*	
in GEO Visibility Area	**PNAB = P x (Ra/365) x (D/1440) x Rgeo x Dfgeo x Rt**		1.64	5.27	1.31	8.22	2.48	8.20	3.34	14.02	2.70	8.78	4.02	15.50
Population for Self-Test Tr. Observed		745,451												
Observed Self-Test Traffic (2008 / GEO / France) = OSTT		0.629												
Average Self Test Traffic	ASTT = OSTT / Rgeo / Df(geo)	1.2												
Self-Test Peak-Time Factor	STPT	2.5												
Self Test Ratio	STR = ASTT x STPT / P	4.083E-06												
Self-Test Peak Traffic (geo)	**STT = P x STR x Rgeo x Dfgeo**					2.00				3.71				4.19
Test Beacons	**TB (geo)**					3				3				3
System Beacons	**SB (geo)**					0				0				0
TOTAL GEOSAR TRAFFIC	**GEO Traffic = TB (geo) + SB (geo) + STT + PNAB**					**13.22**				**20.72**				**22.69**

Error Correction in Beacon Messages



b 25:	Message format flag:	0 = short message, 1 = long message
b 26:	Protocol flag:	1 = User protocols
b 27 - b 36:	Country code number:	3 digits, as listed in Appendix 43 of the ITU Radio Regulations
b 37 - b 39:	User protocol code:	000 = Orbitography 001 = Aviation 010 = Maritime 011 = Serial 110 = Radio call sign 111 = Test 100 = National 101 = Spare

b 37 - b 39: 010 = Maritime user	110 = Radio call sign user	011 = Serial user	001 = Aviation user	100 = National User
b 40 - b 75: Trailing 6 digits of MMSI or radio call sign (modified-Baudot)	b 40 - b 63: First four characters (modified-Baudot) b 64 - b 75: Last three characters (binary coded decimal)	b 40 - 42: Beacon type 000 = Aviation 001 = Aircraft Operator 011 = Aircraft Address 010 = Maritime (float free) 100 = Maritime (non float free) 110 = Personal b 43: C/S Certificate flag b 44 - b 73: Serial No. and other data	b 40 - b 81: Aircraft Registration Marking (modified - Baudot)	b 40 - 85: National use
b 76 - b 81: Specific beacon (modified-Baudot)	b 76 - b 81: Specific beacon (modified-Baudot)	b 74 - b 83: C/S Cert. No. or National use		
b 82 - b 83: 00 = Spare	b 82 - b 83: 00 = Spare		b 82 - b 83: 00 = Spare	

b 84 - 85:	Auxiliary radio-locating device type(s):	00 = No Auxiliary radio-locating device 01 = 121.5 MHz 10 = Maritime locating: 9 GHz SART 11 = Other auxiliary radio-locating device(s)	
b 86 - b 106:	BCH code:	21-bit error-correcting code for bits 25 to 85	
b 107:	Emergency code use of b 109 - b 112:	0 = National use, undefined (default = 0) 1 = Emergency code flag	b 107 - 112: National use
b 108:	Activation type:	0 = Manual activation only 1 = Automatic and manual activation	
b 109 - b 112:	Nature of distress:	Maritime emergency codes (see Table A.4) (default = 0000) Non-maritime emergency codes (see Table A5) (default = 0000)	

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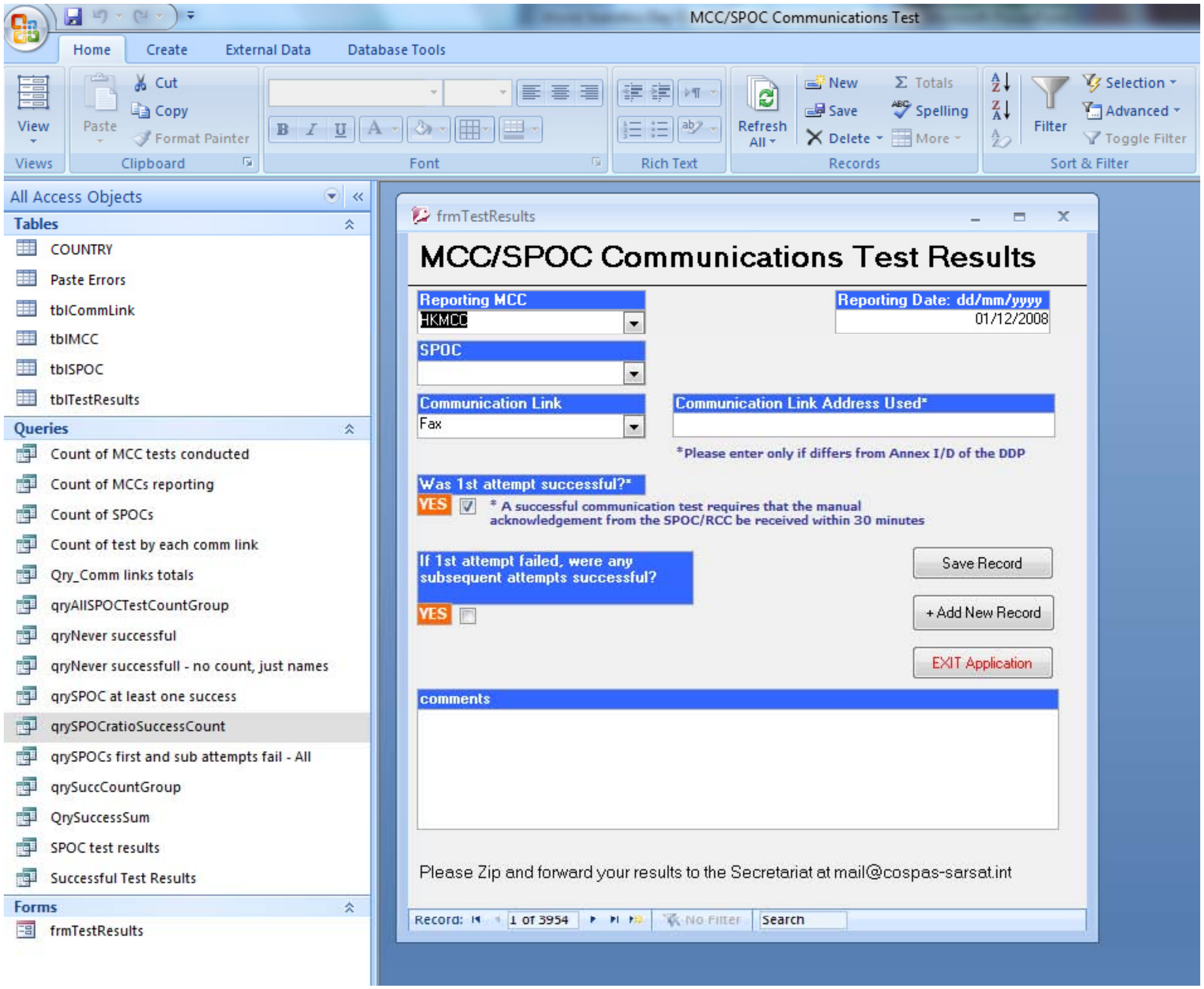
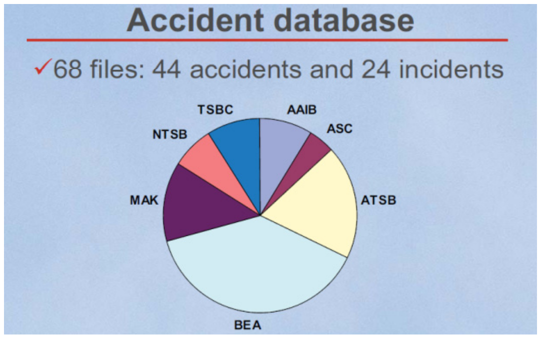
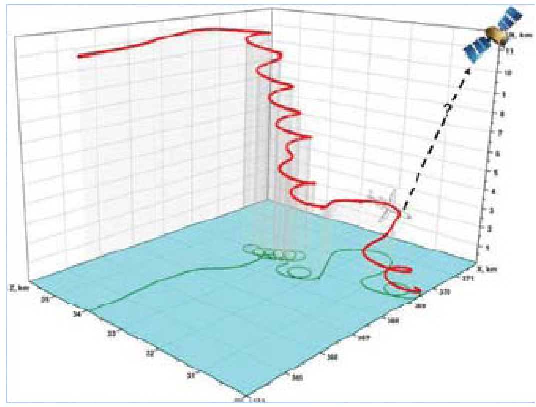
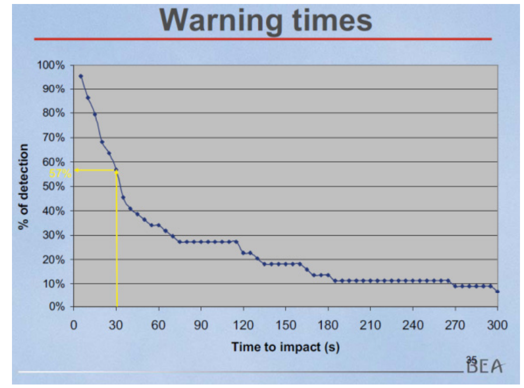
Communication with SPOCs



Next Generation Beacon Operational Requirements







Draft Next Generation Beacon Requirement

3.1.6 Increased Performance in First Thirty Seconds of Distress Alert Transmission

3.1.6.1 Requirement

The beacon shall have increased performance in the first thirty seconds of activation including increased probability of detection and independent location.

1. Increased repetition rate [10 seconds]
2. Increased power [50% increase in power]

Conclusions

Cospas-Sarsat enjoys a global reach with:

- A large SAR customer base and fast growing beacon user base
- Strong involvement of SAR authorities in the management of the Programme, including the definition of strategic goals and objectives

Statistics are important:

- Monitor and enhance the quality of services
- Take advantage of new technologies (next generation beacons)
- Assist customers and users to ensure full and proper use of the System (reduce false alerts, improve beacon registration)