Welcome to the NOAA Satellite Operations Facility

S A R S A T

US SARSAT Program Partners

United States
Cospas-Sarsat Program Administration

Inland SAR	Maritime SAR	Research & Development	System Operation
U.S. AIR FORCE	UNITED STATES COAST GUARD 1790	NASA	NOAA

Representative to Cospas-Sarsat Program

What is Cospas-Sarsat???

COSPAS = **Cosmicheskaya Systyema Poiska Aariynyich Sudov**

Which loosely translates into: "The Space System for the Search of Vessels in Distress"

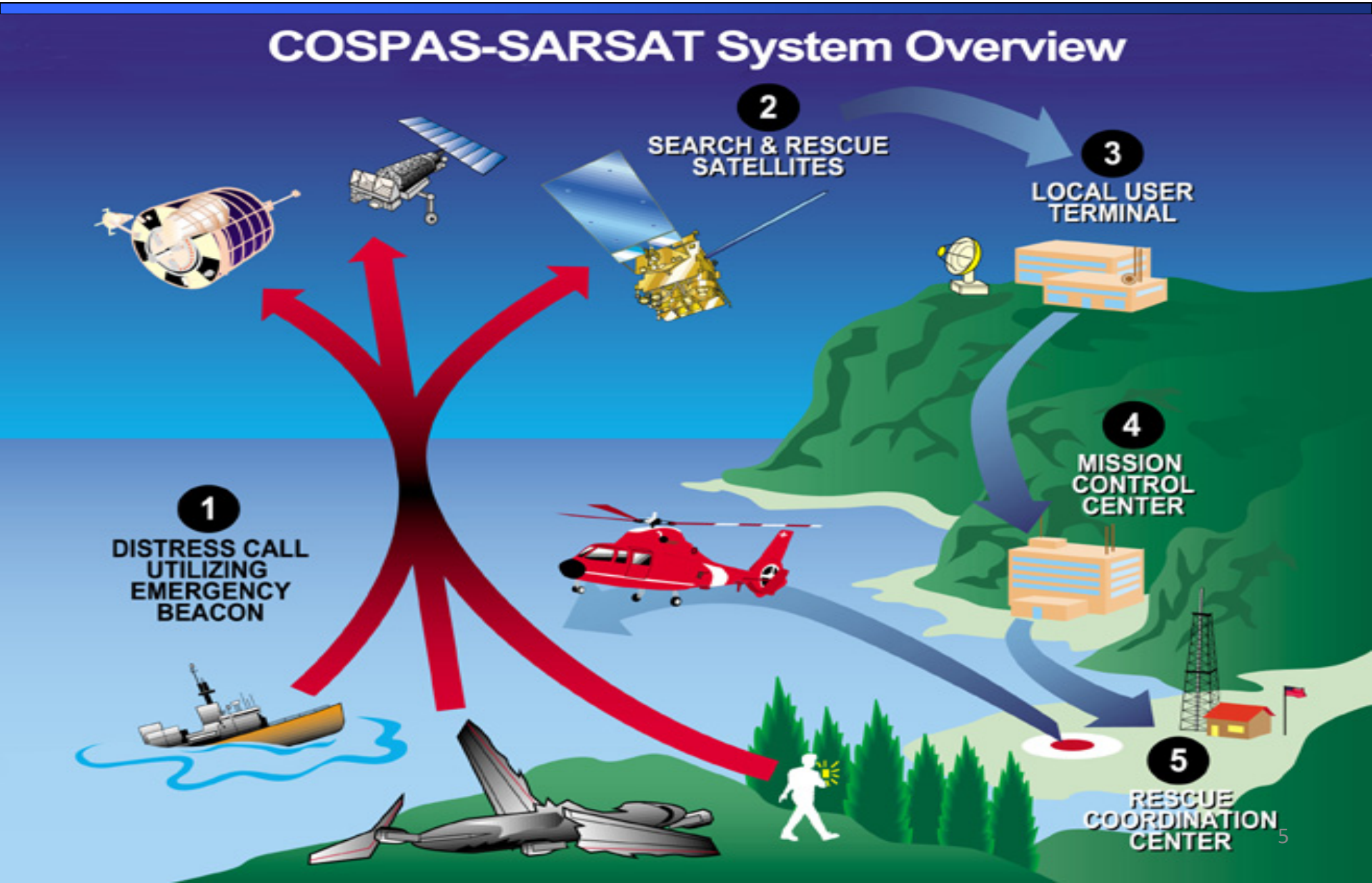
SARSAT = **Search And Rescue Satellite Aided Tracking**

In short, COSPAS-SARSAT takes the "search" out of Search & Rescue

Who makes up COSPAS-SARSAT?

International Cospas-Sarsat Partners: 40 member nations

How does it work?



Emergency Beacons

- Frequency: 406.025 - 406.050 MHz channels currently open
- Four applications:
  - Emergency Position Indication Radio Beacons (EPIRB) *for Maritime Distress*
  - Emergency Locator Transmitters (ELT) *for Aviation Distress*
  - Personal Locator Beacons (PLB) *for Remote Recreational Distress*
  - Ship Security Alerting System (SSAS) *for Maritime Security (Piracy and Terrorism)*

LEOLUT (Ground Station) Status

44 LEOLUTs in 27 countries

U.S. operates 5 LEOLUTs:

- Suitland, MD (USMCC)
- Miami, FL
- Fairbanks, AK
- Honolulu, HI
- Anderson AFB, Guam

SARSAT LUT Locations in the US and Protected Territories

	Earth Station	Longitude				Latitude				Altitude
		Deg	*Min*	*Sec*	*E/W*	*Deg*	*Min*	*Sec*	*N/S*	[m]
MD	LUT 1 (GEO)	76	55	52	W	38	51	04	N	43
	LUT 2 (GEO)	76	55	48	W	38	51	04	N	39
	LUT 3 (GEO)	76	55		W	38	51		N	
	LUT 4 (LEO)	76	55		W	38	51		N	
	Goddard LUT	76	51	05	W	38	59	44	N	105
FL*	LUT 1	80	22	59	W	25	36	58	N	138
	LUT 2	80	22	59	W	25	36	58	N	138
AK	LUT 1	147	31	26	W	64	58	37	N	292
	LUT 2	147	31	34	W	64	58	41	N	292
HI*	LUT 1	157	59	46	W	21	31	16	N	425
	LUT 2	157	59	46	W	21	31	16	N	425
GUAM	LUT 1	144	56	20	E	13	34	41	N	184
	LUT 2	144	56	20	E	13	34	41	N	184

Cospas Sarsat Interference

Historical and reference documents

Cospas/Sarsat space segment providers have developed a protection criteria for the Cospas-Sarsat search and rescue instruments and local user terminals, respectively, in the 406.0-406.1 MHz (uplink) and 1544-1545 MHz (downlink) bands in order to protect them against broadband out-of-band emissions and against narrow-band spurious emissions. These protection criteria have been recognized at ITU level through two specific documents: ITU-R M.1478-1 for the protection of the 406.0-406.1 MHz band and ITU-R M.1731-1 for the protection of the 1544-1545 MHz band.

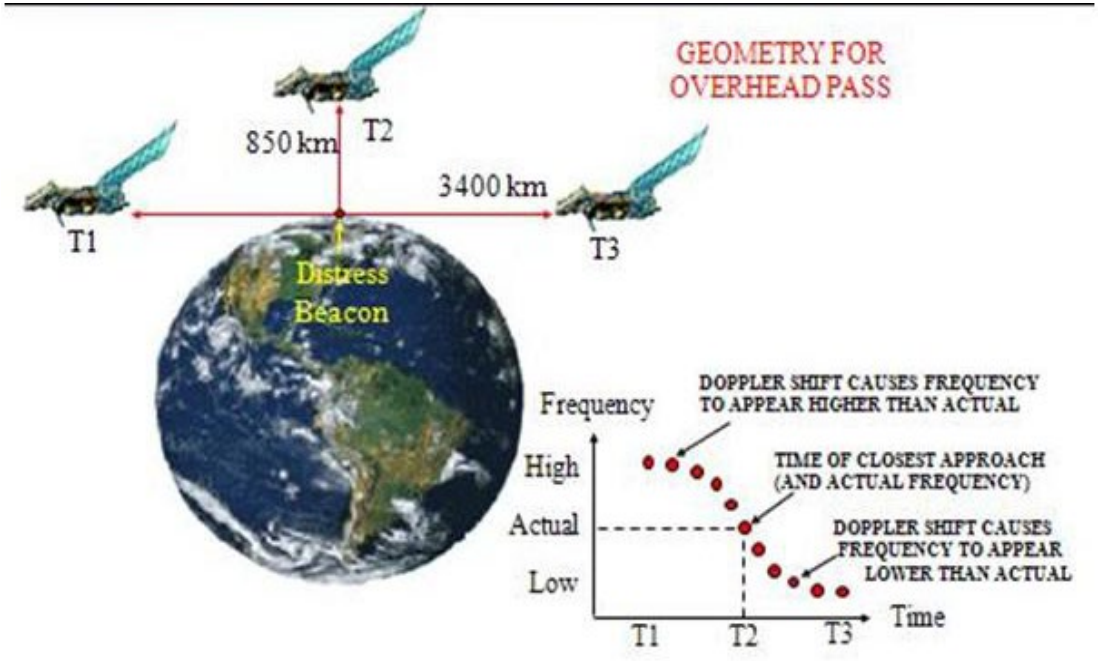
Protection criteria from adjacent band emissions

While the protection criteria developed in documents ITU-R M.1478-1 and M.1731-1 provide allowable power flux-density requirements against broadband out-of band and narrow band spurious emissions for the frequency bands used by the Cospas-Sarsat systems, they do not provide protection against "strong" emissions in adjacent bands. Emissions in adjacent bands, if not adequately controlled, could raise the level of noise captured by the Cospas-Sarsat systems and hinder their abilities to detect and/or relay signal from beacons.

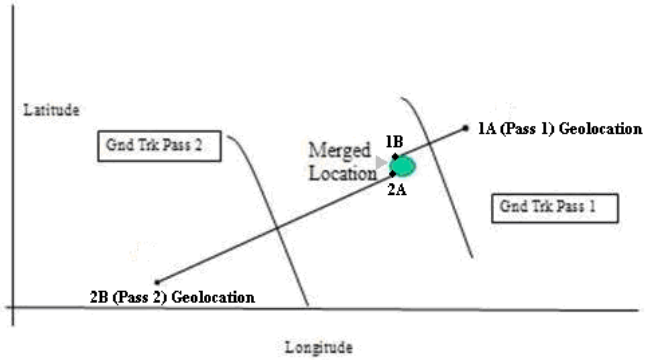
Mitigation and resolution of in-band interferers

While the 406-406.1 MHz band used for SARSAT uplink has discrete narrowband channels allowed for operational use, interference sources are present worldwide, in the band. The accurate detection, location and elimination of these interference sources is critical to maintaining the functionality of the SARSAT space segment in detecting actual distress beacons. The 1544-1545 MHz band used for SARSAT downlink is managed effectively at the International Cospas Sarsat level, but, any user outside of the SARSAT community needs to be identified and rectified.

How Doppler Processing works



An important point to note is that the Doppler-localization process actually yields two possible locations, one on each side of the ground track, referred to as the "A" side and "B" side geo-locations. This creates an ambiguity which requires additional information to resolve, such as a second satellite pass which provides a second Doppler solution and resolves the ambiguity.



Automated Interference Monitoring System (AIMS)

Interferers

Two other interfering signals can be seen beginning about 80 seconds after AOS at about 14 kHz and 60 kHz. Doppler localizations could be made for both of these interfering signals. Doppler localizations can be determined for each of the interfering signals which make up the broad-band spectrum shown (approximately 40 signals spread across the band (resulting in 40 pairs of estimated locations) using the AIMS.

Eight (8) countries have LUTs monitoring the LEO satellites which have proprietary software that allow the LUT to maintain a database of interfering signals which is sent to its associated Mission Control Center. On a monthly basis, each participating country uses the interference data bases from its LUTs to prepare a Monthly 406 MHz Interference Report for the ITU.

US Interferer Location and Reporting

Background

In the United States, interfering signals in the 406.0 – 406.1 MHz band are detected and processed by the USA LUTs. The resulting location approximations are sent to NOAA's Automated Interference Monitoring System (AIMS) which analyzes the data to determine if a persistent interferer is present. When enough data of sufficient quality is collected so that the interference source is statistically within 12 km of the estimated position, the latitude and longitude of the estimated position are provided, automatically via AIMS, to the FCC's Centralizing Office (the FCC Operations Center). Although radio interference in all three frequency bands has been a continuing problem for the Cospas - Sarsat System, only interference in the 406.0 - 406.1 MHz band is analyzed by the AIMS. At present, all AIMS location communication is via Fax.

AIMS – FCC Reporting Procedure (internal to US)

The AIMS monitors the interference site database solution files for interferers which are estimated to lie within the FCC area of responsibility.

The AIMS computes an estimated search area radius, which is updated in near real time as new solutions are added to the database.

When at least eight satellite overflights have detected interference, and the estimated search area radius is less than 12 km, the AIMS sends its automated message to the FCC. Note: Both of these parameters (number of satellite overflights, and search area radius) are readily changed

406 MHz Monthly Report Format

406 MHz ITU Monthly Report Format

Reporting Period (DD Month - DD Month YY)

Site ID Number[2]	Location				Search Area[8] (probable search radius from mean location)	Mean Latitude (degr. & decimal parts of degree)	Mean Longitude (degr. & decimal parts of degree)	Median Detected Freq. (MHz)	Modulation Charact.[3]	Impact on System[4]	Monthly Detection Ratio[5, 6] (number/ total number of passes in visibility)	Monitoring Period		Times and Days of Week of Occurrences				Number of Observations (number since last report and total)		Other Details
	Country	Nearest City	Direction	Distance (km)	(km)							First Date of Occur-rence	Last Date of Occur-rence	Date	Day of Week	Start Time	End Time	Current Period	Total	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
MID123456	Text	Text	NE,W, SW, etc.	nn	nn	±nn.nn	±nn.nn	406.nnn	N/ME/PE	H/M/L	0.nn	DDMonthYY	DDMonthYY	DDMonthYY	Sn,M, Tu,etc	HH: MM	HH:MM	nn	nnnn	Text
MID123457																				
etc.																				

Final thoughts

Future

The current operational LEO satellites have filtering that didn't account for adjacent band power levels of 2015 and beyond.

Implementing new payloads with sufficient filtering is not possible for US until 2026 (US SAR/GPS).

In the interim, interference monitoring, reporting and elimination is critical to the operational Cospas-Sarsat system.

The current MEOLUTs utilizing the DASS payloads allow for temporary monitoring of the bands adjacent to 406-406.1 MHz as the experimental payloads have a "wider" bandwidth that covers the 50 KHz on the upper and lower sides of the band.

Questions?

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