UN/South Africa Training Course on Satellite Aided Search and Rescue

Cape Town, South Africa

20-24 November 2006

Low Cost Beacons and SSAS

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Montreal

Source: CNES – D. Ducros

Low Cost Beacons…

Why?

- Phase-Out of 121.5 MHz Satellite Alerting Services
- Phase-Out of Inmarsat L-band EPIRB

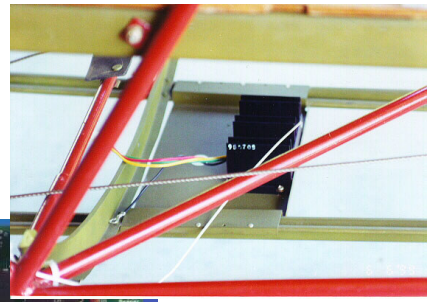
What?

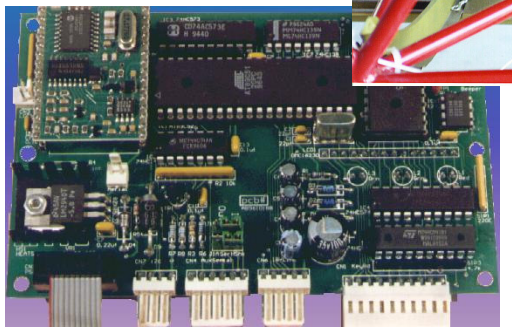
- Increased pressure to approve non-compliant beacons as “compatible”
- Are beacons already “low cost”?

~US $400

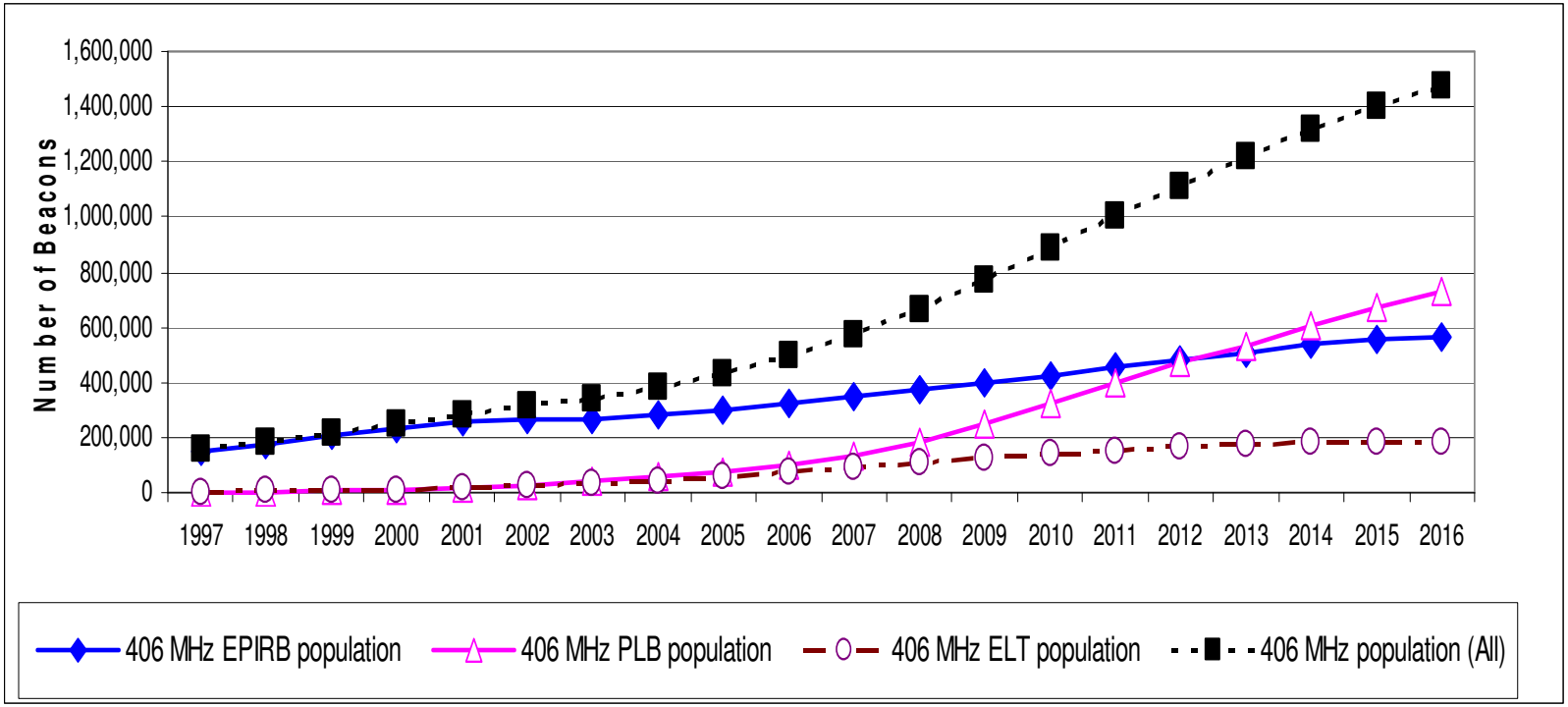
What determines the cost of a 406 MHz beacon?

- Design / Manufacturing **costs**
  - electrical characteristics, compatibility with the satellite system
  - specified by Cospas-Sarsat
- Operations **costs**
  - installation and maintenance costs
  - specified by Administrations and organisations (e.g. RTCA, RTCM, EUROCAE)
- Testing and certification **costs**
  - spread over sales volume
- **Price** is affected by
  - market demand – sales volume
  - level of competition
  - decisions made at the national level





406 MHz Beacon Population Survey Results and Forecast to 2016



Future population growth affected by:

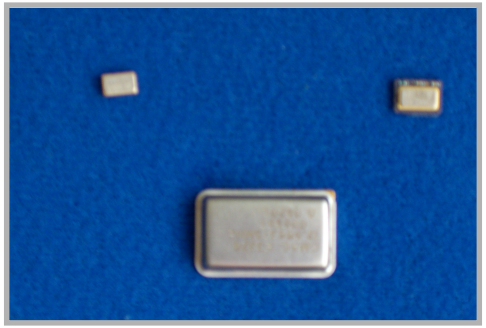
- 121.5 MHz processing phase-out
- international regulations, e.g. ICAO carriage requirements
- loss of L-band EPIRB alerting services

What determines the cost of a 406 MHz beacon?

- Document C/S T.001, “Specification for Cospas-Sarsat 406 MHz Distress Beacons” specifies:
  - minimum operating time (24 hours)
  - temperature range of operating conditions (Class 1: -40°C to +55°C, Class 2: -20°C to +55°C)
  - stability of the transmitted frequency
  - signal characteristics and power output required
  - antenna characteristics
  - etc.
- IMO/ICAO require an auxiliary 121.5 MHz radio-locating device at another frequency (T.001 does not)
- Cost of components to meet these specifications
  - more efficient components draw less power
  - standardization of components, e.g. prefabricated RF circuitry and GPS receiver modules
  - technology changes, e.g. oven-controlled (OCXO) vs. temperature compensated (TCXO) oscillators

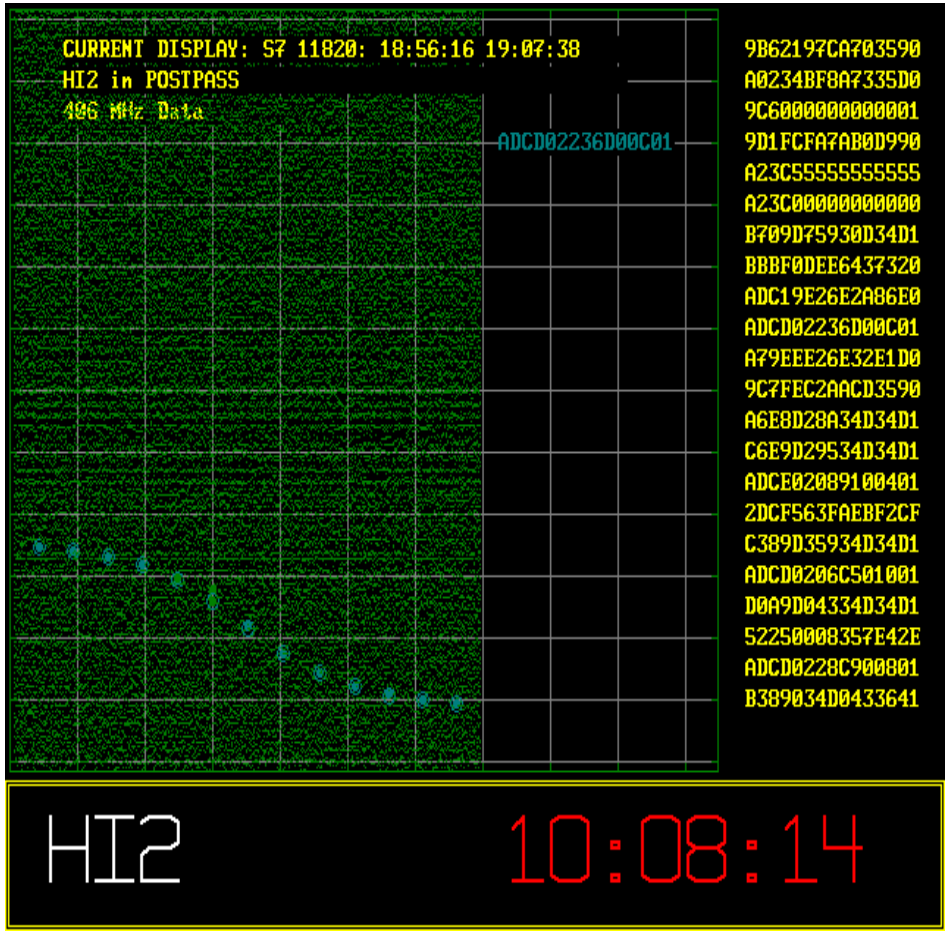
Lower the Cost ?

- Components become less costly over time and market demand may increase
- Cospas-Sarsat conducted tests and determined that improvements in LUT processing allow relaxation of beacon medium term frequency requirement without impacting overall System performance
  - specifications were changed in 2003
  - allowed the introduction of the TCXO
- Other ideas…
  - reduce the required battery power
  - remove the auxiliary “homer”
  - change installation requirements, e.g. authorise use of PLBs (with G-switch?) rather than fixed ELTs

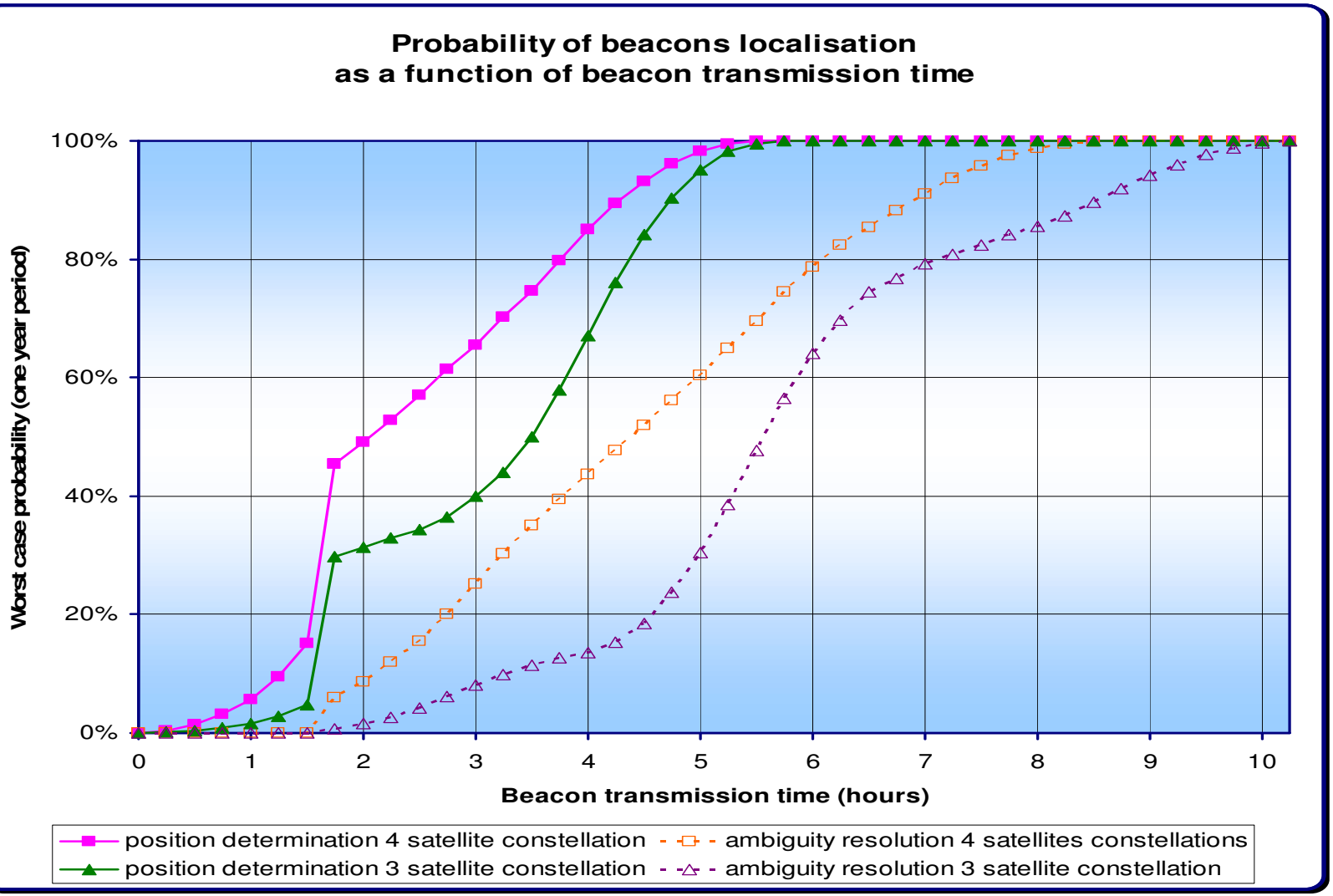


Transmission Frequency Stability

- Stability of the frequency of transmissions directly affects the accuracy of the Doppler location
- Medium term frequency stability is defined as the stability of the frequency of transmission over 15 minutes and is a cost driver (beacon's oscillator)



Minimum Operating Time



Compatible but not Compliant

- Proposed distress alerting device with an operating temperature range of +5ºC to +50ºC and a guarantied minimum life time of 16 hours
- At CSC-37 (Oct 2006), the Council decided that
  - no waiver could be issued for beacons/devices that did not meet the minimum operating temperature requirement of –20º C
  - the current Cospas-Sarsat policy did not allow granting letters of compatibility for commercial products aimed at the general public

Compatible but not Compliant

- IMO GMDSS EPIRBs – 48 hour required transmit time
- C/S Letters of Compatibility have been issued:
  - when 24 hour minimum lifetime cannot be guaranteed in all circumstances (e.g. have an operator controlled ancillary device)
  - for devices to be used by trained military personnel, under the responsibility of the Administration

UKMCC: 19 Dec 2003

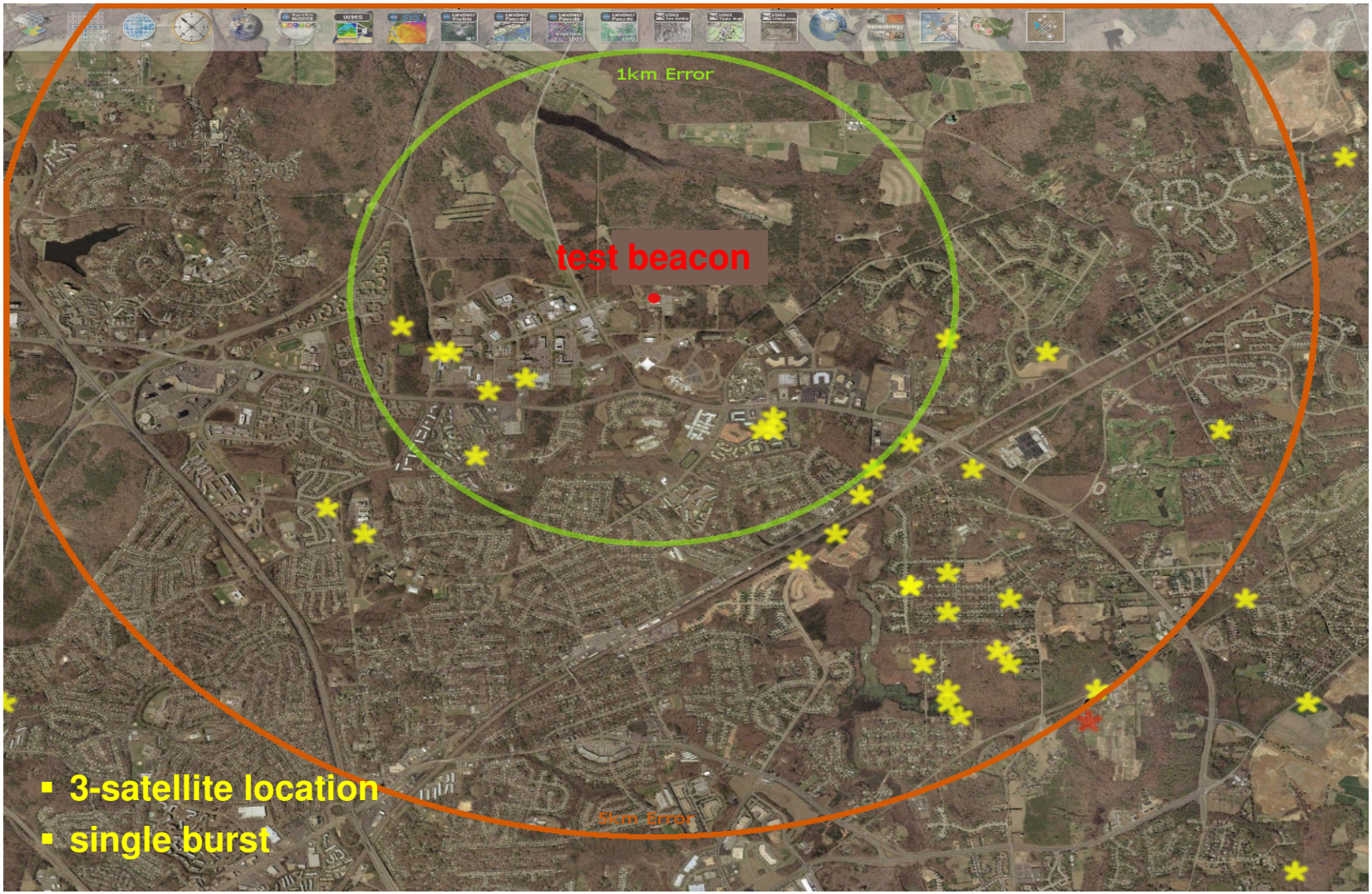
"It is an incredible system and no-one does it better… If the people who came for us did not have the proper co-ordinates they would never have found us."

--- Jennifer Murray

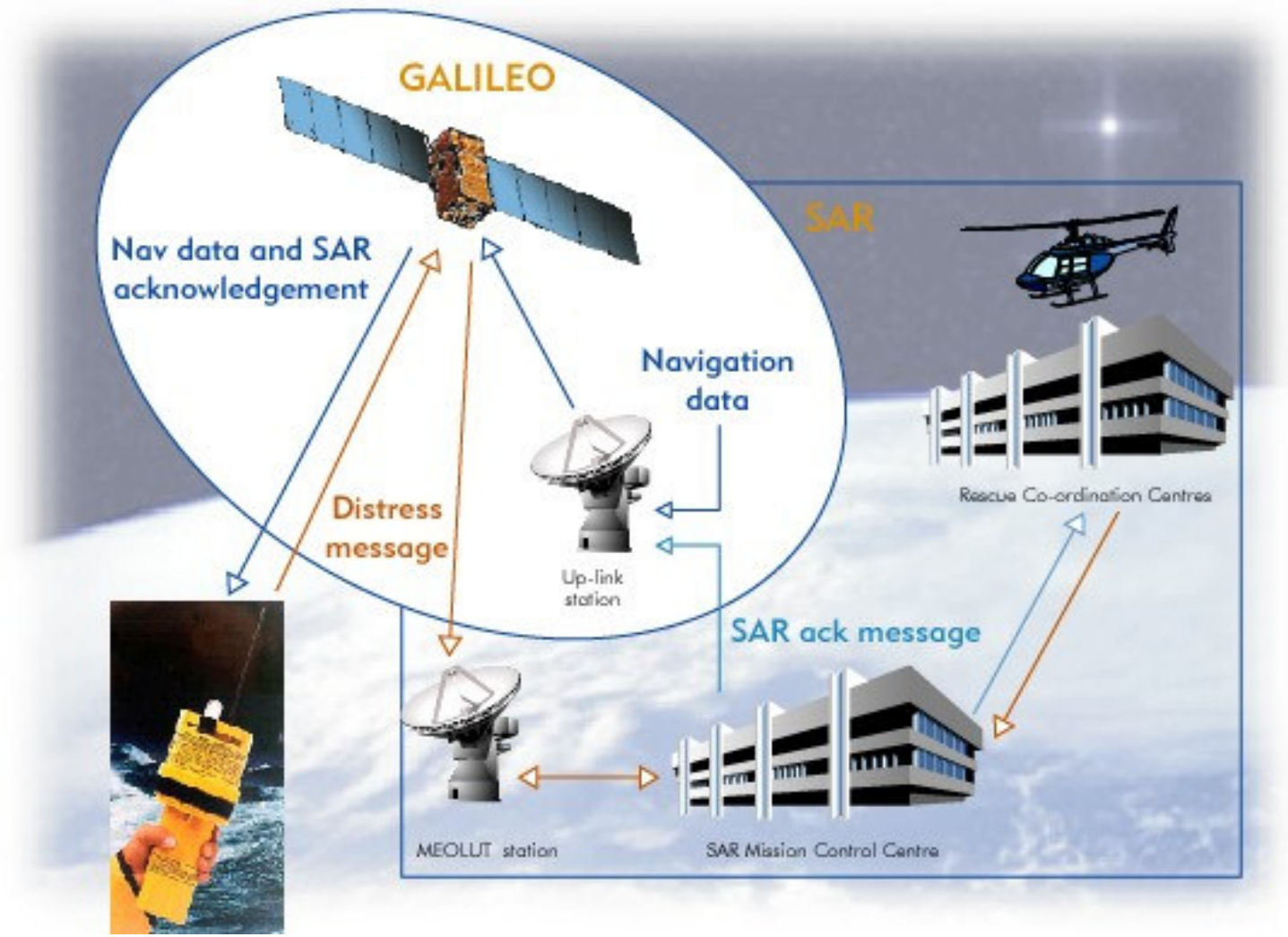
Beacons in the MEOSAR Era

- MEOSAR – 2012
  - a highly stable transmit frequency will likely not be required for beacon location
  - may allow a change in transmission pattern, lowering battery power requirements
- Galileo's Return Link Service may drive development of new beacon technologies

NASA Search and Rescue Mission Office
Distress Alerting Satellite System (DASS)



MEOSAR Concept



Ship Security Alert System

- Requirements for SSAS were outlined by IMO in SOLAS Chapter XI-2
  "Special Measures to Enhance Maritime Security"
- C/S implemented an SSAS service based on 406 MHz transmitters as decided at CSC-31 (October 2003)
- Minimal modifications to the System were implemented and tested by the IMO required date (1 July 2004)

SSAS Implementation

- Two major elements: transmitter and a methodology for data distribution

- Modification to C/S document T.001 provides for:
  - Beacon coding protocol to indicate SSAS
  - Accurate GNSS encoded information
  - Requires the use of vessel MMSI for beacon identification
  - Prohibits the use of a 121.5 MHz homing device to make transmissions more covert

406 MHz Ship Security Alert System: Data Fields of the Long Message Format

	Bit Synchronization	Frame Synchronization	First Protected Data Field (PDF-1)				BCH-1	Second Protected Data Field (PDF-2)	BCH-2
Unmodulated Carrier (160 ms)	Bit Synchronization Pattern	Frame Synchronization Pattern	For-mat Flag	Protocol Flag	Country Code	Identification plus Position Data	21-Bit BCH Code	Supplementary and Position	12-Bit BCH Code
Bit No.	1-15	16-24	25	26	27-36	37-85	86-106	107-132	133-144
	15 bits	9 bits	1 bit	1 bit	10 bits	49 bits	21 bits	26 bits	12 bits

C/S doc A.001 Table III/B/4: Protocol Validation
C/S doc T.001 Table A.2: Protocol Code Assignment

Protocol Codes
Bits 37 - 40 = 1100
SHIP SECURITY

SAMPLE MESSAGE FOR
SIT 185
406 MHz SHIP SECURITY ALERT
(to be transmitted only to competent security authority)
(LEOSAR - with encoded position)

1. **SHIP SECURITY COSPAS-SARSAT POSITION RESOLVED ALERT**

2. MSG NO. 17002 UKMCC REF 12345

3. DETECTED AT 10 JUL 04 2130 UTC BY SARSAT 09

4. DETECTION FREQUENCY 406.0281 MHZ

5. COUNTRY OF BEACON REGISTRATION 232/G.BRITAIN

6. USER CLASS – SHIP SECURITY WITH ENCODED POSITION – MMSI LAST SIX DIGITS 387718

7. EMERGENCY CODE - NIL

8. POSITIONS
   RESOLVED - 55 23.2N 022 29.9W
   DOPPLER A - 55 19.1N 022 25.4W
   DOPPLER B -
   ENCODED - 55 23.2N 022 27.0W
   UPDATE TIME UNKNOWN

9. ENCODED POSITION PROVIDED BY EXTERNAL DEVICE

10. NEXT PASS TIMES
    RESOLVED - 10 JUL 04 2201 UTC
    DOPPLER A - NIL
    DOPPLER B - NIL
    ENCODED - NIL

11. HEX ID 1D18BD50C0FFBFF

12. ACTIVATION TYPE - MANUAL

13. BEACON NUMBER ON AIRCRAFT OR VESSEL - NIL

14. OTHER ENCODED INFORMATION
    A. ENCODED POSITION ACCURACY - 4 SECONDS

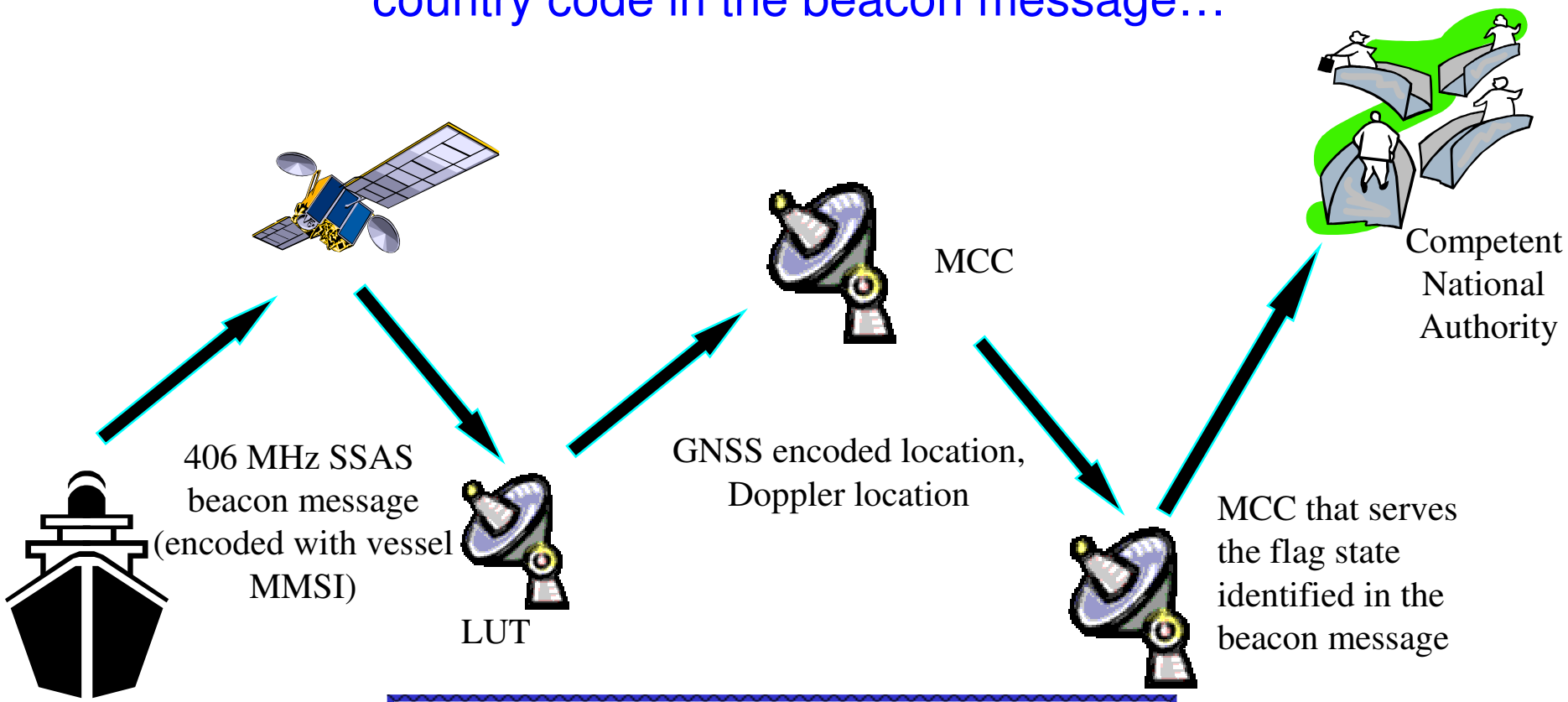
15. OPERATIONAL INFORMATION
    REGISTRATIONAL INFORMATION AT UKMCC
    TELEX: 75194 UKMCCK G
    AFTN: EGQPZSZX
    TELEPHONE: (44-1343) 836015

16. **REMARKS-This is a ship security alert. Process this alert according to relevant security requirements.**

END OF MESSAGE

Alert Distribution Procedure

…in the C/S system, the alert is processed according to the same procedures that apply for 406 MHz distress alerts except that the resulting ship security alert message is forwarded based only on the country code in the beacon message…



C/S doc. A.001 Annex III/B.9-11 Alert Distribution

SSAS

- The Cospas-Sarsat specification only deals with the electrical and transmission requirements that ensure the compatibility of the SSAS beacon with the satellite processing system
- Administrations should define national requirements for 406 MHz SSAS beacon activation and installation
- Administrations should register their “competent authority” with IMO and contact their supporting MCC to establish an appropriate method of distributing SSAS alerts

Currently…

- Two type-approved SSAS beacons are available for commercial sale
- Several Administrations have elected to use C/S as one approved method for ship security alerting

SSAS Population and Forecast

Country	2005	Forecast	
		2010	2015
Algeria	11	NA	NA
China	0	1,000	2,000
Hong Kong	0	1,000	1,500
Norway	0	50	100
Thailand	0	50	50
UK	0	500	1,000
USA	7	500	1,000
Total	18	3,100	5,560


6559
U.S. COAST GUARD
Questions
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