

# Satellite Detection of AIS-SART-EPIRB Sea Trials

2010 Beacon Manufacturers Workshop San Diego, 21 May 2010 Jim King



#### **Automatic Identification System (AIS)**

- Collision Avoidance and Traffic Management System
- Installed on more than 70,000 vessels
- AIS carriage requirements increasing



- AIS Transponders emit VHF signal
  - Automated
  - Dynamic
  - Short range (50 nm)
- Standard message content includes:
  - Vessel Identification
  - GPS Position
  - Course and Speed

Satellite AIS shifts detection of signals into space, <u>extending range</u> of the system and <u>creates new</u> <u>applications</u>

Source: USCG Navigation Center

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# **AIS Search & Rescue Sea Trials**

- COM DEV has:
  - been developing and building a global Satellite-AIS system to detect these devices
  - set up new data services company: exactEarth Ltd
- We were invited to participate in AIS Search and Rescue Sea Trials organized by:
  - USCG U.S. Coast Guard ; and
  - IALA International Association of Marine Aids to Navigation and Lighthouse Authorities
- Our NTS (nano-satellite for Tracking of Ships) was used to detect AIS signals from new types of SAR devices
- Sea Trials conducted in Hawaii on 20-21 Jan 2010





#### **AIS-SART Transmissions**

•For 20 years, SARTs were SAR "Radar Transponders" for use in life rafts

AIS Search and Rescue Transmitters : AIS-SARTs :

new devices authorized by IMO from 1 Jan 2010
Low-power, battery operated devices
designed for use in life raft or in water by users in distress
Intended for detection by nearby vessels to assist in rescue

Only 1/10 as strong as regular Class A AIS on a vessel (1 Watt vs 12.5 Watts)

- AIS-SART antenna usually near the water, and bobbing in the waves
- Adding AIS transmitter in a 406 MHz EPIRB could facilitate homing

• Transmits a special message defined by ITU: 8 quick bursts each minute, alternating on channels AIS 1 & AIS 2:



#### Taking AIS to the next level



- AIS today globally deployed, locally used
- ~70,000+ transponders, many years of successful operation
- –>\$1B invested in coastal AIS monitoring systems
- Satellite AIS detection 'takes AIS global'
- Enables a range of new capabilities for AIS
- Does NOT require any change to the ship's equipment
- Advanced Satellite detection technology is a must
  - Satellite may see up to 8,000 ships at once, must be able to resolve these overlapping signals



#### The Results – from NTS Demo Sat





# North Atlantic Satellite AIS Coverage

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#### **Northern Australia**

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Fortune Touchet Tide Sea Riches 📥 Jayne-I Fu Xiang Xing Medi Singapore Chemroute Sun Best Lucky Best Lucky Fortuna Reefer 👝 Fortuna Reefer 🗍 🖓 Magenta Pelagia 🍙 Pelagia Probity Nightwhisper 477103000 - 477103000 Nanaumi Nanaumi Sea 1193046 Brave Wind reer Geo Atlantic A Star Pollux Ceram Sea Agios Spyridon Agios Spyridon CSCL Dalian CSCL Dalian Lee Ling 88 Shin Ho Chun No 102 Tanto Sejati Nicos L Tidar Tidar Kirana Tritya Minas/Pertamina 35 📥 Kota Kado 👝 Kota Kado Ciremai 🌰 Dyna Crane 📥 Dyna Crane Star Zulu Star Zulu Cape Daisy 📥 Infinity 🔿 MCP Blankenese Marigo P: Marigo P. Katherine L. Maritime Coaction A Hera 477103000 Shinta Shinta Sanko Spark Man Hai Astrale Fu Heng Star Valente Venus 🖄 Valente Venus Bukit Siguntang 🙈 Triton werpennjeliersgracht 525008001 👝 Bergen Surveyor Western Enterprise Azalea Galaxy ing Hai Caesar Caesar Theo T. Theo T Ocean Cougar Silver Sea Line Seven Seas Wan Dong 02 Clipper Kamoshio Western Endeavour 🖌 Western Endeavour Sun Flower Jaya Niaga III-9 Doro Londa 🔶 Jatianom PB 400 Emerald Hanjin Roberts Bank Griya Dayak Aruni Rickmers **Kikori** Chief ndiri Delapan 🔶 Ocean Seal Morobe Coast YM Equality C.Utopia Java Sea 6 Lepta Galaxy 👝 Lepta Galaxy Kiunga Chief 🛆 Kiunga ChieGoada Chief Multi Spirit TritorOcean Planet Voge Renate A Pacific Triangle Perjaya I Priam Priam Caladium Ocean Lord Shine HoHanjin Port Kembla 525017043 St.Katharinen 👝 St. Katharinen matYunita Grace River Nan Shan Nan Shan Western Enterprise GL-La Paz 👝 Maritime Setoshio 👝 Ellida Ace 👝 Bougainville Coast Western Star Boral Gas Bass Bulker IDAS Bulker Cape Conway Carnat Crest Radiant 1 Adriatica Asian Lily Powhatan 🙈 Powhatan Paimpol A 5030101 5030101 SC Brave Lowlands Patrasche A Lowlands Patrasche SC Brave High Energy, nggara Sa Alantic Trader Atlantic Trader Mundu 0.0 Mundu udip Ikan Sudip Molunat Molu 215076000 Ryoei M Lowlands Maine Lowlands Maine Brilliant River Ploneer 🚔 Adriatica Graeca Peteka 5401 Minh Tho 18 Ken Yu Sea Harvest 636006587 Oriental Princess 5030045 Axios Ocean Globe Britanniaver Example TIM Piramu 352104000 Global Discovery Global Discovery Corona Ace Barramundi Stella Maria Chemroad Haya Chemroad Haya MCP Salzburg BalzoHakufu Hakufu Pacific Leo Cemtex Renaissance 5030098 RidleyThomas Spring Fortune Advance II 353997000306563000 🚔 306563000 Molunat 👝 Molunat Mare Verde Halifax Bay Tai Gu Hai Prabhu Mihikaa 🤗 Prabhu Mihikaa Matsushima Intwerpen Katsue Fourcroy Ocean Concord Ocean Concord Jimrich 📥 Jimrich Lincoln Expressivos 5504 WOS 5504 Svitzer Forti Svitzer Brani Torm Bornholm \_\_\_\_\_Madrisa Kinei I New Irene Corona Emblem C.Royal Blue Jasper **Biquele Bay** Energy Progress River Embley Warrender Warrender Elora Pionee Carrera int 📥 Challenge Point Marrakai Pacific Titan Lady Valisia Stolt Transporter Constant Stolt Transporter A Maliksia A Nizo Panthera 0 Forestal Gaia Successor 503053000 503053000 aesar 📥 Ocean Caesar 🙆 Sun Princess 🍙 Sun Princess Darwin 219305000Alaknanda 📥 Namhae Gas 📥 ANL KokodaMichele Bottiglieri Guofeng First Talent 👝 Talent Jin He 👝 Jin He 🚔 Hansa Lauenbu whisper 📥 Nightwhisper 503010Beluga Fantastic 🛛 👩 Cielo di Amalfi Bulk China\_ady Caroline Kerry Express Java Sea Laurel Express 15 Groote Evlandtaki Maru 📥 Kunisaki Maru 🛛 Pepito Tourmaline A.M.S. 23 Pacific Challenger 5030079 5030078 5030078 Ming May 📥 Ming May354284000 Seal 256915000 Marina Pacific 2 Marina Pacific 2 Aburri Ocean MatMOL Trumph VogebulkerNSS Confidence Lady Astrid Pacific Responder MSC Chitra MSC Chitreshin Tonami NO. eral Sines 🙆 🦨 Southern Surveyor 🌰 V-Rod Pacific Horizon Full Sour Shin Seto Svitzer Doolja 📥 Svitzer Doolja Semirio 📥 Semirio Brisbane Brisbane little Prince © 2010 Google Hyundai Olympia 👝 Hyundai Olympia 5030107 TA DO Daewoo Spint 2009 © 2010 MapData Sciences PtyLtd, PSMA 5030053 VOC Rose Hanna C. A Hanna C. Map Data © 2010 AND 5030054 Ena Jade Cape Condor Jul Sofus K. A Jul Sofus K. © 2010 Tele Atlas Cielo di Vancouver Cielo di Vancouver RZS Fortune RZS Fortune 131°35'14.42" E elev 0 m Chloe Chloe, Sun Ruby 564237Eye alt 3454 49 km 3°21'59.95" S



# **Our Satellites for AIS**

- Satellites pass over North and South Poles, like C-S LEOSAR system
- at 850 km altitude, satellite circles the globe in 100 minutes
- Moving satellite "footprint" is about the size of a continent (~5,000 km dia)
- From Earth, satellite moves across the sky in about 10 minutes
- Satellite remains in one orbital plane and the Earth rotates beneath it
- Therefore, <u>one</u> satellite scans the <u>entire</u> globe in less than half a day
- More satellites coming soon...





# **Our S-AIS Principle of Operation**

- Each satellites continually receives AIS signals from all ships in its footprint (1000's of ships !)
- Signals stored in satellite memory
- Memory data is encrypted & replayed as satellite passes over next ground receiving station
- Encrypted data is fed to the Data Processing Centre where AIS signals are extracted and forwarded to authorized users
- Soon will have multiple satellites for faster coverage (3 plus 3 more)





### **NTS Satellite passing over Hawaii**

20/01/10 19:34:54 UTC Time frozen



- Data collected from the AIS transmitters as satellite passed over Hawaii
- Data collected for about 1 to 1.5 minutes and stored in NTS satellite memory
- Data downloaded to ground station / processing centre in Canada



# **AIS Test Signals**

• 5 different test units activated for sea trials near Hawaii:

1 AIS-EPIRB at 1 Watt
3 AIS-SARTs at 1 Watt
1 AIS Class A at 12.5 Watt (that incremented its MMSI number every 2 sec)

•AIS devices deployed in water, above water, on floating lifejacket or on vessel

 In addition, many ships in the Pacific Ocean were transmitting regular AIS signals





#### **AIS-EPIRB Floating in water**



# AIS-SART- On life jacket in water





#### **AIS-SARTs- Floating 1m above water**





#### **AIS-SARTs- on vessel railing**





#### **AIS-SARTs- on vessel railing**





## **Satellite Detection of AIS Signals**

All 5 AIS Test Units
 were detected by the
 COM DEV NTS satellite

 In addition, about 270 – ships in satellite footprint were also detected





# **Satellite Detection of AIS Signals**

# Zooming in shows the unique MMSI number of each ship's AIS transmitter:



#### **NTS Satellite Passes**

#### •NTS satellite passes during test period:

Day 1: 20 Jan 2010 at 19:34:54 UTC (= 09:34:54 Hawaii time)
Satellite collected AIS data for 90 seconds
Elevation angle to the satellite = 14 degrees
Distance to the satellite = 1,800 km

•Day 2, 21 Jan 2010 at 19:53:54 UTC (=09:53:54 Hawaii time)
•Satellite collected AIS data for 60 seconds
•Elevation angle to the satellite = 25 degrees
•Distance to the satellite = 1,300 km

•Multiple AIS bursts received from each Test Unit, approx equal number on each AIS channel (AIS 1 & AIS 2)

•GPS position encoded in each message was plotted on map



### Satellite Detection – Day 1

2 AIS-SART Test Units were deployed on day 1
Floating in water, about 1nm off the coast of Hawaii
COM DEV satellite collected AIS data for 90 sec

•AIS-SART MMSI 970010118 detected several times

•AIS-SART MMSI 970010119 was also detected by the satellite, but it had only default location data in its message, (due to faulty test unit) so its location could not be plotted on the map as it had default lat/long)



Regular AIS on a vessel in port (not a test unit)

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## **Satellite Detection – Day 2**

• 5 AIS-SART Test Units were activated on day 2 while vessel in marina

•COM DEV satellite collected AIS data for 60 sec

• All 4 low-power AIS-SARTs detected:

- 1 W in EPIRB- 970010117 and
- 1 W in SARTs- 970010118, 19 & 20

Also detected 12.5 W Class A onboard vessel





# Satellite Detection – Day 2 (con't)

Zooming in shows EPIRB & SARTs and cluster of multiple bursts from Class A onboard vessel, with ID number changing every 2 sec (...1515, 1516.... to 1544) during satellite's 60 sec

970010120 97001544 97001542 970010118 >> 970010118 97001516 9700152897001530 970010117 970010117 970010118 970010119

Earth





#### **SAR Aircraft 'Homing' Trials** (from previous year sea trials-Florida -2009)





### **S-AIS for Search and Rescue**

#### **New Capabilities for Search and Rescue Needs**





- ✓ Satellites can detect AIS-SARTs
- Can also identify ships within proximity of distress as first responders
- Tracking of drifting life raft from distress call location
- Proactive notice to SAR coordinator of ship entering remote coverage zones
- Identify projected track based on last known position

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## **Satellite-AIS sees Vessels in Vicinity**



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# Summary

- AIS-SART Sea Trials were a challenging environment:
  - Low power transmitter (1/10 power of Class A)
  - Device bobbing in waves and antenna near water
- Sea Trials demonstrated that AIS-SART signals are detected by SAR a/c & vessels, ships in vicinity & satellites
- 'Homing' distance far more than 121.5 MHz or Radar SART
- Satellite-AIS can also provide local and global coverage of maritime traffic
- S-AIS data can be valuable tool for SAR forces
- exactEarth Ltd is pleased to be building this new tool and to working with SAR forces

"Every Ship, Every Time"

# Thank you

#### **Need more information?**

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#### "Every Ship, Every Time"

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