A world map with a blue background and yellow-green landmasses. Three satellite orbits are shown as yellow lines: one around the equator (GOES-10), one around the South Pole (INSAT-2A), and one around the North Pole (GOES-18). A red circle highlights the African continent. Labels 'INSAT_2A', 'GOES_10', and 'GOES_18' are placed near their respective orbits.

Alert Message Formats for SAR Points of Contact (SPOCs)

- Overview and Interpretation -

Tom Griffin, USMCC Senior Systems Analyst

**U.N./USA Training Course on Satellite Aided
Search and Rescue**

19 – 23 January 2009



Overview



- **Doppler Location Processing**
- **Alert Message Formats**
- **Important Fields in SPOC Messages**
- **Example of a Moving Beacon**
- **A Complete Sample Message**





Doppler Location Processing



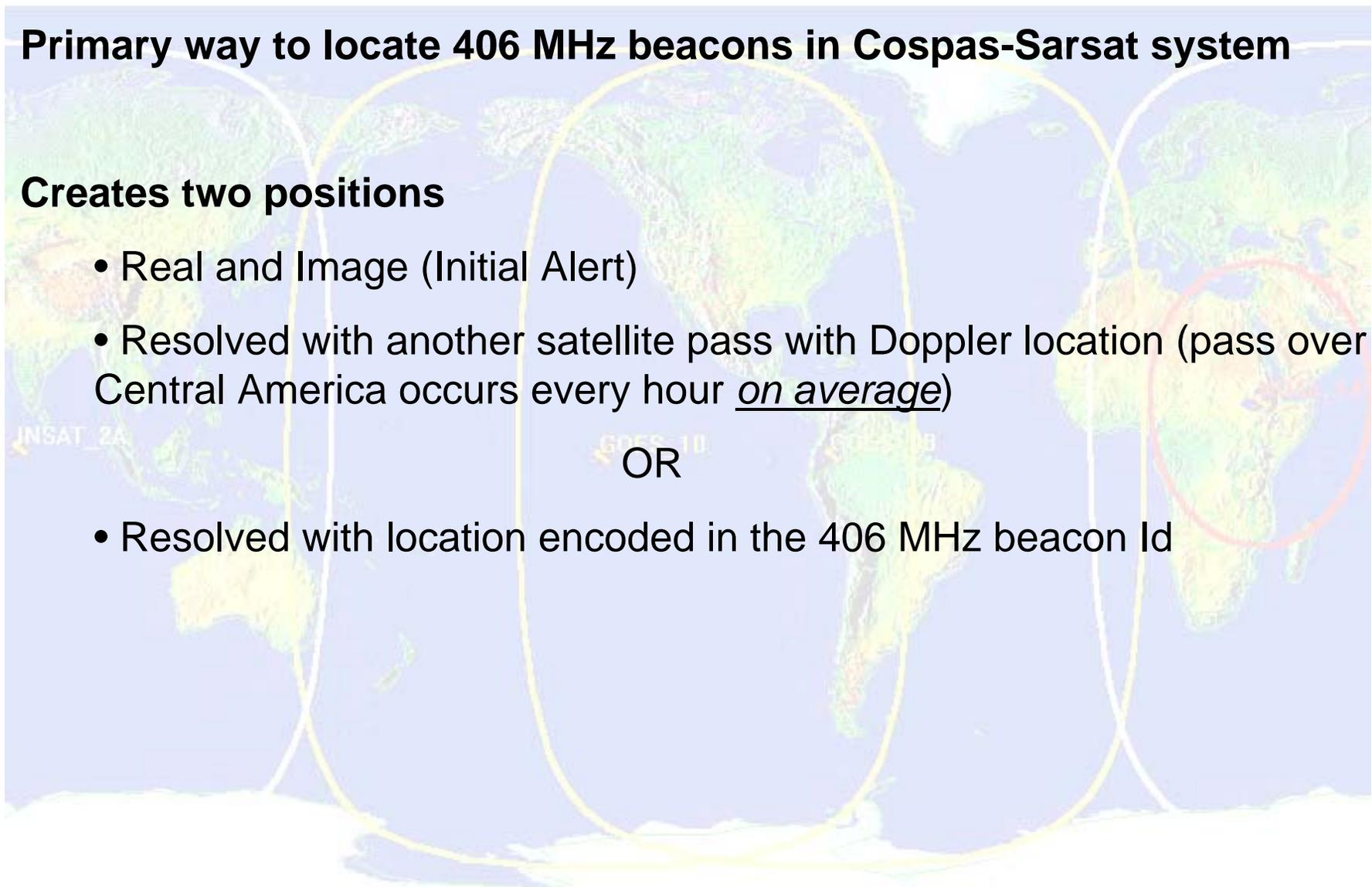
Primary way to locate 406 MHz beacons in Cospas-Sarsat system

Creates two positions

- Real and Image (Initial Alert)
- Resolved with another satellite pass with Doppler location (pass over Central America occurs every hour on average)

OR

- Resolved with location encoded in the 406 MHz beacon Id





Doppler Location Processing Resolving Ambiguity



Two Pass Solution for a Beacon Located in Brazil

Dotted lines show ground tracks of two spacecraft orbits

① 1A, 1B (Real and Image) solutions from pass 1

② 2A, 2B (Real and Image) solutions from pass 2

Real location resolved to matching locations 1A and 2A



Alert Message Formats



Cospas-Sarsat Standard Indicator Type (SIT) 185 Format messages

- Sent by USMCC to most of its international SAR Points of Contact (SPOCs)
- Is the subject of this presentation

USMCC National RCC Format messages (SIT 160 to 169)

- Sent by USMCC to a few international SPOCs and all US RCCs
- Not discussed further in this presentation



Alert Message Formats



In the unlikely event that the primary USMCC and backup USMCC are not available, the MCC of Australia (the land “down under”) assumes the international responsibilities of the USMCC.

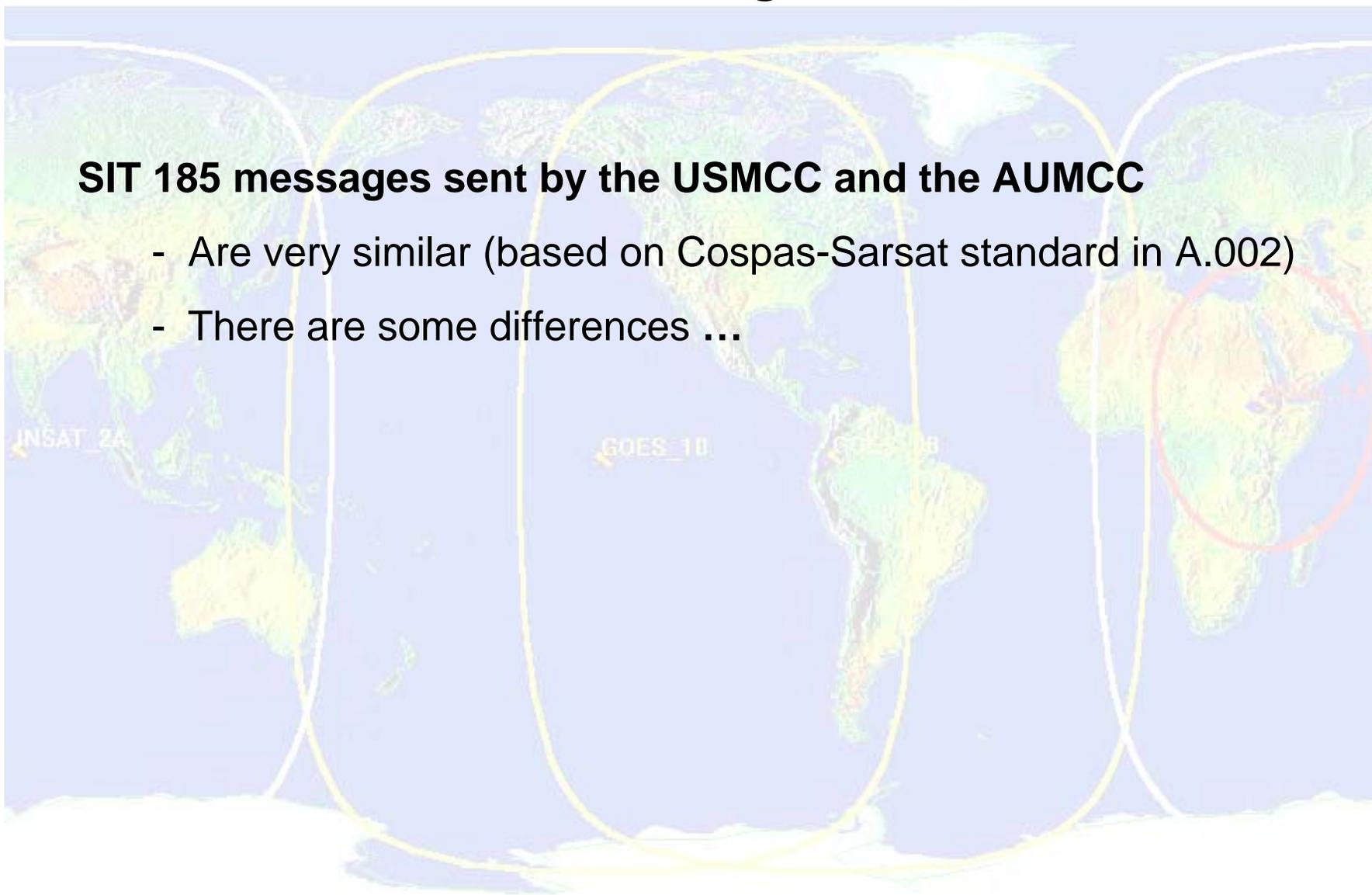
- During backup of USMCC, the Australian MCC (AUMCC)
 - Sends SIT 185 alerts to the USMCC office via Fax
 - USMCC personnel send SIT 185 alerts to its SPOCs via Fax



Alert Message Formats

SIT 185 messages sent by the USMCC and the AUMCC

- Are very similar (based on Cospas-Sarsat standard in A.002)
- There are some differences ...





USMCC Sample SIT 185 Message

(part 1)



/02109 00000/3660/09 009 0312

/185/3450

- 1. DISTRESS COSPAS-SARSAT POSITION RESOLVED ALERT**
- 2. MSG NO. 02109 USMCC REF 18074**
- 3. DETECTED AT 09 JAN 09 0256 UTC BY SARSAT 09**
- 4. DETECTION FREQUENCY 406.0249 MHZ**
- 5. COUNTRY OF BEACON REGISTRATION 366/USA**
- 6. USER CLASS - EPIRB SERIAL ID 79181**
- 7. EMERGENCY CODE - NONE**
- 8. POSITIONS**

RESOLVED - 29 09.4N 082 03.9W

DOPPLER A- 29 09.2N 082 04.2W PROB 88

DOPPLER B- NIL

ENCODED - NIL



AUMCC Sample SIT 185 Message (part 1)



090301 JAN 09
 FM AUMCC
 TO RCC AUSTRALIA
 1. DISTRESS COSPAS-SARSAT POSITION RESOLVED ALERT
 2. MSG NO: 02109 AUMCC REF ADCD04D534C0801
 3. DETECTED AT: 09 JAN 09 0256 UTC BY SARSAT 09
 4. DETECTION FREQUENCY: 406.0249 MHZ
 5. COUNTRY OF BEACON REGISTRATION: 366/USA
 6. USER CLASS: EPIRB SERIAL ID 79181
 7. EMERGENCY CODE: NONE
 8. POSITIONS:
 RESOLVED - 29 09.4N 082 03.9W
 DOPPLER A - 29 09.2N 082 04.2W
 DOPPLER B - NIL
 ENCODED - NIL



AUMCC Sample SIT 185 Message

(part 1)



090301 JAN 09

FM AUMCC

TO RCC AUSTRALIA

1. DISTRESS COSPAS-SARSAT POSITION RESOLVED ALERT

2. MSG NO: 02109 AUMCC REF ADCD04D534C0801

3. DETECTED AT: 09 JAN 09 0256 UTC BY SARSAT 09

4. DETECTION FREQUENCY: 406.0249 MHZ

5. COUNTRY OF BEACON REGISTRATION: 366/USA

6. USER CLASS: EPIRB SERIAL ID 79181

7. EMERGENCY CODE: NONE

8. POSITIONS:

RESOLVED - 29 09.4N 082 03.9W

DOPPLER A- 29 09.2N 082 04.2W

DOPPLER B- NIL

ENCODED - NIL



Alert Message Formats



SIT 185 Message Title describes the type of data to be sent

406 MHz Initial Alert

406 MHz Position Resolved Alert

406 MHz Position Resolved Update Alert

406 MHz Position Conflict Alert

406 MHz Encoded Position Update Alert

406 MHz Notification of Country of Beacon Registration (NOCR)

121.5/243.0 MHz Alerts will not be sent as of 1 Feb 2009 (**Phaseout**)



Alert Message Formats



- **Initial Alert** may contain:
 - No Doppler location **without** encoded position
 - Must use registration information
 - No Doppler location **with** encoded position
 - Real position normally within 4 seconds (180 meters) of encoded position for Location Protocol beacons
 - Doppler location **only** with an “A” and “B” positions
 - Real position normally within 5 Km of Doppler position
 - “A” is correct 90% of the time, **but** use the probability
 - Look at “A” and “B” positions – is one side of EPIRB on land?
 - Use registration information (use beacon Id on Alert message)
 - Contact vessel
 - Call owner or Point of Contact
 - Check homeport
 - Doppler location **and** encoded position
 - If matched within 50 km, sent as “Position Resolved Alert”



Alert Message Formats



Position Resolved Alert

- Sent when the real position is determined (when ambiguity is resolved in previous Doppler “A” and “B” locations)
- Requires match within 50 KM of two independent locations, from
Two satellite passes with Doppler location
OR
One satellite pass with Doppler location and encoded location
- Resolved Position is normally within 4 KM of actual location (if encoded location matches resolved position, it is usually more accurate than the Doppler position)



Doppler Location Processing Resolving Ambiguity



Two Pass Solution for a Beacon Located in Brazil

Dotted lines show ground tracks of two spacecraft orbits

① 1A, 1B (Real and Image) solutions from pass 1

② 2A, 2B (Real and Image) solutions from pass 2

Real location resolved to matching locations 1A and 2A



Alert Message Formats



Position Resolved Update Alert

- Sent when a new position matches the resolved position within 50 km
- Compare the new position and resolved position. A large distance indicates the beacon may be moving
- Resolved position will get closer to the real position with each **Position Resolved Update Alert** (if beacon is not moving)
- USMCC automatically sends a maximum of nine **Position Resolved Update Alerts**
 - Request the USMCC to continue to send, as needed



Alert Message Formats



- **Position Conflict Alert**

- Sent when new location(s) differ from previous location(s) by more than 50 km
- May indicate poor quality location data or a moving beacon
- Prior to ambiguity resolution, any provided location (new or old) may be the real position, but the “A” location with highest probability is most likely to be the real position
- After ambiguity is resolved, new locations are compared only to the resolved position.

Repeated Position conflicts (without a **Position Resolved Update Alert**) probably indicates the beacon is moving.



Alert Message Formats



- **Encoded Position Update Alert**

- Sent when the position encoded in 406 MHz beacon message changes by more than 3 km but less than 50 km
- Likely indicates that the beacon is moving (for example, a beacon at sea is drifting)
- Only sent when new Doppler location not available
If new Doppler and encoded location are available, the encoded location is included but not identified in the Message Title
- May be sent before or after ambiguity resolution



Alert Message Formats



- **406 MHz Notification of Country of Beacon Registration**
 - Sent based on Country encoded in 406 MHz Beacon Id
 - Sent to Country of Beacon Registration when alert location is not within that Country's Search and Rescue (SAR) area
 - Allows recipient Country to ensure that there is a SAR response for its beacon owners

INSAT_2A



Overview



- Doppler Location Processing
- Alert Message Formats
- **Important Fields in SPOC Messages**
- Example of a Moving Beacon
- A Complete Sample Message





Important Fields in SPOC Messages



- **Message number**

- On first line of SIT message header
- On line 2 of SIT message body
- Track to ensure all messages are received
- Reference to discuss a specific message with USMCC

/01078 00000/3660/09 019 0556

/185/3520

1. DISTRESS COSPAS-SARSAT POSITION CONFLICT ALERT

2. MSG NO. 01078 USMCC REF 47214



Important Fields in SPOC Messages



- **USMCC REFerence Number**

- On line 2 of SIT message body
- Use to discuss beacon activation (alert site) with USMCC, U.S. RCCs and SPOCs in US Service Area

- **HEX ID**

- On line 11 of SIT message body
- Is unique identifier for 406 MHz beacon
- Used to access a 406 MHz Beacon Registration Database

2. MSG NO. 01078 USMCC REF **47214**

11. HEX ID **9A89529934D34D1** HOMING SIGNAL 121.5



Important Fields in SPOC Messages



- **Message Title**

- On line 1 of SIT message body
- Describes type of message sent and status of alert site
- Indicates if beacon type is “**DISTRESS**” (most activations) or “**SHIP SECURITY**”

- **Detection Frequency**

- On line 4 of SIT message body
- Specific frequency (such as 406.025 MHz or 406.028 MHz) may assist a search with 406 MHz direction finder

1. **DISTRESS** COSPAS-SARSAT POSITION RESOLVED ALERT
4. DETECTION FREQUENCY **406.0248** MHZ



Important Fields in SPOC Messages



- **Country of Beacon Registration**

- On line 5 of SIT message body
- Derived from 406 MHz beacon Id (in line 11 of SIT message)
- Determines Point of Contact for Registration information (provided in line 15 of SIT message)

- **User Class**

- On line 6 of SIT message body
- Derived from 406 MHz beacon Id (in line 11 of SIT message)
- Provides beacon type (e.g., if EPIRB, location likely not on land)
- Use non-serialized Craft Id to get registration data

5. COUNTRY OF BEACON REGISTRATION 355/PANAMA

6. USER CLASS - EPIRB MARITIME USER ID 426000



Important Fields in SPOC Messages



- **Positions on line 8**

- Use probability when ambiguity is not resolved
- Image positions not shown once ambiguity is resolved
- Encoded position only available for some 406 MHz beacons
- On **Position Resolved Update Alert**, compare resolved position with the new Doppler/Encoded position(s) to check for a moving beacon.

8. POSITIONS

RESOLVED - NIL

DOPPLER A- 16 03.0N 101 18.2W PROB 70

DOPPLER B- 07 37.5N 081 41.4W PROB 30

ENCODED - NIL



Important Fields in SPOC Messages



- **Operational Information on line 15 (part A)**
 - Use to get 406 MHz Registration Data, may be in a National Database or International Beacon Registration Database (IBRD)
 - If in IBRD, web address (www.406registration.com) is provided

15. OPERATIONAL INFORMATION

A. REGISTRATION INFORMATION AT

USMCC

TELEX:

AFTN: KZDCZSZA

TELEPHONE: 1 301-817-4576

FACSIMILE: 1 301-817-4568

EMAIL: usmcc@noaa.gov

WEB ADDRESS:



Important Fields in SPOC Messages



- **Operational Information on line 15 (parts B, C)**
 - Provides the reliability of 406 MHz Doppler position data
 - Provides the likely 406 MHz Doppler image position, when this can be computed from other satellite data (example below and on next page). “Likely image” does not resolve ambiguity.

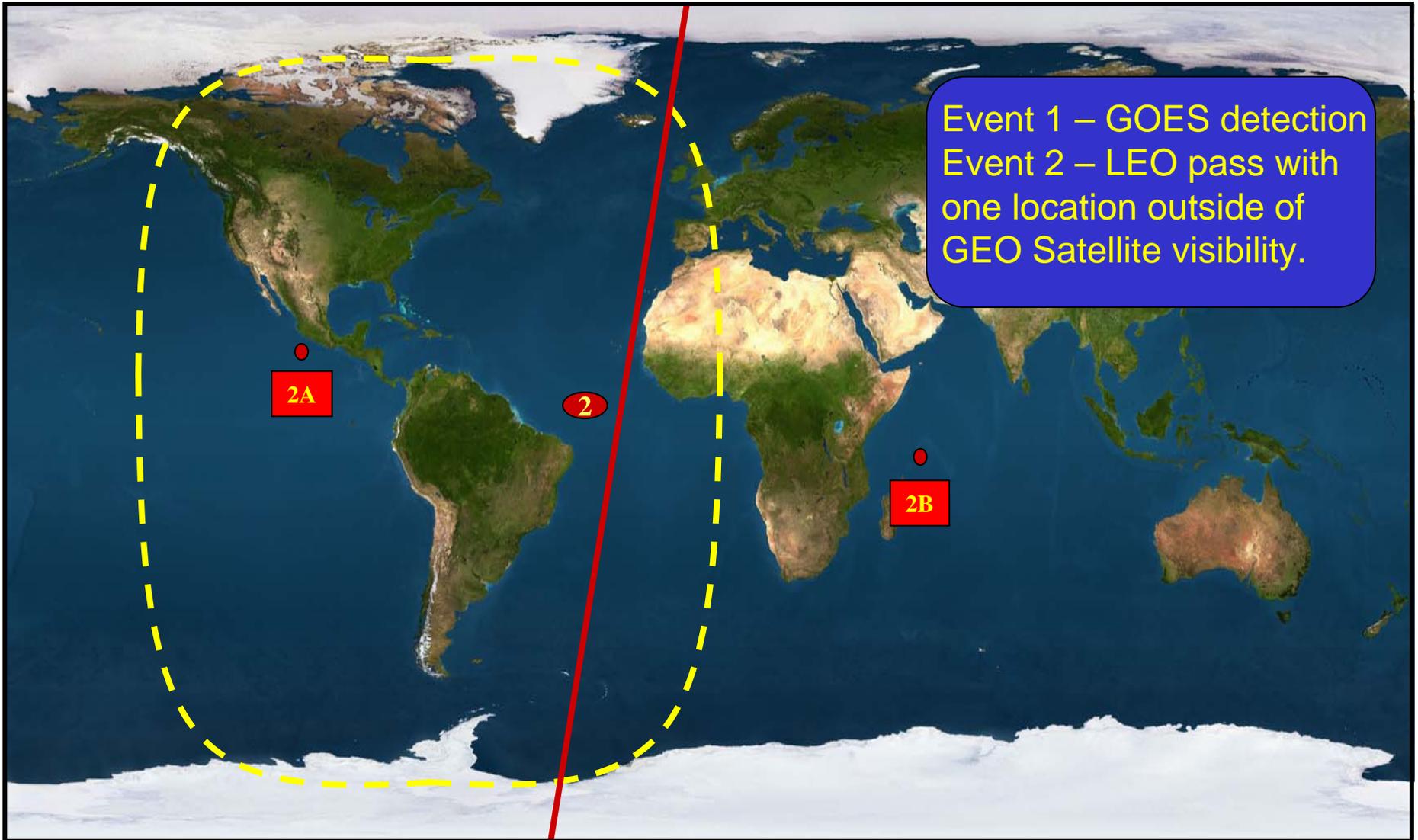
15. OPERATIONAL INFORMATION

B. RELIABILITY OF DOPPLER POSITION DATA -

C. THE B POSITION IS LIKELY TO BE AN IMAGE POSITION.



406 MHz Image Determination with GEO Satellite





Important Fields in SPOC Messages



Invalid 406 MHz Beacon Message

- Occurs when component fields do not comply with C/S standards
- Associated alert processed based only on Doppler location
- No information used from beacon message (including beacon type, country code and encoded position)
- Alert message shows “NIL” in fields derived from beacon message and special Remarks (see example below)

16. REMARKS -

DATA DECODED FROM THE BEACON MESSAGE IS NOT RELIABLE



Important Fields in SPOC Messages



- **Remarks on line 16**

- For invalid 406 MHz beacon message (see previous example)

- On Ship Security Alert

“THIS IS A SHIP SECURITY ALERT. PROCESS THIS ALERT ACCORDING TO RELEVANT SECURITY REQUIREMENTS.”

- On Position Conflict Alert (see example below)

16. REMARKS -

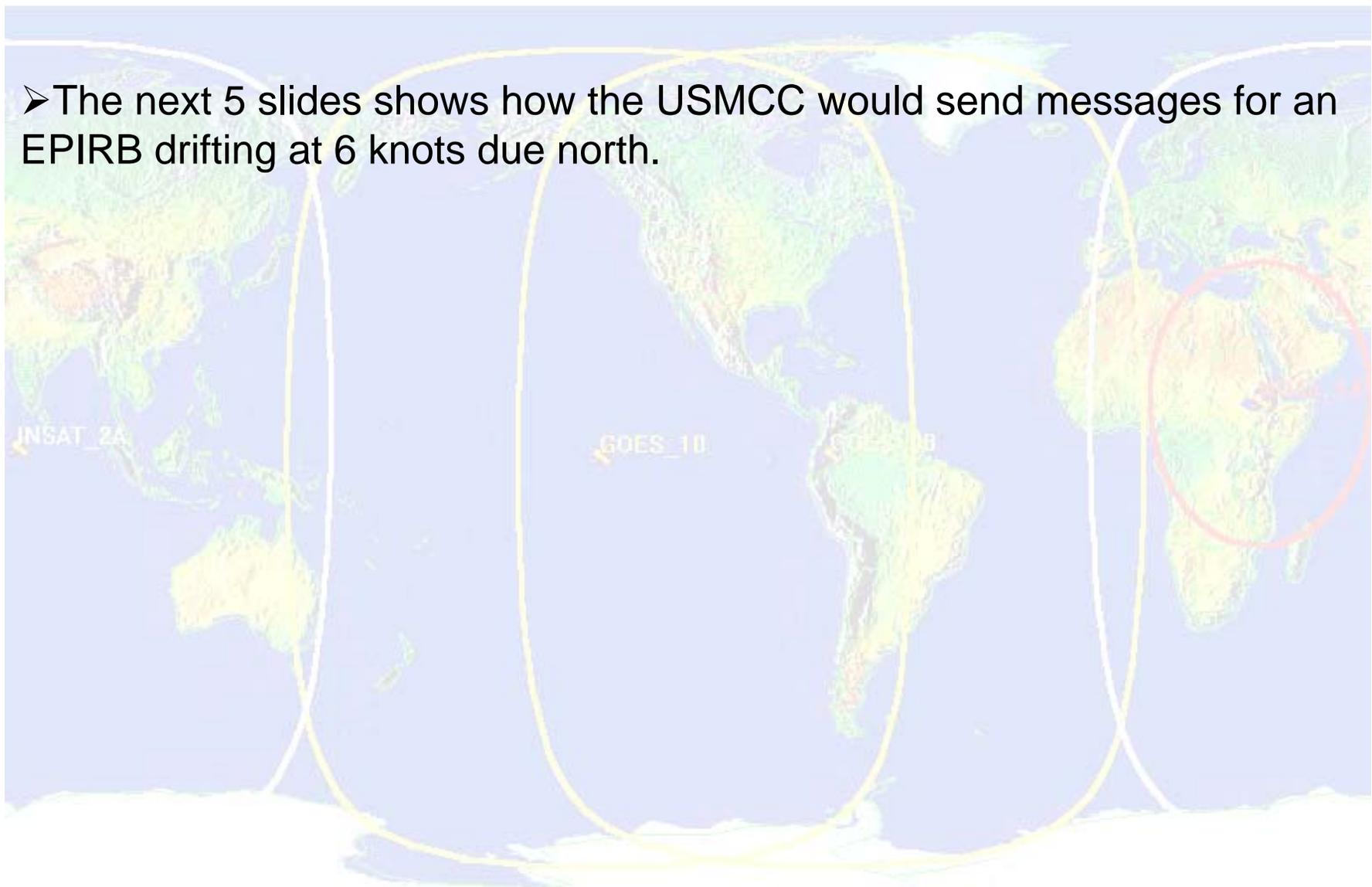
THIS POSITION MORE THAN 50 KILOMETERS FROM PREVIOUS ALERT



An Example of a Moving Beacon



- The next 5 slides shows how the USMCC would send messages for an EPIRB drifting at 6 knots due north.

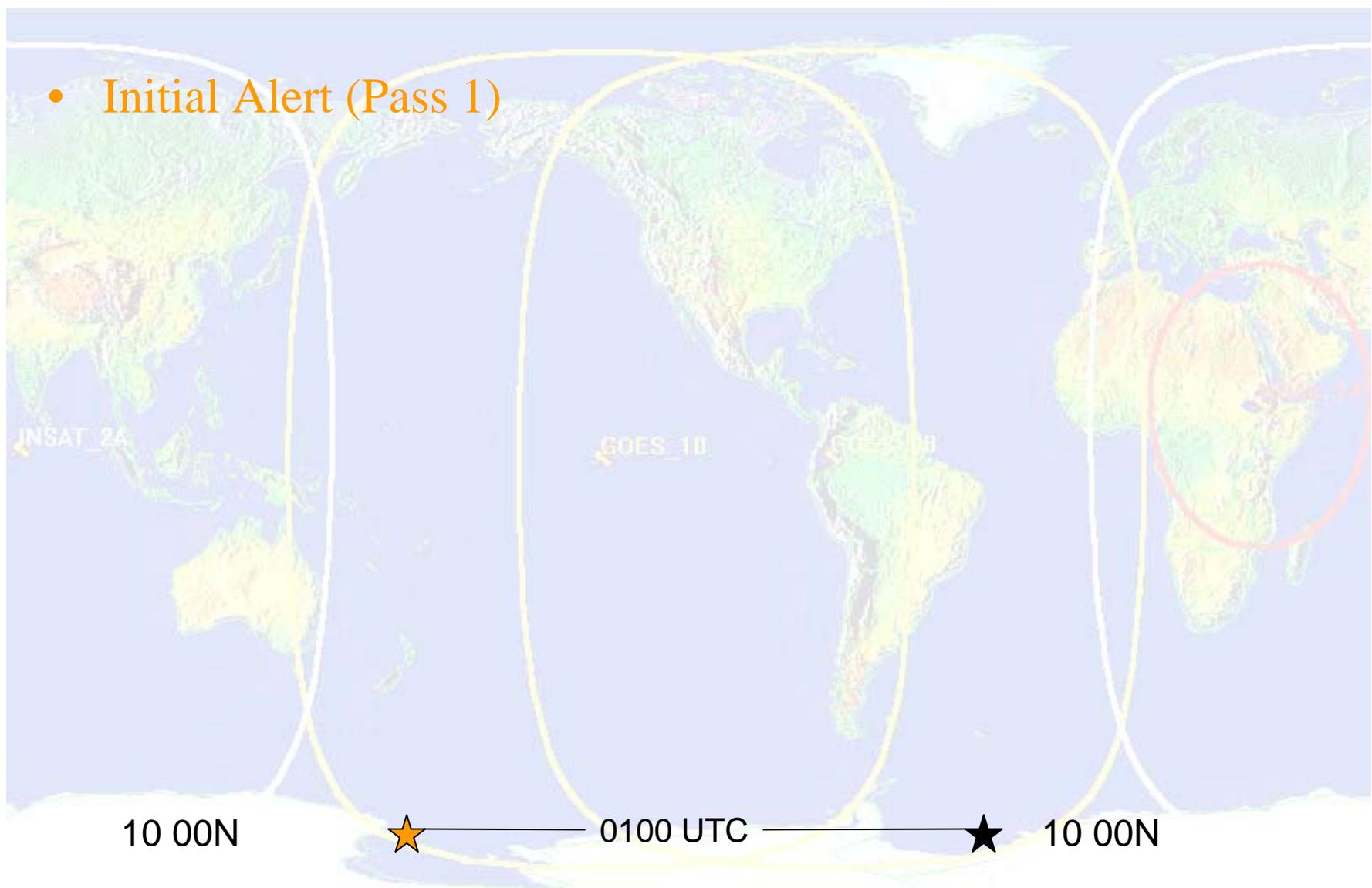




An Example of a Moving Beacon



- Initial Alert (Pass 1)

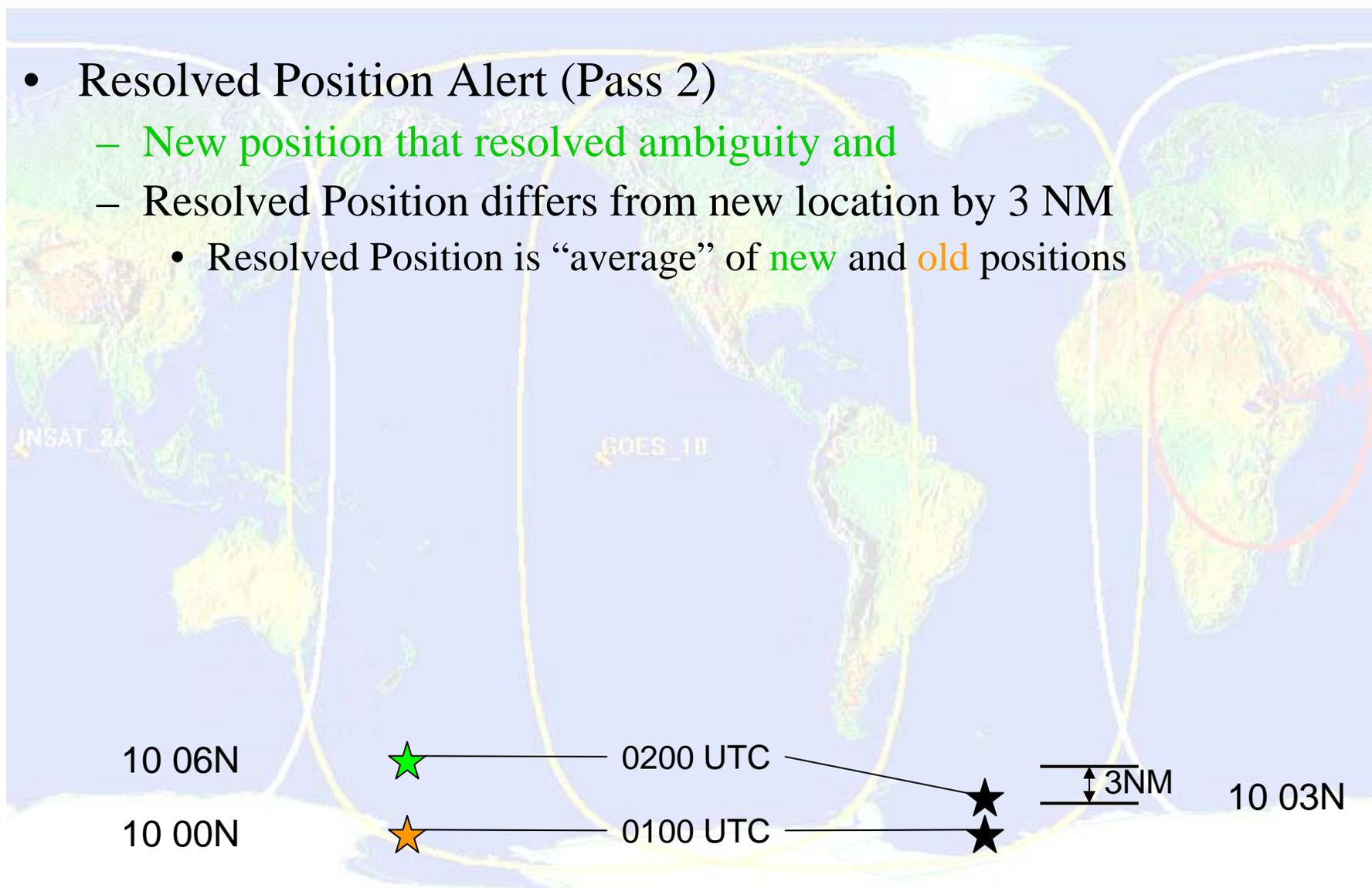




An Example of a Moving Beacon



- Resolved Position Alert (Pass 2)
 - New position that resolved ambiguity and
 - Resolved Position differs from new location by 3 NM
 - Resolved Position is “average” of new and old positions

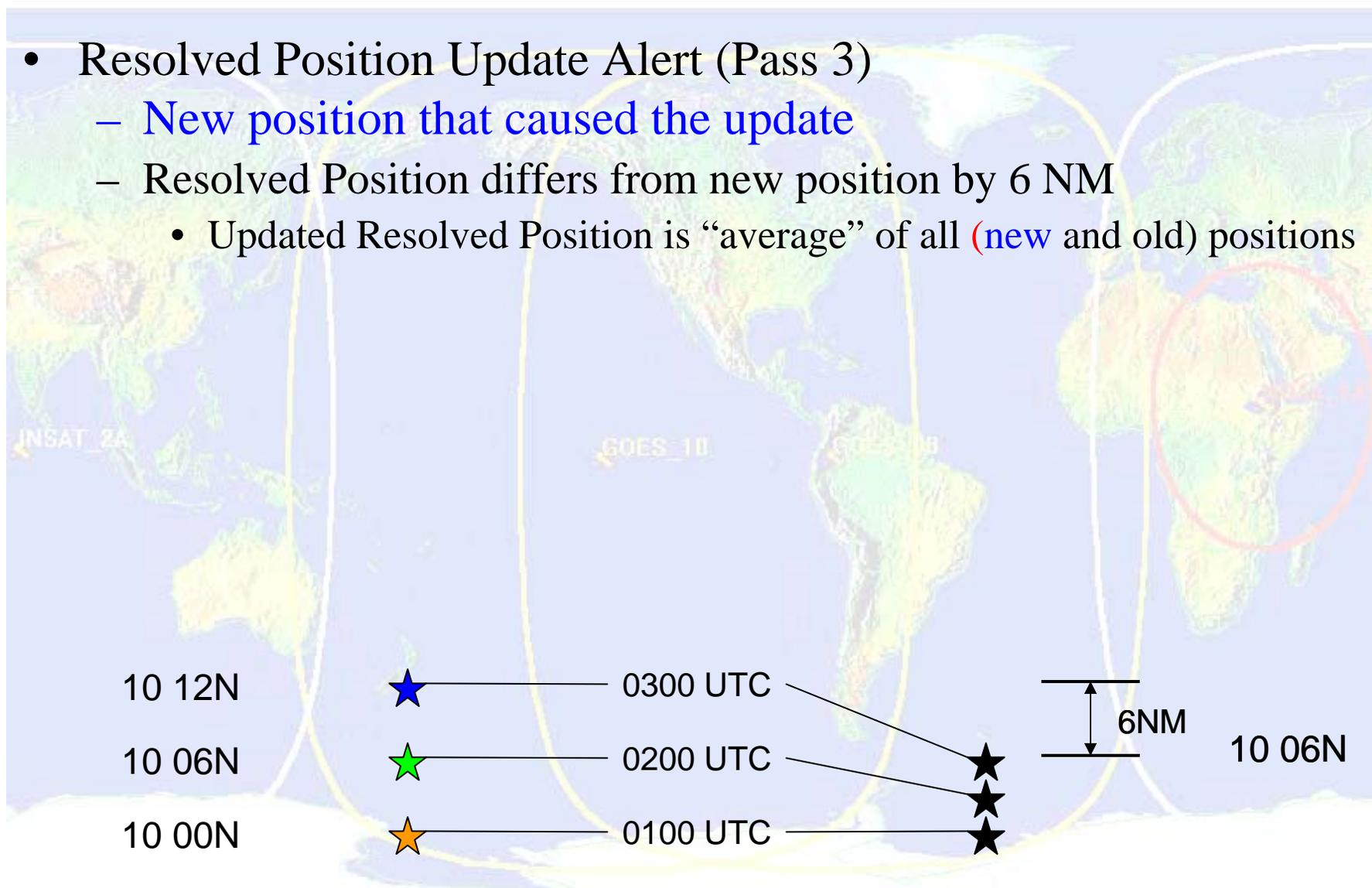




An Example of a Moving Beacon



- Resolved Position Update Alert (Pass 3)
 - New position that caused the update
 - Resolved Position differs from new position by 6 NM
 - Updated Resolved Position is “average” of all (new and old) positions

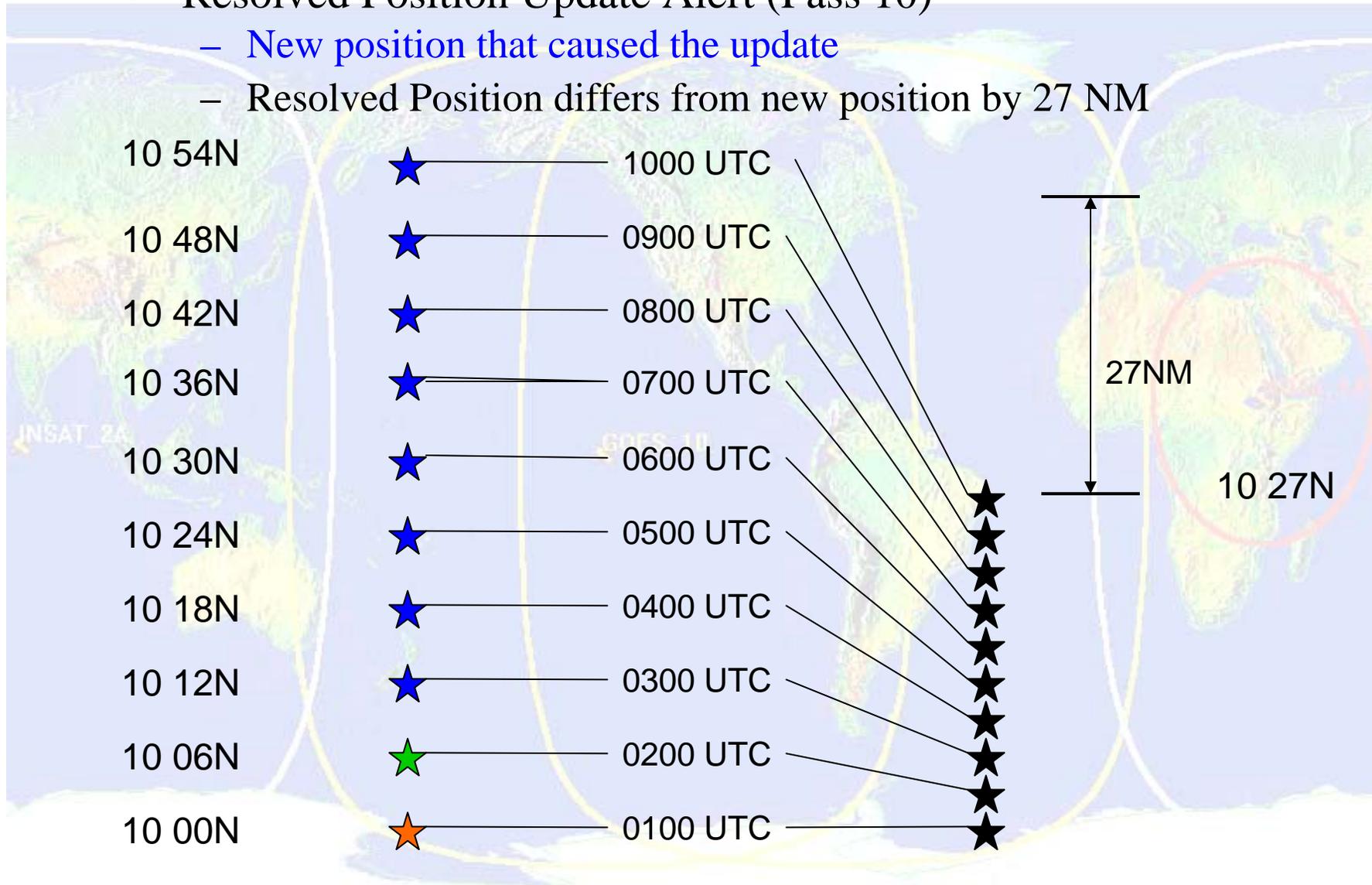




An Example of a Moving Beacon



- Resolved Position Update Alert (Pass 10)
 - New position that caused the update
 - Resolved Position differs from new position by 27 NM



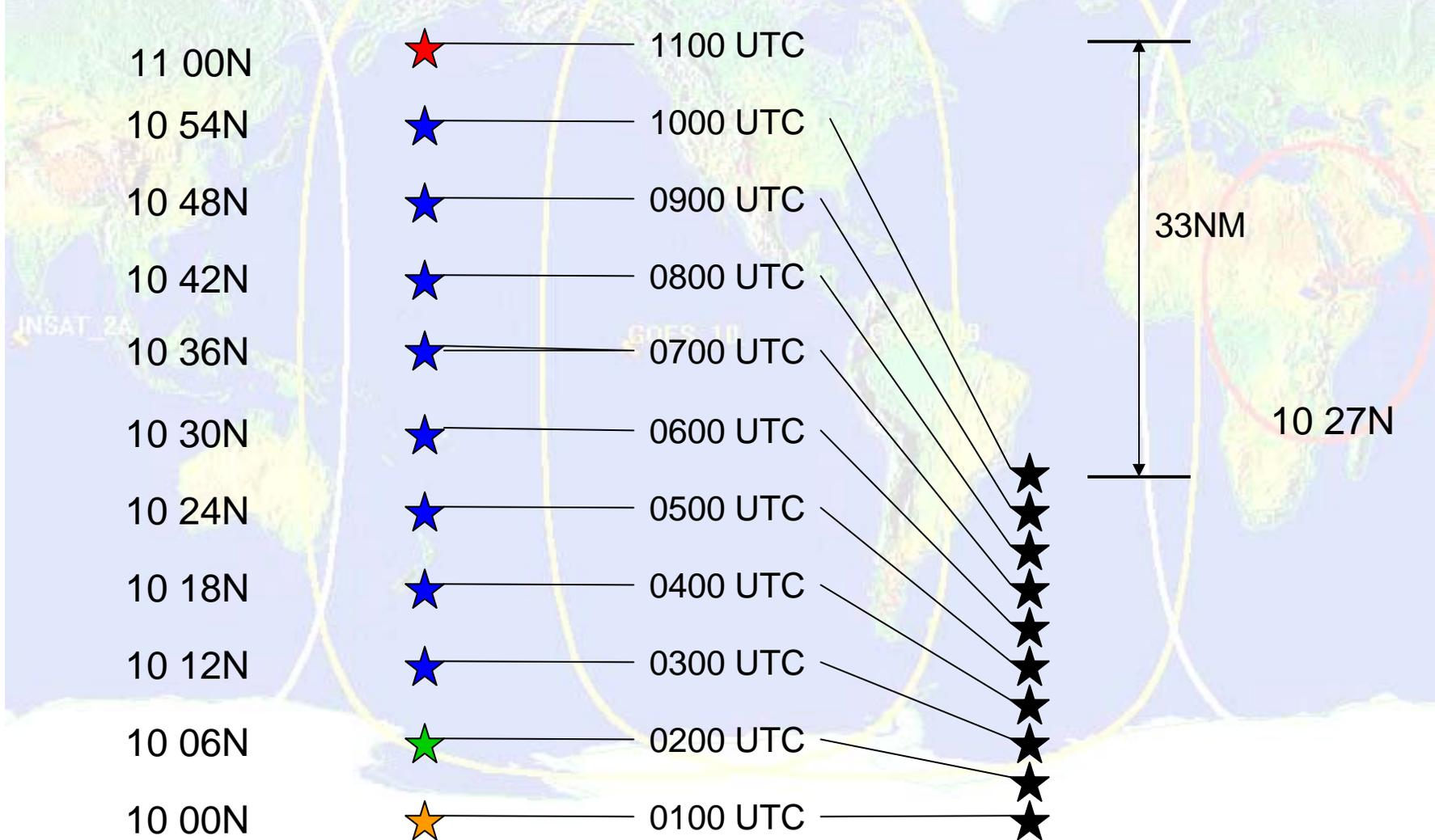


An Example of a Moving Beacon



- Position Conflict Alert (Pass 11)

- New position differs from resolved position by 33 NM (over 50 km)





An Example of a Moving Beacon



➤ Identifying a moving beacon

- Always compare new and old locations
- Plot positions on map in sequence by Time of Detection (may differ from sequence of message receipt at SPOC)
- Use automated map display tool (such as SarMaster)
- Waiting for Position Conflict Alert may greatly delay effective SAR response





Overview



- Doppler Location Processing
- Alert Message Formats
- Important Fields in SPOC Messages
- Example of a Moving Beacon
- **A Complete Sample Message**





Sample Message – Part 1



/02109 00000/3660/09 009 0312

/185/3450

- 1. DISTRESS COSPAS-SARSAT POSITION RESOLVED ALERT**
- 2. MSG NO. 02109 USMCC REF 18074**
- 3. DETECTED AT 09 JAN 09 0256 UTC BY SARSAT 09**
- 4. DETECTION FREQUENCY 406.0249 MHZ**
- 5. COUNTRY OF BEACON REGISTRATION 366/USA**
- 6. USER CLASS - EPIRB SERIAL ID 79181**
- 7. EMERGENCY CODE - NONE**
- 8. POSITIONS**

RESOLVED - 29 09.4N 082 03.9W

DOPPLER A- 29 09.2N 082 04.2W PROB 88

DOPPLER B- NIL

ENCODED - NIL



Sample Message – Part 2



9. ENCODED POSITION PROVIDED BY: NIL

10. NEXT PASS TIMES

RESOLVED - 09 JAN 09 0412

DOPPLER A- NIL

DOPPLER B- NIL

ENCODED - NIL

11. HEX ID ADCD04D534C0801 HOMING SIGNAL 121.5

12. ACTIVATION TYPE - UNKNOWN

13. BEACON NUMBER ON AIRCRAFT OR VESSEL NIL

14. OTHER ENCODED INFORMATION

A. BEACON MANUFACTURER AND MODEL NUMBER -

MPR/NAT/ SATFIND M3



Sample Message – Part 3



15. OPERATIONAL INFORMATION

A. REGISTRATION INFORMATION AT

USMCC

TELEX:

AFTN: KZDCZSZA

TELEPHONE: 1 301-817-4576

FACSIMILE: 1 301-817-4568

EMAIL: usmcc@noaa.gov

WEB ADDRESS:

B. RELIABILITY OF DOPPLER POSITION DATA - N/A

C. LIKELY DOPPLER IMAGE POSITION - N/A

16. REMARKS - NIL

END OF MESSAGE

/LASSIT

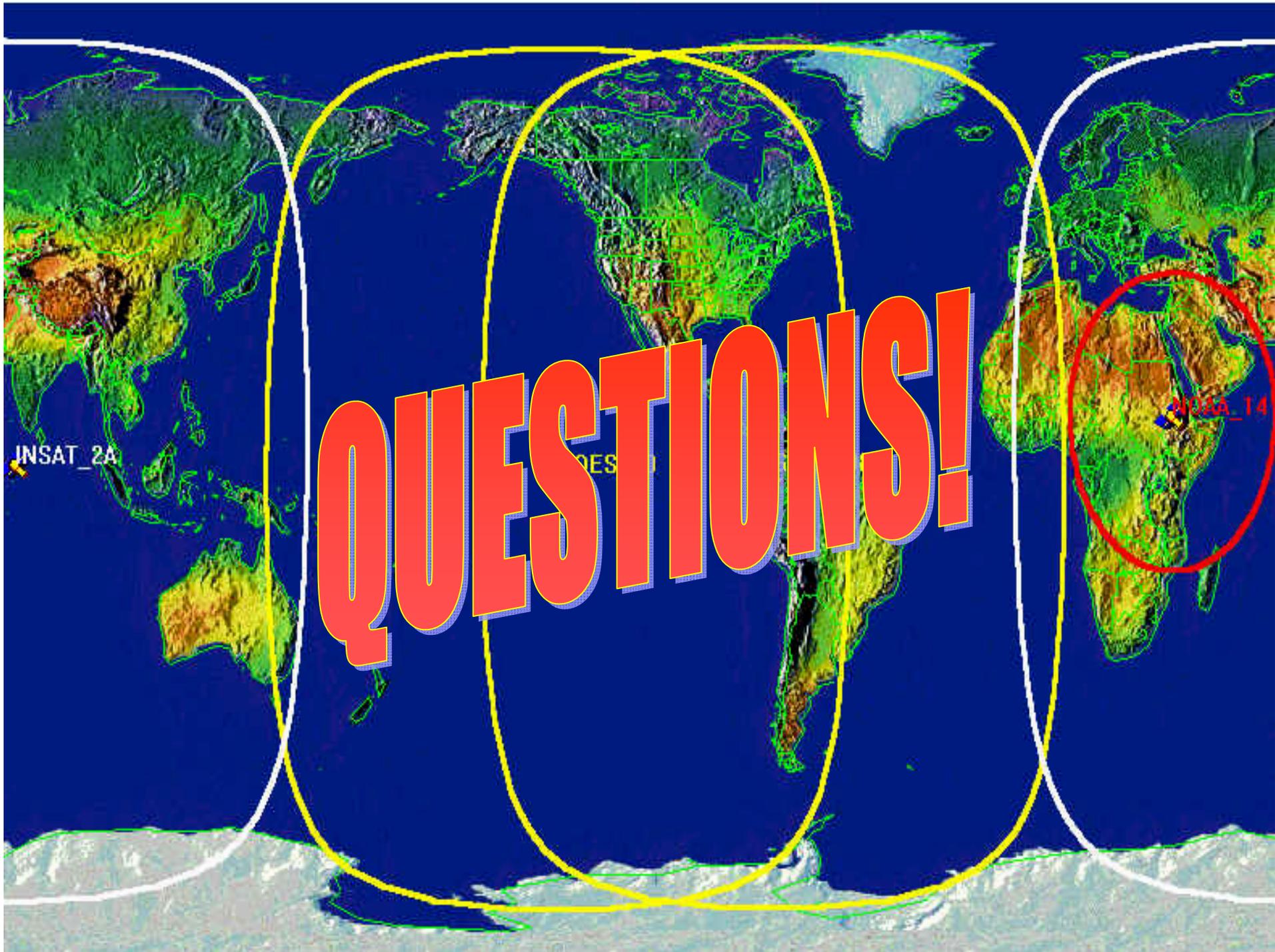
/ENDMSG



Further Information on SPOC Messages



- **Cospas-Sarsat documents**
 - A.002 (Standard Interface Description)**
 - G.007 (Handbook on Distress Alert Messages for RCCs and SPOCs)**
 - go to www.cospas-sarsat.org
- **U.S. RCC/SPOC Message Manual**
 - go to www.sarsat.noaa.gov
 - contact USMCC (tom.griffin@noaa.gov)



QUESTIONS!

INSAT_2A

NOAA_14