

4.0 ALERT PROCESSING REQUIREMENTS

The Alert Process comprises: reception and validation of incoming alert messages from LUTs and MCCs via the Communications Process; classification of incoming messages into appropriate categories; filtering, matching and merging of alert data received from LUTs and MCCs; computation of the next passes and missed passes for beacon locations; request and reception of Geosort data from the SAR Mapping Process and beacon data from the 406 Beacon Registration Data Base; maintenance of files of active SAR sites (Active Sites File) and closing of SAR sites; generation, routing and formulation of alert messages to RCCs, MCCs and SPOCs via the Communications Process; and formulation and maintenance of Morning Reports and Site Summary reports for Active Sites.

4.1 ALERT INPUT DATA PROCESSING

LUT Incident data and MCC Alert messages coming into the FG-USMCC are received by the Communications Process and transferred to the Alert Process which is responsible for subsequent processing to produce output alert messages.

4.1.1 ALERT DATA TRANSFER

The following data arriving at the US MCC shall be collected for transfer to the Alert Process:

US LUT Data, as per Reference G:

- (a) Header 123 with associated Tag Buffer
- (b) Solution 123 with associated Tag Buffer
- (c) Header 406 with associated Tag Buffer
- (d) Solution 406 with associated Tag buffer
- (e) Pass Completion Report with associated Tag Buffer

MCC Alert Data, as per Reference D:

- (f) SITs 100 - 199 inclusive

4.1.1.1 Items (a) through (f) above shall be accompanied by the time of arrival at the US MCC, with 1-second resolution. Time of arrival shall be the time at which the transfer of the data item to the US MCC was complete, as determined by the Communications Process.

4.1.1.2 The Alert Process shall accept both "OLD SIT" numbers and "NEW SIT" numbers as given in Reference D. "OLD SIT" numbers shall be converted to "NEW SIT" numbers by the Alert Process as per Table A1 in Annex A of Reference D. All SIT numbers in this requirements document refer to "NEW SIT" numbers.

4.1.1.3 All data shall be received from the Communications Process in original form of References G and D.

4.1.1.4 Each data item shall be accompanied by a field written by the Communications Process indicating whether the data (a) contained no communications errors as received, (b) was received with errors that were corrected by communications, or © contains uncorrectable communications errors.

4.1.2 PASS PREDICTION DATA INPUT

4.1.2.1 Data Input

The Alert Process shall retrieve LUT Pass Schedules in the format of Appendix L from the FG-USMCC shared files as needed for the Alert Process.

4.2 LUT DATA VALIDATION

1. All LUT Data shall be checked by the Alert Process before processing. The checks shall serve to identify extreme, missing, or erroneous values in LUT solutions that may indicate malfunction.

2. These data checks shall take place after, and be in addition to, communication error checks performed during input.

3. The results of the checks shall be recorded in a permanent shared file and also shall be attached to the data for use by the Filtering process.

4. LUT interferer solutions shall be identified as such at 121.5/243-MHz.

4.2.1 LUT Validation Parameters

The allowable values and ranges for LUT Validation items, and the actions taken if any item fails the check, shall be contained in the LUT Data Validation Parameters. Separate parameters are to be set and modified for:

- (1) LUT 121.5/243-MHz Incident Data
- (2) LUT 121.5/243-MHz Interferer Data
- (3) LUT 406-MHz Interferer Data
- (4) LUT 406-MHz PDS Incident Data
- (5) LUT 406-MHz Repeater (GSARP) Data
- (6) LUT 406-MHz Unlocated beacon data

4.2.2 LUT Validation Items

The items to be checked in the LUT Data Validation are given in Table 3.

Table 3: LUT Data Validation Parameters

LUT 121.5/243-MHz Header Checks

- (a) LUT Identifier
- (b) Satellite Identifier
- (c) LUT LOS-AOS (Track Time)
- (d) LUT TPC-LOS (Processing Time)
- (e) LUT Receive-LOS Time

LUT 121.5/243.-MHz Solution Data Checks

- (a) Signal-Noise ratio
- (b) Sweep period
- (c) Sweep Shift
- (d) Number of points on the curve
- (e) Curve duration
- (f) CTA
- (g) Curve duration minus curve duration for CTA
- (h) Curve start time minus TCA, adjusted for CTA
- (I) Curve stop time minus TCA, adjusted for CTA
- (j) Window factor (TCA relative to point span) - Maximum
- (k) Window factor (TCA relative to point span) - Minimum
- (l) Data Residual (Measurement noise)
- (m) Frequency bias
- (n) Frequency bias standard deviation
- (o) A-Probability plus B-Probability
- (p) Current time minus TCA
- (q) Receipt time minus TCA

LUT 406-MHz Interferer Data Checks:

- (a) Signal-Noise ratio
- (b) Curve duration
- (c) CTA
- (d) Curve duration minus curve duration for CTA
- (e) Curve start time minus TCA, adjusted for CTA
- (f) Curve stop time minus TCA, adjusted for CTA
- (g) Window factor (TCA relative to point span) - Maximum
- (h) Window factor (TCA relative to point span) - Minimum
- (i) Data Residual (Measurement noise)
- (j) Frequency bias
- (k) A-Probability plus B-Probability

- (l) Current time minus TCA
- (m) Receipt time minus TCA
- (n) Time of Processing Complete minus time of LOS
- (o) Time of AOS minus time of LOS

LUT 406-MHz Header Checks:

- (a) LUT Identifier
- (b) Satellite Identifier
- (c) LUT LOS-AOS (Track Time)
- (d) LUT TPC-LOS (Processing Time)
- (e) LUT Current-LOS Time
- (f) LUT Receive-LOS Time

LUT 406-MHz PDS Solution Data Checks:

- (a) Beacon 406 Message Test as per DDP
- (b) Beacon 406 Message BCH Check, first protected field
- (c) Beacon 406 Message BCH Check, second protected field
- (d) Beacon Code Test, as per DBEACON
- (e) Number of points on the curve
- (f) Curve duration
- (g) CTA, A-side and B-side
- (h) Curve duration minus curve duration for CTA
- (i) Curve start time minus TCA, adjusted for CTA
- (j) Curve stop time minus TCA, adjusted for CTA
- (k) Window factor (TCA relative to point span) - maximum
- (l) Window factor (TCA relative to point span) - minimum
- (m) Data Residual (Measurement noise)
- (n) Frequency bias
- (o) Frequency bias standard deviation
- (p) A-Probability plus B-Probability
- (q) Current time minus TCA
- (r) Receipt time minus TCA

LUT 406-MHz Bent Pipe Location (GSARP) Data:

- (a) Beacon 406 Message Test as per DDP
- (b) Beacon 406 Message BCH Check, first protected field
- (c) Beacon 406 Message BCH Check, second protected field
- (d) Beacon Code Test, as per DBEACON
- (e) Number of points on the curve
- (f) Curve duration
- (g) CTA, A-side and B-side
- (h) Curve duration minus curve duration for CTA
- (i) Curve start time minus TCA, adjusted for CTA
- (j) Curve stop time minus TCA, adjusted for CTA

- (k) Window factor (TCA relative to point span) - maximum
- (l) Window factor (TCA relative to point span) - minimum
- (m) Data Residual (Measurement noise)
- (n) Frequency bias
- (o) Frequency bias standard deviation
- (p) A-Probability plus B-Probability
- (q) Current time minus TCA
- (r) Receipt time minus TCA

LUT 406-MHz Unlocated Beacons:

- (a) Beacon 406 Message Test as per DDP
- (b) Beacon 406 Message BCH Check, first protected field
- (c) Beacon 406 Message BCH Check, second protected field
- (d) Beacon Code Test, as per DBEACON
- (n) Frequency Bias
- (q) Current time minus TCA field
- (r) Receipt time minus TCA field

4.2.3 LUT Beacon BCH Check

The 406 Message, field 23 of C/S A.002, shall be checked for correct BCH as received at the USMCC, as follows:

(a) For the Short Message, the protected field (bits 25-85) shall be checked against the BCH error-correcting code (bits 86-106) of the same message, as exemplified in the Annex B-1, of Reference F.

(b) For the Long Message, the First Protected Field (bits 25-85) shall be checked against the First BCH Error-Correcting code (bits 86-106) and the Second Protected Field (bits 107-132) shall be checked against the Second BCH Error-Correcting code (bits 133-144) of the same message, as exemplified in Annex B-2 of Reference F.

(c) Short Messages that have uncorrectable bit errors as per (a) above shall be tagged as uncorrectable.

(d) Long Messages that have no uncorrectable bit errors in the First Protected field, but have uncorrectable bit errors in the Second Protected field, shall be tagged as partly uncorrectable; the second protected data field (bits 107 - 132) shall be set to its default value.

4.2.4 LUT Beacon ID Checks

The Beacon ID in the LUT 406-MHz PDS Incident, LUT 406-MHz Bent Pipe Location (GSARP), and LUT 406-MHz Unlocated Beacon data shall be checked as specified in Reference E, Annex III/B.1.1. and also in Appendix H of this document.

4.2.5 24-Hour Time Tag and USO Rollover Check

The TCA given in the LUT 406-MHz Incident data and LUT 406-MHz Repeater Location (GSARP) data, and the beacon message time given in the LUT 406-MHz Unlocated Beacon data, shall be checked against similar times for the same beacon event, as contained in the 406-MHz Active Site File. allowable differences shall be stored as LUT Data Validation Parameters.

4.2.6 LUT Data Exceptions

Solution files that fall outside the allowable LUT Data Validation Parameters, or fail the Beacon ID Checks or 24-Hour Time Tag Check will be written to the LUT Data Exceptions File.

4.2.7 Operator Interface to LUT Data Exceptions

In general, the operator is notified of errors detected on a pass in his status display, and may recover the data files for examination from the LUT Data Exceptions File.

4.2.8 TCA and Receipt time Checks

The allowable differences between TCA or time of receipt at the satellite and current time or time of receipt at the MCC shall be stored in the LUT Validation Parameters.

4.3 MCC DATA VALIDATION

1. All MCC Alert Message, SITs 100-149, shall be checked by the Alert Process before processing. The checks serve to identify extreme, missing, or erroneous values in MCC solutions that may indicate malfunction.

2. These data checks shall take place after, and be in addition to, communication error checks performed during input.

3. The results of the checks shall be recorded in a permanent shared file and also shall be attached to the data for use by other sub-Processes.

4.3.1 MCC Data Checks

4.3.1.1 MCC Message Field Checks

Each MCC Alert Message shall be checked by the Alert Process for message CONTENT as per Table C.1 of Reference D, Annex C. Fields indicated by 'A' or 'X' in Table C.1 of Reference D shall be checked against the allowable values of those fields shown in Table B.1 of that document, including default values where applicable.

4.3.1.2 MCC Receipt Time Check

The time of receipt at the USMCC, as provided by the communications Process, shall be checked against the Message Transmit Time, field 3 of Reference D, C/S A.002. Allowable value ranges shall be stored in the MCC Data Validation Table.

4.3.1.3 MCC Local/Global Flag and Frequency Band Checks

The Local/Global Flag and Frequency Band fields, field 12 of Table C.1, Annex C, Reference D, shall be checked against the SIT number, field 4, of the same Table, as follows:

<u>SIT</u> <u>Number</u>	<u>Allowable</u> <u>Frequency Bands</u>	<u>Allowable Local/</u> <u>Global Flags</u>
115,117	1,2,3	+
125, 126, 127, 133	4,8,9	+,-

4.3.1.4 MCC Latitude/Longitude/TCA Check (future expansion)

In SITs 115, 117, 121, 125, 126, 127, and 133, the indicated latitude and longitude (Reference D, Annex C, Table C.1, MF #25 and #26) for the A- and B-positions shall be checked against the location of the spacecraft at TCA. In SITs 122, 123, and 124, the encoded latitude and longitude in the 406 Message (MF #23 of Table C.1, *ibid*), if available, shall be checked against the location of the spacecraft at TCA. The TCA shall be that of MF #14, and spacecraft location at TCA shall be computed using the Pass Prediction Input Data of Section 4.1.6. Allowable values of the differences shall be stored in the MCC Data Validation Table.

4.3.1.5 MCC A-B Probability Check

The sum of A- and B-Probabilities shall be checked against allowable values in the MCC Data Validation Parameter File.

4.3.1.6 MCC 406 Beacon Message Check

The 406 Message, MF #23 of Table C.1, Annex C, Reference D, shall be checked as specified in Appendix H, and also as per Reference E, Annex III/B.1.1.

4.3.1.7 MCC BCH Check

The 406 Message, MF #23 of C/S A.002, shall be checked for correct BCH as received at the US MCC, as follows:

(a) For the Short Message, the protected field (bits 25 - 85) shall be checked against the BCH error-correcting code (bits 86 - 106) of the same message, as exemplified in Annex B-1, of Reference F.

(b) For the Long Message, the First Protected Field (bits 25 - 85) shall be checked against the First BCH Error-Correcting code (bits 86 - 106) and the Second Protected Field (bits 107 - 132) shall be checked against the Second BCH Error-Correcting code (bits 133 - 144) of the same message, as exemplified in Annex B-2, of Reference F.

(c) Short Messages that have uncorrectable bit errors as per (a) above shall be tagged as uncorrectable.

(d) Long Messages that have no uncorrectable bit errors in the First Protected field, but have uncorrectable bit errors in the Second Protected field, shall be tagged as partly uncorrectable; the second protected data field (bits 107 - 132) shall be set to its default value.

4.3.1.8 Geosort Check

The Service Area, MF #24, if contained in the SIT, shall be checked against the Latitude and Longitude (MF #25 and #26) of the same message.

4.3.2 MCC Data Validation Parameters

The allowable values for checks 4.3.1.1 through 4.3.1.8, and the actions taken if any of the checks fails, shall be contained in an MCC Data Validation Parameters File.

4.3.3 MCC Data Exceptions File

MCC Alerts that fail the tests are written to a special MCC Data Exceptions File, removed from processing, or both, as indicated in the MCC Data Validation File.

4.3.4 Operator Interface to MCC Data Validation

The MCC Data Validation Parameters and the MCC Data Exceptions File shall be accessible for viewing, but not for modification, by the MCC Operator.

4.4 ALERT DATA CLASSIFICATION

After Validation, incoming data shall be classified in the Alert Process by frequency (121.5/243.-MHz or 406.-MHz), and formatted into the Alert Data Items (ADIs) shown in Table 4. Each ADI shall be assigned an ADI Type Code, as shown in the Table. The four bits in the ADI Type Code indicate the presence of: Beacon ID, LEO Event, Doppler location, Encoded location.

Table 4: Alert Data Items

121.5/243-MHz Doppler Location Data, **ADI Type Code 0110**

- (1) LUT 121.5-MHz Incident Data
- (2) LUT 243.-MHz Incident Data
- (*) LUT 121.5/243-MHz Interferer Data
- (3) LUT 406-MHz Interferer Data
- (4) MCC SIT 115 121.5/243. Incidents
- (5) MCC SIT 117 121.5/243. Ambiguity Resolution
- (6) MCC SIT 121 406 Interferer Notification

406-MHz LEO Doppler Encoded Location Data, **ADI Type 1111**

- (7) LUT 406-MHz PDS Doppler Encoded
- (8) LUT 406-MHz GSARP Location Data, Encoded
- (9) MCC SIT 125 406 Incident (Encoded)
- (10) MCC SIT 126 406 Position Conflict (Encoded)
- (11) MCC SIT 127 406 Ambiguity Resolution (Encoded)
- (12) MCC SIT 133 406 NOCR (Encoded)

406.-MHz LEO Doppler Location Data, **ADI Type 1110**

- (13) LUT 406.-MHz PDS Doppler Unencoded
- (14) LUT 406-MHz GSARP Location Data, Unencoded
- (15) MCC SIT 125 406 Incident (Unencoded)
- (16) MCC SIT 126 Position Conflict (Unencoded)
- (17) MCC SIT 127 Ambiguity Resolution (Unencoded)
- (18) MCC SIT 133 NOCR (Unencoded)

406- MHz LEO Unlocated Encoded Data, **ADI Type 1101**

- (18) LUT 406-MHz PDS and GSARP Unlocated Encoded
- (19) MCC SIT 122 406 Incident (No Doppler, Encoded)
- (20) MCC SIT 123 406 Position Conflict (Encoded Only)
- (21) MCC SIT 124 406 Ambiguity Resolution (Encoded Only)
- (22) MCC SIT 132 406 NOCR (Encoded Only)

406 MHz LEO Unlocated Unencoded, **ADI Type 1100**

- (23) LUT 406-MHz Unlocated

(24) MCC SIT 122 406 Incident (No Doppler) Unencoded

406-MHz GEO Encoded Data, ADI Type 1001

- (25) MCC SIT 122 406 Incident (Encoded)
- (26) MCC SIT 123 406 Position Conflict (Encoded Only)
- (27) MCC SIT 124 Ambiguity Resolution (Encoded Only)
- (28) MCC SIT 132 406 NOCR (Encoded Only)

406-MHz GEO Unencoded Data, ADI Type 1000

- (29) MCC 406 Incident (No Doppler, Unencoded)

NOTE: (*) Indicates expansion capability only

4.4 (A) The LUT Alert Data Items in Table 4. include all data items of both LUT Header and LUT solution data, grouped together and categorized according to the “fun” field of the associated Tag Buffers. In addition to the Headers and solutions, these items shall include (1) the time of receipt at the USMCC, as attached by the Communications Process, (2) the identification of the LUT sender, as indicated in the Tag Buffer, (3) communications errors, if any, and (4) flags appended by the LUT Validation indicating disposition of processing.

4.4 (B) The MCC SIT Items in Table 4. shall include the entire incoming SIT message, the time of receipt at the USMCC, and communications errors, as determined by the Communications Process, and flags appended by the MCC Validation indicating the disposition of processing.

4.4 (C) Non-Doppler Data (Encoded Location) Items in Table 4. shall contain vehicle location extracted from the beacon digital message, as per Reference F, and converted to latitude and longitude as per MF #25 and #26 of Reference D, annex B, plus the contents of the LUT or SIT message.

4.4 (D) Identification Only Data Items (1100 and 1000) shall contain the decoded beacon code. These Alert Data Items are present only if the beacon code does not include vehicle location encoded as per Reference F.

4.5 ALERT DATA FILTERING

4.5.1 Data Item Filtering

4.5.1.1 Alert Data Item Filtering shall provide the option of selecting Alert Data Items for (1) normal Match/Merge and further processing, (2) Special Processing, (3) Special routing, (3) Exceptions Processing, or (4) any combination of these.

4.5.1.2 Filtering options will be set by the operator or stored in the Alert Configuration File. Filtering options shall be specified according to any logical combination of the following Filtering Parameters applicable to the incoming Alert Data Item as given in Table 5.

Table 5: Alert Data Filtering Parameters

- (a) Results of Validation checks
- (b) Beacon ID, including selective bit configurations
- (c) Source (LUT, MCC)
- (d) Spacecraft
- (e) Spacecraft Instrumentation
- (f) TCA range
- (g) Location bounds
- (h) Long Message content
- (i) Frequency band and bias range
- (j) Destination of MCC message
- (k) Country of Beacon Registration (MID Code)
- (l) SIT Number
- (m) Beacon Protocol, Air/Marine/Personal Locator Type, Emergency Type, National Registration bits, vessel call sign, aircraft tail number.
- (n) Receipt time range
- (o) Input Data Item

4.5.1.3 The Filtering Parameter ranges and values shall be contained in the Alert Configuration File.

4.5.1.4 The Alert Process shall convert beacon ID characteristics entered by the operator to selective bit configurations for use in the Filtering (b) above.

4.5.2 Special Processing

Special Processing Options shall be determined by parameters stored in the Alert Configuration File. The options shall be carried out in the Alert Process, performed in other Processes, performed off-line, or performed by expansion capability in the FG-USMCC. Special Processing options in the FG-USMCC shall include, as a minimum, on-line storage of (1) data with Orbitography Beacon ID, (2) data with Test Beacon ID, (3) selected beacon data (Special Processing Beacon Data), and (4) data from beacons having locations in given bounds specified in the Alert Configuration File.

4.5.3 Exceptions Processing

The Exceptions Processing shall be capable of forwarding to Match/Merge, or suppressing from Match/Merge, any 406-MHz operational, test, or orbitography beacon data, based on processing options stored in the Alert Configuration File and applied to the Beacon ID.

Exceptions processing shall incorporate all Special routing defined for (U.S.) National Protocol beacons, as indicated in the Alert Configuration File. Special routing shall, as a minimum, reference a combination of country (MID) code and Block ID, so that the output message

can be sent to a special SRR, in addition to or in place of the SRR to be determined by Geosort. The position of the Block ID within the Beacon ID shall be configurable to different beacon protocols. The result of the Special routing process shall be attached to the data item in the form of a routing flag.

4.5.4 Special Routing

Special Routing shall provide for the attachment of codes to filtered items for routing to special destinations. Items shall be selected for special routing by the alert Filtering .

(a) Items filtered for special Routing shall be further filtered by MID-Code and Block ID if necessary to determine specific destinations.

(b) Special Routing shall be controlled by configuration Parameters contained in the Alert Configuration File. (the USMCC Operator will have the capability of setting the Alert Configuration File parameters that control Special Routing)

4.5.5 Conditions

Exceptions Processing, Special Processing, and Special Routing shall operate independently, so that no one of them will preclude or require the operation of any other.

4.6 ALERT DATA MATCH/MERGE

4.6-a: Validated Alert Data Items shall be matched and merged in the order of time of receipt at the FG-USMCC; Match/Merge shall be initiated when all Alert Data Items have been received for a particular pass over a LUT, as indicated by the Pass Completion Report, or when a complete SIT Message is received from an MCC.

4.6-b: Incoming Alert Data Items shall be Matched and Merged by the Alert Process into a separate 121.5/2443-MHz Active Site File and a 406-MHz Active Site file. The 406-MHz Interferer data shall be included in the 121.5/243-MHz Active Site File.

4.6-c: The Alert Process shall maintain the 121.5/243-MHz and 406-MHz Active Site Files continuously current as FG-USMCC shared files.

4.6-d: The Alert Process shall maintain 121.5/243-MHz and 406-MHz Closed (inactive) Files as FG-USMCC shared files in the same format as the corresponding Active Site Files.

4.6-e: The data retained in the Active and Closed Site Files shall, as a minimum, include the information given in Reference P and any other information contained in the incoming Alert Data Items.

4.6-f: Active and Closed Sites shall carry a code for classification, depending on the type of Alert Data Items contained in them, as follows: (1) Distress, (2) Test and Demonstration, (3) Interferer, (4) other.

4.6.1 121.5/243-MHz MATCH/MERGE

Terminology

The purpose of the 121.5/243 Match/Merge is to assimilate the incoming Alert Data Items of Table 4, ADI Type Code 0110, into the 121/243 Active Site File. The 121/243 Active Site File consists of any number of 121/243-MHz Active Sites, each identified by a unique Site number. An Active Site corresponds to a single beacon location on the Earth. A satellite pass over the beacon location (Pass) is reported by one or more LUTs or MCCs as a Doppler Location Data Item. Several LUTs and MCCs may report the same Pass. The Data Items are stored in the Active Site File for the beacon as Single Pass Locations, containing both A- and B- positions. Single Pass Locations for the same pass that coincide within certain criteria are merged into a Composite Single Pass Location. Single Pass Locations (whether or not Composite) from two or more passes may be merged into a Site Composite Location if either A- or B- location matches with another A- or B- location. In that case the A-B ambiguity is resolved, and a Composite Active Site Solution is produced. A Site consisting of only one Single Pass Location is termed a Single Pass Active Site.

Both Single and Composite Active Sites are employed for Alert message formation and graphic SAR display; upon certain conditions, Active Sites are closed to matching and merging with new Alert Data Items and become Closed Sites.

Requirements

1. The 121.5/243 Match/Merge shall consist of a Sideband Processing, a Single Pass Match, a Single Pass Merge, a Multiple Pass Match and a Multiple Pass Merge.
2. The 121.5/243-MHz Match/Merge shall be repeated as often as necessary to accommodate data from the US LUTs, late arrival data from LUTs, or data from foreign MCCs, as long as the Site remains open.
3. The 121.5/243-MHz Active Sites shall be identifiable as (a) Distress (b) 121.5/243-MHz Interferer, (c) 406-MHz Interferer, (d) Test and Demonstration, and (e) Special; identification shall be dependent on the type of the Alert Data Items and/or the geographic area of the beacon as defined by the operator.
4. Matching and Merging among data items shall be controllable by (a) frequency, i.e., 121.5 or 243-MHz, (b) the presence of sweep, (c) the presence or absence of interferer status. The controlling parameters shall be modifiable and stored in the Alert Configuration File.

4.6.1.1 Sideband Processing

1. Function: Sideband Processing shall combine all solutions reported by a LUT for the

sidebands and for the central frequency of a beacon transmission into a single solution for the pass from the LUT, having the parameters given in Reference G, Table 3.2. This single solution will be treated as a single 121.5/243-MHz LUT Doppler Location Data Item, but the solutions from which it is composed shall be retained in the Active Site File.

2. Initiation: Sideband Processing shall be initiated after all solution files and associated headers have been received from a LUT after the LOS. No Sideband Processing shall be performed if the LUT reports no 121.5/243-MHz solutions for the pass.

3. Selectivity: Separate Sideband Processing shall be performed for LUT 121.5-MHz Incident Data, for LUT 243-MHz Incident Data, for LUT 121.5/243-MHz Interferer Data, or for LUT 406-MHz Interferer Data.

4. Selection: Solutions shall be selected before combining. Selection of solutions of the same LUT shall be done on the basis of:

- (1) location proximity of A- and B- solutions
- (2) frequency band (i.e., 121.5-MHz Incident, 243-MHz Incident, or 121.5/243-MHz Interferer)
- (3) frequency bias from center of band, if available.

using configurable or default parameters for the location difference, frequency difference, and frequency band, as set in the Alert Configuration File.

5. Combining: Combining shall take place immediately after selection and shall be such as to produce a single solution representative of the beacon location, based on parameters and weighting factors stored in the Alert Configuration File.

6. Configurability: The parameters used for Selection and Combining shall be modifiable and stored in the Alert Configuration File.

4.6.1.2 121.5/243-MHz Single Pass Match/Merge

4.6.1.2.1 Single Pass Match

The Single Pass Match/Merge is intended to combine all Data Items for a single beacon pass.

(1) Data Items from LUTs and MCCs shall be matched in the order received from the Sideband Processing against all Single Pass Sites in the 121.5/243-MHz Active Site File.

(2) Matching shall be done by applying the following criteria, in the order shown:

- (a) same satellite and TCAs within M minutes, where M is specified in the Alert Configuration File.
- (b) location proximity, for paired A- and B- solutions

- (c) frequency bias separation, for paired A- and B- solutions
- (d) sweep period and score (expansion capability)

(3) Matching shall be based on the Match Probability Ratio of Reference M, or similar probability criteria. In evaluating criteria (b) and (c), the AA/BB and AB/BA combinations of the match candidates will be considered with different probability criteria.

(4) Interferer Data Items (LUT 121.5, 243, and 406-MHz Interferer Data, SIT 121 406 Interferer Notification) shall be matched only with data items of like type.

(5) If no Single Pass Site is found to match the incoming data, the incoming data shall become a New Single Pass Solution.

(6) Matching probability ratios and other parameters shall be stored in the Alert Configuration File, and shall be modifiable.

4.6.1.2.2 Single Pass Merge

(1) Data that match by the Single Pass Match shall be merged by Kalman Filter, batch least squares, or an equivalently enlightened error minimization method. Both A- and B- sides shall be merged using weighting factors stored in the Alert Configuration File.

(2) The result of the merge shall be a New or Revised Single Pass Composite Solution with the following merged parameters:

- (a) TCA and CTA
- (b) latitude and longitude
- (c) lat/lon standard deviation
- (d) lat/lon correlation coefficient
- (e) frequency bias and standard deviation
- (f) sweep period standard deviation (expansion capability)

The estimates (a) through (e) shall be developed separately for A- and B- solutions; estimate (f) is the same for both solutions.

4.6.1.3 121.5/243.-MHz Multiple Pass Match/Merge

4.6.1.3.1 Multiple Pass Match

- (1) The inputs for the 121.5/243-MHz Multiple Pass Match shall be either:
 - (a) a New Single Pass Solution resulting from the Single Pass Match, or, in future versions,
 - (b) a New or Revised Single Pass Composite Solution resulting from the Single Pass Merge, provided it is not in a Composite Site.

(2) The inputs shall be matched against all 121.5/243-MHz Active Sites. If the Active Site against which it is being matched is a Composite Site (ambiguity resolved), the input A-side and B-side shall be matched separately against the Composite Site solution; if the Active Site contains only one Single Pass Solution, or Single Pass Composite, the Candidate Solution A- and B- sides shall be matched successively against the A- and B- sides of the Single Pass Solution, i.e., the combinations AA, AB, BA, and BB will be tested.

- (4) Multiple Pass Matching shall be based on:
 - (b) location proximity
 - (c) frequency bias separation
 - (d) sideband separation (if available)
 - (e) sweep period and score (if available).

(5) Multiple Pass Matching shall employ the Match Probability Ratio of Reference M, or similar probability criteria to select the best match or no match. LUT 121.5/243-MHz Interferer Data Items shall be matched only with data items of like type.

(6) If a match is found within a Single Pass Site, or Single Pass Composite Site, the ambiguity will be resolved. If a match is found within an existing Composite Site, no ambiguity resolution is necessary.

(7) If the Multiple Pass Match produces no match, the New Single Pass Solution shall become a New Single Pass Site and shall be assigned a unique Site number according to a scheme defined by the USMCC Operations Chief. The Multiple Pass Merge will not be carried out.

(8) All parameters in the Multiple Pass Match shall be stored in the Alert Configuration File and shall be modifiable.

4.6.1.3.2 Multiple Pass Merge

4.6.1.3.2.1 Conditions

The Multiple Pass Merge shall be carried out in three cases:

(1) the Single Pass Merge produces a Single Pass Composite Solution in a Composite Site; in this case no Multiple Pass Match is performed and the Single Pass Composite Solution from the Single Pass Match and all other Single Pass Solutions in the Site Composite shall be re-merged to form a Revised Site Composite.

(2) the Multiple Pass Match produces a match to a Single Pass Site; in this case the ambiguity will be resolved and the Multiple Pass Merge shall be carried out on the matching sides of the two Single Pass Composite Solutions to form a New Site Composite.

(3) the Multiple Pass Match produces a match to a Composite Site; in this case the matching side of the Single Pass Solution shall be merged into the Composite Solution to form an Expanded Site Composite.

4.6.1.3.2.2 Method

Merging shall be by Kalman Filter, batch least square, or equivalent enlightened error minimization method, as appropriate. The result of the merge shall be improved estimates for the composite solution of:

- (a) TCA and CTA
- (b) latitude and longitude
- (c) lat/lon standard deviation
- (d) lat/lon correlation coefficient
- (e) frequency bias and standard deviation
- (f) sweep period standard deviation (expansion capability)

4.6.1.3.2.3 New Single Site

The above items (a) through (f) will be set to default values if the Multiple Pass Match produces no match and a New Single Site is formed.

4.6.1.3.2.4 Ambiguity Resolution

The Ambiguity resolution flag as indicated in Alert Data Item: MCC SIT 117, MF #24 (Ambiguity Resolution) shall not be used to resolve ambiguity, but the ambiguity resolution indicated in the SIT message shall be preserved in the Alert Data Item as stored in the Active Site.

4.6.2 406-MHz MATCH/MERGE

General

(1) The 406-MHz Match/Merge shall assimilate incoming Alert Data Items (ADIs) into the 406 Active Site File. The 406 Active Site File shall consist of any number of 406-MHz Active Sites, each Site containing all received Alert Data Items (ADIs) for a single Beacon ID. The Site ID is taken to be the Beacon ID.

(2) ADIs are assigned to Event Groups according to satellite and, within a satellite, according to Event Times. Event Times shall be taken as the contents of the TCA field of the ADI; this field contains the satellite-beacon TCAs for LEO Doppler data, burst reception time at the satellite for LEO non-Doppler data, and ground station reception times for GEO data.

(3) For purposes of Match/Merge, the Encoded Location portion of ADI Types 1001, 1101, and 1111 shall be contained in a separate Encoded Event Group. (Provision shall be made for future expansion to several such Encoded Event Groups.)

(4) The Single Pass Match/Merge shall form clusters of one or more Doppler Locations or Encoded Locations within their Event Groups. These clusters are either Doppler Clusters (containing Single Pass Doppler Solutions or Single Pass Doppler Composite Locations) or Encoded Clusters (containing Single Encoded Locations or Composite Encoded Locations). Locations in a Composite Cluster shall have met the Single Pass Match Criteria and have been Single Pass Merged to form the Composite Location.

(4-a) If the incoming ADI contains a Doppler Location, the Single Pass Match/Merge forms a New Single Pass Doppler Solution, a New Single Pass Doppler Composite Location, or a Revised Single Pass Doppler Composite Location.

(4-b) If the incoming ADI contains an Encoded Location, the Single Pass Match/Merge can form a New Encoded Location, a New Encoded Composite Location, or a Revised Encoded Composite Location.

(5) The Multiple Pass Match/Merge shall apply the Multiple Pass Match Criteria to the results of the Single Pass Match/Merge, as follows:

(5-a) If the Single Pass Match/Merge result already is in a Site Composite, the elements of the Site are re-merged to form a Revised Site Composite;

(5-b) If the Single Pass Match/Merge result is not in a Site Composite, it may meet the Multiple Pass Match Criteria with an existing Site Composite and merged with it to form an Expanded Site Composite;

(5-c) If the Single Pass Match/Merge result does not meet the conditions of (1) or (2), it is matched against all previous Single Pass Doppler Solutions, or Single Pass Composite Doppler Solutions not already in a Site Composite. The best match, if any, results in Ambiguity Resolution and the merge results in a New Site Composite.

(5-d) Single Pass Match Merge results that are not covered by (4-a), (4-b), or (4-c) above become New Blown Solutions or Revised Blown Solutions.

The 406 Active Site File is used for Alert message formation and graphic Alert display; Sites are closed and subsequently removed to the Closed Site Files as described below.

(6) Match/Merge shall be initiated when all solutions from a given LUT pass have been received, or when all solutions in a single MCC SIT message have been received.

(7) The Alert Process shall record for each Site the total number of Doppler Clusters and the number of Doppler Clusters in a Site Composite.

(8) The Alert Process shall record for each Site the total number of Encoded Clusters and the number of Encoded Clusters in a Site Composite.

(9) The Alert Process shall calculate the number of Blown Locations in each Site as the total number of Doppler and Encoded Clusters minus the total number of Doppler and Encoded Clusters in a Site Composite.

4.6.2.1 406-MHz Match/Merge (incoming Doppler Location Items)

The incoming Doppler Location Items of Table 4., having ADI Types 1110 and 1111, shall be passed through the Single Pass Match/Merge.

4.6.2.1.1 406-MHz Single Pass Match (incoming Doppler Location Items)

(1) If an incoming ADIs has a Beacon ID that does not match the ID of any existing 406-MHz Active Site, a New Site shall be opened with the incoming Beacon ID as Site ID. Two IDs match if they have the same Beacon ID (15 hex code) with default values for encoded bits, as inserted during LUT and MCC Validation. The incoming ADI shall be matched and Merged with the newly opened Site.

(2) Incoming Alert Data Items that match an existing 406-MHz Active Site ID shall be matched in the order received against all Single Pass (AB) Locations in the matching Site.

(3) Redundant Doppler Locations among the incoming ADIs shall be identified by matching against previously received Doppler Locations in the same Site having the same LUT or MCC Source, similar location, similar number of points, similar frequency bias and similar TCA. Similarity shall be determined by ranges set in the Alert Configuration Parameters. Redundant Doppler locations shall be Single Pass Matched but not Single Pass Merged.

(4) The Single Pass Match Criteria shall be:

- (a) same Beacon ID (15 hex code) with default values for encoded bits as inserted during LUT and MCC Validation, Sections 4.3.
- (b) same Event Group (same satellite and TCA within 20 minutes)
- (c) location proximities in either the configuration AA/BB or in the configuration AB/BA

(5) Location Matching for (c) shall employ the matching criteria of Reference E, or similar matching criterion to A- and B- sides to select the best match or no match.

(6) Given the match criteria, the following steps shall be followed to incorporate the incoming Data Items into the Active Site File:

a. Doppler Location Items that match no existing Active Site by criterion 4.(a) shall be established as a New Single Pass Site under a new Active Site number.

b Doppler Location Items that best match an existing Single Pass Solution in criteria (a), (b) and (c) shall be merged with it via the Single Pass Merge (below) to form a New Single Pass Composite Solution or a Revised Single Pass Composite Location.

c Doppler Location Items that match an existing Single Pass Solution in (a) and (b) but not in (c) shall be added as a New Single Pass Solution for the Event Group

d Doppler Location Items that match an existing Site in criteria (a) but have no match in (b) shall be identified as New Single Pass Solutions for that Site.

(7) Matching shall be controlled by the Alert Configuration Parameters, which shall be configurable and stored in the Alert Configuration File.

4.6.2.1.2 406-MHz Single Pass Merge (incoming Doppler Location Items)

(1) Doppler Location Data Items that meet the Single Pass Match Criteria 4. (a) (b) and (c) shall be merged into it via a Single Pass Merge.

(2) The Single Pass Merge shall be carried out by Kalman Filter, batch least squares, or equivalent enlightened error minimization process. The output of the Single Pass Merge shall be a New or Revised Single Pass Composite Solution with improved estimates for both A- and B-sides of:

- (a) TCA
- (b) latitude and longitude
- (c) lat/lon standard deviation
- (d) lat/lon correlation coefficient
- (e) frequency bias and standard deviation.

(3) Merging shall be controlled by a set of parameters stored in the Alert Configuration File.

4.6.2.1.3 406-MHz Multiple Pass Match (incoming Doppler Location Items)

4.6.2.1.3.1 Inputs

The 406-MHz Multiple Pass Match shall be carried out on one of the following results of the Single Pass Match/Merge (SPMM result):

- (a) a New Single Pass Solution in a new Event Group, resulting from the Single Pass Match;
- (b) a New Single Pass Solution in an existing Event Group, resulting from the Single Pass Match;
- (c) a New or a Revised Single Pass Composite Solution in an existing Event Group, resulting from the Single Pass Merge, provided that it is not in a Site Composite.

4.6.2.1.3.2 Method

The A- and B- sides of the Single Pass Match/Merge result shall be matched first against all Site Composites (C) in the Site, considering possible AC and BC matches; then against all Single Pass Solutions (not in a Site Composite) in other Events in the Site, considering possible AA, AB, BA, and BB matches; and finally against all Encoded (E) Locations not in a Site Composite, considering AE and BE combinations. Matching shall be based on:

- (a) location proximity
- (b) frequency bias separation (expansion capability)

The matching shall employ the Match criteria of Reference E, or similar criteria, to select the best match or no match. Matching parameters shall be modifiable and shall be stored in the Alert Configuration File.

4.6.2.1.3.3 Results

CASE A: If a match is found to a Composite Site Solution, the Multiple Pass Merge shall be performed to produce an Expanded Site composite.

CASE B: If a match is found to a Single Pass Doppler Solution or Single Pass Doppler Composite Solution in another Event in the Site, or to a Single or Composite Encoded Location, then Ambiguity Resolution shall be take place, and the Multiple Pass Merge shall be performed to produce a Site Composite.

If no match is found the result of the Multiple Pass Match will be:

CASE C: A New or Revised Single Pass Composite in the Event Group, or

CASE D: A New Single Solution in the Event, (Blown Solution) that does not match in position with other Single Pass Solutions in the Event Group, or

CASE E: A New Single Pass Solution in a New Event

4.6.2.1.4 406-MHz Multiple Pass Merge (incoming Doppler Location Items)

4.6.2.1.4.1 Inputs

The Multiple Pass Merge shall be carried out on CASE A or CASE B resulting from the Multiple Pass Match, or on the Composite Single Pass Solution resulting from the Single Pass Merge if it belongs to a Site Composite.

4.6.2.1.4.2 Method

Merging shall be by Kalman Filter, batch least square, or equivalent enlightened error minimization method. Merging shall be controlled by a set of configurable parameters, stored in the Alert Configuration File. The result of the merge shall be resolution of the ambiguity, if any, and improved estimates for the composite values of:

- (a) TCA and CTA
- (b) latitude and longitude
- (c) lat/lon standard deviation
- (d) lat/lon correlation coefficient
- (e) frequency bias and standard deviation (future expansion)

The composite values (a) through (f) above are set to default values when a Site is opened

4.6.2.1.4.2 Conditions

Merging in CASE A shall limit the weight of older passes contained in a Site when merged with an incoming New or Revised Single Pass Solution (Doppler or Encoded), so as to allow the merged solution to move with more recent pass locations.

4.6.2.1.4.3 Results

A New or revised Composite Site Solution will be formed from the sides selected in the Multiple Pass Match, or from the real sides in the Site Composite.

4.6.2.2 406-MHz Match/Merge (incoming Encoded Location Items)

4.6.2.2.1 406-MHz Single Pass Match (incoming Encoded Locations)

4.6.2.2.1.1 Inputs

Incoming 406-MHz Encoded Location Data shown in Table 4 (ADI Types 1001, 1101, 1111) shall be Single Pass Matched and Merged first as the corresponding Unencoded Data Types 1000, 1100, and 1110 and then as Encoded Data Types.

4.6.2.2.1.2 Encoded Location Data - Single Pass Match

The incoming Encoded Location Data Items shall be matched to Single Encoded Locations and Composite Encoded Locations as follows:

4.6.2.2.1.2.1 Event Time

The Event Time of the incoming Encoded Location Data Item shall be the TCA field of the Doppler Data from which it was derived or the time in the TCA field of the MCC SIT, or the time of burst message reception at the satellite, reported by the LUT, or the time of reception reported by the GEO ground station. (See Section 4.6.2. (2) of this document)

4.6.2.2.1.2.2 Site Match

- a. if no matching Site ID is found, the Data Item will be used to create a New Site;

4.6.2.2.1.2.3 Event Group

- a. all incoming Encoded items shall be matched to a single Encoded Event Group
- b. if a matching ID is found but there is no Encoded Event Group, a New Encoded Event Group shall be established for the Site;

4.6.2.2.1.2.4 Location Match

- a. if a matching Site and Event are found, the incoming Data Item shall be matched against all Single Encoded Locations and Composite Encoded Location clusters in the Event Group
- b. if no match is found, the incoming Data Item will be entered into the matching Event Group as a New Encoded Location.

4.6.2.2.1.2.5 Match Criteria

The location matching shall employ the Match Criteria of Reference E, or equivalent criteria, to select the best match, or no match. Matching parameters shall be configurable and stored in the Alert Configuration File.

4.6.2.2.1.2.6 Redundant Encoded Data

- (a) An incoming Encoded Data Item shall be considered redundant if its Beacon ID (30 hex message) matches, bit for bit, the Beacon ID of the Encoded Location Data Item with the immediately preceding TCA field.
- (b) The Encoded Location with the earliest TCA field shall not be considered redundant.
- (c) Redundant Encoded Location Data Items shall be Single Pass Matched but not Single Pass Merged.

4.6.2.2.2 406-MHz Single Pass Merge (incoming Encoded Locations)

4.6.2.2.2.1 Encoded Location Merge

(1) Encoded Location Data Items that meet the Single Pass Match Criteria shall be merged into the matching Encoded cluster via a Single Pass Merge.

(2) The Single Pass Merge shall be carried out by Kalman Filter, batch least squares, or equivalent enlightened error minimization process. The output of the Single Pass Merge shall be a New or Revised Single Pass Encoded Solution with improved estimates for E- location of:

- (a) latitude and longitude
- (b) lat/lon standard deviation
- (c) lat/lon correlation coefficient
- (d) frequency bias and standard deviation (future expansion)

(3) Merging shall be controlled by a set of parameters stored in the Alert Configuration File.

4.6.2.2.3 406-MHz Multiple Pass Match (incoming Encoded Locations)

4.6.2.2.3.1 Inputs

The 406-MHz Multiple Pass Match shall be carried out on one of the following results of the Single Pass Encoded Match/Merge in the Encoded Event Group:

- (a) a New Encoded Location
- (b) a New or Revised Composite Encoded Location that it is not in a Site Composite.

4.6.2.2.3.2 Method

The Single or Composite Encoded Location shall be matched first against all Site Composites in the Site, then against all Single Pass Doppler Solutions and all Single Pass Doppler Composite Solutions not in a Site Composite. Matching shall be based on:

- (a) location proximity
- (b) frequency bias separation (expansion capability)

The matching shall employ the Match criteria of Reference E, or similar criteria, to select the best match or no match. Matching parameters shall be modifiable and shall be stored in the Alert Configuration File.

4.6.2.2.3.3 Results

- CASE A: If a match is found to a Composite Site Solution, the Multiple Pass Merge shall be performed to produce an Expanded Site Composite.
- CASE B: If a match is found to a Single Pass Doppler Solution or Single Pass Doppler Composite Solution then Ambiguity Resolution shall be take place, and the Multiple Pass Merge shall be performed to produce a Site

Composite.

If no match is found in CASE A or B above, the result of the Multiple Pass Match will be:

CASE C: A New Encoded Location the Encoded Event Group

CASE D: A Revised Composite Encoded Location in the Encoded Event Group, or

CASE E: A New Single Location in the Encoded Event Group, that does not match in position with other encoded Location in the Encoded Event Group (Blown Encoded Location).

4.6.2.2.4 406-MHz Multiple Pass Merge (incoming Encoded Location Items)

4.6.2.2.4.1 Inputs

The Multiple Pass Merge shall be carried out on CASE A or CASE B resulting from the Multiple Pass Match, or on the Composite Encoded Solution resulting from the Single Pass Merge if it belongs to a Site Composite.

4.6.2.2.4.2 Method

Merging shall be by Kalman Filter, batch least square, or equivalent enlightened error minimization method. Merging shall be controlled by a set of configurable parameters, stored in the Alert Configuration File. The result of the merge shall be Ambiguity Resolution, if CASE B, and improved estimates for the composite values of:

(a) latitude and longitude

(b) lat/lon standard deviation

(c) lat/lon correlation coefficient

(d) frequency bias and standard deviation (future expansion)

The composite values (a) through (d) above are set to default values when a Site is opened

4.6.2.2.4.3 Conditions

Merging in CASE A shall limit the weight of older passes contained in a Site when merged with an incoming New or Revised Single Pass Encoded Solution so as to allow the merged location to move with more recent pass locations.

4.6.2.2.4.4 Results

A New or Revised Site Composite will be formed from the sides selected in the Multiple Pass Match, or from the real sides in the Site Composite.

4.6.2.3. 406-MHz Match/Merge (No Doppler or Encoded Data)

Data Items of Table 4 having no Doppler or Encoded Data (ADI Type 1000 and 1100) shall undergo an Identification and Event Match. The following steps shall be taken:

1. the Beacon ID shall be matched against all Sites. If no matching Site is found, a New Site shall be opened.
2. if a matching Site is found, the Event Time (TCA field of the Alert Data Item) shall be matched against all Event Groups in the Site, if any, using the match parameters given in the Alert Configuration File.
 - a. If no match is found, the Data Item shall be entered under the Site as a New Event
 - b. If a matching Event Group is found the Data Item shall be entered into it
3. if the matching Site has no Event Groups the Data Item shall be entered as a New Event in the Site.

4.6.3 Exceptions Processing

Orbitography beacons, test beacons, and specially selected beacon IDs shall be processed through Match/Merge only if so routed by the Classification and Filtering, Section 4.4. Exceptions Processing shall consist of matching and merging as above, and internal storage of the results rather than issuance of an alert or message, as per Section 4.5. In addition, the operator shall have the following options:

1. Matching, but not merging
2. Computation of error from preset true location
3. Display of error statistics at the operator's console
4. Recording Active Site Data and error statistics on a special file.

4.6.4 Processing of Invalid Data

Alert Data Items failing LUT Data Validation or MCC Data Validation checks as indicated above, and routed to Match/Merge by Alert Data Filtering, shall be matched to the Event Level and stored, but not merged, in the Active Site File, provided they have been flagged for such action by the Exceptions Processing. Flagging shall be a configuration parameter, and shall also be operator controlled.

4.6.5 Alert Processing Log

The Alert Process shall maintain a log of its operation, including:

- (a) time of receipt of LUT and MCC Input Data
- (b) Times of initiation and completion of Match/ Merge
- (c) Times of completion of Message Formation and Routing
- (d) changes in configuration files, including previous values, and time of modification

4.7 NEXT PASS AND MISSED PASS COMPUTATION

4.7.1 Next Pass Computation

- (a) The Alert Processor shall employ the Pass Schedule Input Data of Section 4.1.6 to compute the next N satellite passes expected over any A-, B-, C-, or E- beacon location created or modified in the Match/Merge, where N is a parameter set in the Alert Configuration File. (Next Passes for image locations need not be retained if a Composite Site is formed.)
- (b) Next Pass Visibility shall include both Local Visibility, based on simultaneous beacon and LUT visible to the satellite, and Local/Global visibility, based on beacon visibility to satellite immediately prior to a Global satellite dump to the LUT.
- (c) Both Local and Local/Global visibility shall be determined by a set of configuration parameters stored in the Alert Configuration File.
- (d) The following Next Pass Data shall be computed for use in Message Formation:
- location Type (=A, B, C, E)
 - TCA,
 - satellite,
 - LUT
 - start time of visibility,
 - stop time of visibility,
 - beacon-satellite elevation angle
 - visibility type (Local, Global/Local)
- (e) LUT availability, satellite instrumentation availability, mutual satellite/LUT/beacon visibility, and minimum beacon visibility angle (obtained from the appropriate USMCC shared data or indicated by operator input) shall be taken into account in computing next passes.
- (f) The Alert Process shall maintain a list of current Next Passes for all Sites in the Active Site File (Next Pass List).
- (g) Next Pass data from other MCCs shall be retained for the Message Formation process, but any one Next Pass over a US LUT shall be employed instead of the other MCC data if it is earlier.

4.7.2 Missed Pass Computation

- (a) The Alert Process shall increment the Missed Pass Counter and generate a Missed Pass Message Type when a missed pass is generated.
- (b) A missed pass shall be generated when a Data Processing Group has been received

from a LUT or MCC that does not contain data for a site that has visibility to the LUT on the pass. Visibility to the LUT on the pass shall be determined by the Next Pass algorithm.

4.8 SITE MAINTENANCE

a. The Alert Process shall maintain 121.5/243-MHz and 406-MHz Closed Site File in the same form as the Active Site Files.

b. An Active Site shall be moved to the Closed Site File when X hours have expired since the latest TCA recorded in the Site, or when Y successive predicted passes have not been received, whichever occurs first, where X and Y are set as Alert Configuration Parameters. Separate values of X and Y shall be set for 121.5/243-MHz Sites and for 406-MHz Sites.

c. When a Site is closed on the basis of time since last TCA, a message to that effect shall be transmitted to any US RCC that has received prior notice of the Site.

d. Data received for a Closed Site within Z hours of the last TCA stored in the Site for the same satellite shall be matched as for Active Sites, but not merged; data received after Z hours have expired shall be used to form a new Active Site; a Closed Site shall not be purged from the Alert Process less than Z hours after the last TCA. The parameter time Z shall be a configuration parameter stored in the Alert Configuration File.

e. No messages shall issue from a Closed Site.

4.9 ALERT MESSAGE GENERATION, ROUTING AND FORMATION

Changes to the Active Site File will normally induce the issuance of alert messages to the US RCCs, SPOCs, and foreign MCCs. This section defines the requirements for generation, routing and formation of alert messages.

4.9.1 Message Generation

The FG-USMCC shall generate the Message Types given in the following Sections :

4.9.1.1 121.5/243-MHz Match/Merge Messages Types

The 121.5/243-MHz Match/Merge shall generate the following types of messages:

1. First Alert
2. Composite
3. Continued Composite
4. 406 Interferer New Site (future expansion)
5. 406 Interferer New Composite (future expansion)
6. 406 Interferer Expanded Composite (future expansion)

4.9.1.2 406-MHz Match/Merge Message Types

The 406-MHz match/Merge shall generate the following Message Types

1. First Alert - Unlocated input
2. First Alert - Doppler and/or Encoded input
3. Blown Solution - Doppler and/or Encoded Input
4. Ambiguity Resolution - Doppler and/or Encoded input
5. Continued Composite - Doppler and/or Encoded input
6. Better A-B - Doppler input (future expansion)
7. Continued Blown Solution Message Type

4.9.1.3 New Detection Message Type (future expansion)

This Message Type shall be issued for all input ADIs when no message type has been issued from Match/Merge within a period of time set as a Configuration Parameter. The generation of this Message Type requires that the Missed Pass counter for the Site be reset to zero.

4.9.1.4 NOCR Message Type

- (a) An NOCR Message Type shall be generated for all input Alert Data Items that contain location information, except
- (b) Receipt of a SIT 925 shall not produce an NOCR Message Type; and
- (c) The NOCR Message Type shall be generated no more than once for each Site.

4.9.1.5 SIT 925 Registration Message Type (future expansion)

1. A SIT 925 received at the USMCC shall generate a Registration Message Type if:
 - (1) There is an Active Site matching the Beacon ID of the SIT 925.
 - (2) The Active Site has one or more locations.
 - (3) The Beacon ID in the SIT 925 is not in the US 406 Registration Data Base.
2. An Alert received at the USMCC shall generate a Registration Message Type if:
 - (1) SIT 925 data are available at the USMCC, as an Input Message, or
 - (2) the alert is for a non-US beacon found in the 406 Registration Data Base

4.9.1.6 Missed Pass Message Type

This message type is generated for each Site for which the Missed Pass Counter has been incremented.

4.9.2 Geosort

Geosorting is the determination of SRR designation(s) for a given location on the Earth,

which SRR designations (SRR Codes) are required to generate the addressee lists of SIT messages. Geosorting is performed by the SAR Mapping Function of the FG-USMCC, as initiated by the Alert Process or other FG-USMCC Processes. For the USMCC the possible SRR Areas are:

- (a) RCCs and SPOCs within the US MCC Service Area, as listed in Reference E, Annex II/C.US, with boundaries defined in the FG-USMCC Geosort Data Base;
- (b) Service Areas of Commissioned MCCs other than the USMCC, as listed in Reference E, Annex II/A.1, with boundaries defined in the FG-USMCC Geosort Data Base;
- (c) “Other Regions” as defined in Reference E, Sec 4.1.1.2 c), with boundaries defined in the FG-USMCC Geosort Data Base.
- (d) “Geosort Holes”, which are locations for which no SRR is available in the Geosort.

4.9.2.1 Initiation

The FG-USMCC Alert Process will initiate the Geosorting of A, B, C (Composite) and E (Encoded) locations resulting from the Match/Merge, as required.

4.9.2.2 Requirements

The following requirements shall be met by the Geosort function, when initiated by the Alert Process:

4.9.2.2.1 Determination of SAR Area designation shall be correct for locations 1.0 km or more from a boundary.

4.9.2.2.2 Geosort boundaries shall include as a minimum all US RCC areas, SPOCs in the USMCC Service Area, and all other COSPAS-SARSAT MCC Service Areas.

4.9.2.2.3 SRRs shall be implemented in such a way as to allow one SRR to overlap another, or for a buffer zone of uniform width to be constructed on either side of the line between two SRRs. When a given location falls within more than one SRR, the Geosort will return all SRRs that include the given point.

4.9.2.2.4 For locations for which no SAR Designation is available in the Geosort (a “Geosort Hole”) a SAR Area designation shall be returned to the Alert Process indicating such condition.

4.9.2.2.5 Geosort SAR Area designations shall be geographic area designations rather than communication destinations, and shall indicate primary, buffer, and overlap status of the Area.

4.9.3 Message Routing

4.9.3.1 Routing Data

4.9.3.1.1 SIT Table

Tables 6. and 7. show the SIT Message Numbers that shall be formulated for each Message Type. The COM SITE LISTs are lists of addressees of the Alert messages. They contain the names of communication sites (Com Site Names) to which the USMCC will transmit the Alert Message. Each addressee shall be sent the SIT message shown to the right in the Table, according to whether the addressee is a US RCC, a US SPOC, an (OLD) MCC, a (NEW) MCC, or a Special Addressee (SPCL).

4.9.3.1.1.1 The formats of the SIT messages in Tables 6 and 7 are given in References D and N.

4.9.3.1.1.2 The USMCC shall be capable of transmitting either OLD SIT or NEW SIT messages as defined in Reference D., Table A.1. Selections between OLD and NEW SIT shall be configuration parameters stored by destination, as specified by the USMCC Operations Chief.

Table 6: Sit Table for 121.5/243-MHZ Alert Messages

<u>MESSAGE TYPE</u>	<u>COM SITE LIST</u>	<u>ALERT MSG TYPE</u>				
		<u>US RCC</u>	<u>US SPOC</u>	<u>OLD MCC</u>	<u>NEW MCC</u>	<u>SPCL</u>
Input						
<u>FIRST ALERT</u>						
Doppler	First Alert List	151	185-X	115	115	N/A
<u>MISSED PASS</u>						
US LUT Pass	Missed Pass List	158	N/A	N/A	N/A	N/A
<u>COMPOSITE</u>						
Doppler	Composite	156	185-Y	131	117	N/A
<u>CONTINUED COMPOSITE</u>						
Doppler	Continued Composite List	157	185-Z	131	117	N/A
<u>406 INTERFERER - NEW SITE</u>						
Doppler	406 Interferer List	N/A	N/A	114	121	N/A
<u>406 INTERFERER - NEW COMPOSITE</u>						
Doppler	406 Interferer List	N/A	N/A	114	121	N/A
<u>406 INTERFERER - EXPANDED COMPOSITE</u>						
Doppler	406 Interferer List	N/A	N/A	114	121	N/A

Table 7: Sit Table for 406-MHZ Alert Messages

<u>MESSAGE TYPE</u> Message Sub-Type	COM SITE <u>LIST</u>		<u>ALERT MESSAGE CLASS</u>					
			<u>US</u> <u>RCC</u>	<u>US</u> <u>SPOC</u>	<u>OLD</u> <u>MCC</u>	<u>NEW</u> <u>MCC</u>	<u>RCC</u> <u>135</u>	<u>SPCL</u>
<u>FIRST ALERT</u>								
Unlocated	Unlocated List	160	185-X	135	122	135	N/A	
Doppler	First Alert List		161-F	185-D	125-O	125-N	135	N/A
Encoded	First Alert List		161-F	185-E	135	122	135	N/A
Doppler-Encoded	First Alert List		161-F	185-D	125-O	125-N	135	N/A
<u>NOCR</u>								
Doppler	NOCR List		168	185-N	133	133	N/A	N/A
Encoded Only	NOCR List		168	185-N	135	132	N/A	N/A
Doppler-Encoded	NOCR List		168	185-N	133	133	N/A	N/A
<u>REGISTRATION</u>								
925 Input	925 List		168	985	925	925	N/A	N/A
Alert Input	Registration List		168	985	925	925	N/A	N/A
<u>BLOWN SOLUTION</u>								
Doppler	Blown Solution List		163	185-B	125	126	135	N/A
Encoded	Blown Solution List		163	185-C	135	123	135	N/A
Doppler-Encoded	Blown Solution List		163	185-B	125	126	135	N/A
<u>MISSED PASS</u>								
US LUT Pass - First Alert	Missed Pass List		166	N/A	N/A	N/A	N/A	N/A
US LUT Pass - Composite	Missed Pass List		166	N/A	N/A	N/A	N/A	N/A
<u>AMBIGUITY RESOLUTION</u>								
Doppler	Ambiguity Resolution List		164-F	185-R	134	127	135	N/A
Encoded	Ambiguity Resolution List		164-F	185-S	135	124	135	N/A
Doppler-Encoded	Ambiguity Resolution List		164-F	185-R	134	127	135	N/A
<u>CONTINUED COMPOSITE</u>								
Doppler	Continued Composite List		165-U	185-U	134	127	135	N/A
Encoded	Continued Composite List		165-U	185-V	135	124	135	N/A
Doppler-Encoded	Continued Composite List		165-U	185-U	134	127	135	N/A
<u>CONTINUED BLOWN SOLUTION</u>								
Doppler	Cont'd Blown Solution List		163	185-B	125	126	135	N/A
Encoded	Cont'd Blown Solution List		163	185-C	135	123	135	N/A
Doppler-Encoded	Cont'd Blown Solution List		163	185-B	125	126	135	N/A

4.9.3.1.3 Send Level Codes

Each Active Site shall contain a Message Send Level Code by SRR, inserted by the USMCC Operator.

4.9.3.1.4 SAR Code Table

The USMCC shall store a SAR Code Table as Configuration Parameters. The SAR Code Table shall list, as a minimum, SAR Codes for all SRRs returned by Geosort and all MID Codes for which the USMCC is the Support MCC. For each SAR Code the Table holds: (1) Send Codes for First Alerts, for Missed Passes, and for Composite Missed Passes; (2) the maximum number of Composite messages to be sent at 121.5/243-MHz and at 406-MHz; (3) SAR Codes that are to receive the same message (echo destinations); and (4) the SAR Code from which messages are transmitted to the listed SAR Code (Nodal Overrides).

4.9.3.1.5 MID Code Table

The USMCC shall store a MID Table as Configuration Parameters. It shall list, as a minimum, every Country Code (MID Code) given in Reference E, Annex J, "LIST OF COUNTRY CODES". For each listed MID Code, the MID Table shall hold the name of the country, and the SAR Codes from which the country receives (1) Unlocated Alerts and (2) NOCRs.

4.9.3.1.6 Alert and NOCR Routing Matrix

The USMCC shall store the Alert Routing Matrix and NOCR Routing Matrix, Reference E, Figure G-7 et al. These matrices give the sequence of MCCs traversed by an Alert or NOCR going from one MCC to any other.

4.9.3.2 COM SITE LISTS

The entries in the COM SITE LISTS are the Com Site Names of MCCs, RCCs, and SPOCs with which the USMCC is in direct communication. The COM SITE LISTS are generated as specified in the following sections.

4.9.3.2.1 First Alert List

This is the list of addressees for First Alert Message Type.

- (a) The list shall be made up of the SRR Codes returned from Geosort for the A-, B- and/or E-locations associated with the input ADI.
- (b) the list shall be filtered by the Send Message Levels in the Active Site SRR Table and by the Send Codes in the SAR Routing Table
- (c) "Echo Destinations" from the SAR Routing Table shall be added for each SRR Code in the list
- (d) the resultant list shall be screened for redundancies, Send Message Levels and Send Codes.
- (e) each SRR Code on the list shall be converted to a destination Com Site Name via the SAR Table and the Alert Routing Matrix; the list of destination Com Site Names shall be screened so that

no more than one message is sent to any Com Site Name
no message is sent if the Com Site Name will receive it from another MCC
no message is sent if the Com Site Name is the source of the input ADI

4.9.3.2.2 Ambiguity Resolution List

This is the sum of all previous First Alert Lists generated for the Site, screened for redundancy.

4.9.3.2.3 Better A-B List (future expansion)

4.9.3.2.4 Continued Composite List

This is the list for continued receipt of alerts after the Composite is formed.

- (1) At Ambiguity Resolution, the Composite location (first real side Doppler location to have been processed in the Site) is selected. A list of SRRs is created for the selected location.
- (2) After Ambiguity Resolution, the list of SRRs is retrieved and SRRs are removed from the list if the number of Composite messages sent reaches the maximum indicated in the SAR Table for the SRR Code.
- (3) The SRRs remaining on the list shall be converted to Com Site Names by the process given for First Alert List above. These Com Site Names shall constitute the Continued Composite List.

4.9.3.2.5 406-MHz Interferer List (future expansion)

This list shall consist of the First Alert List that would be generated for the input ADI 406 Interferer Doppler locations, plus a list fixed specified by the USMCC Operations Chief, and stored in the Alert Configuration File.

4.9.3.2.6 Missed Pass List

The Missed Pass List shall contain all Active Site Beacons that were not reported in the LUT pass but which were visible to the reporting LUT, including rejected and low angle passes that meet the mutual or Global Local visibility criteria specified in the Alert Configuration File. The Missed Pass List shall be as specified in 4.2.4.2.

4.9.3.2.7 NOCR List

The NOCR List depends on the MID Code of the Beacon ID and the Alert SRR Codes returned by Geosort for the A-, B-, and E- locations of the input ADI. The NOCR List shall be produced as follows:

- (a) If the MID Code is a US MID Code:
 - (1) if any of the Alert SRR Codes is a US SRR Code, the NOCR List is empty.
 - (2) if all the Alert SRR Codes are outside the USMCC Service area, then the NOCR List consists of LANTAR, PACAR, and the SAR Code of the Homeport or Airport

- for the beacon, if any is contained in the 406 RDB.
- (b) If the MID Code is not US, then the Support MCC is looked up in the MID Table:
- (1) if the Support MCC is USMCC, the Com Site Name is looked up in the SAR Table under the SAR Code corresponding to the MID Code, and this is entered into the NOCR List.
 - (2) if the Support MCC is not USMCC, each of the Alert SRR Codes is converted to a destination Com Site Name, via the SAR Table and the NOCR Routing Matrix. The list of destination Com Site Names is screened so that
 - no more than one message is sent to any Com Site Name
 - no message is sent if the Com Site Name will receive it from another MCC
 - no message is sent if the Com Site Name is the source of the input ADI
- In addition, the following screens shall be applied to NOCR messages:
- no NOCR is sent if an Alert message has already been sent to the Support MCC
 - no NOCR is sent if the input ADI is an unlocated alert
 - no more than one NOCR is sent to the Support MCC
- The screened list of Com Site Names is entered into the NOCR List.

4.9.3.2.8 SIT 925 List

The SIT 925 List is the list of Com Site Names to which the USMCC forwards a SIT 925 received from a foreign MCC. Both US and non-US recipients may appear on the 925 List. Routing is to be via the NOCR network.

- (a) The list shall be made up of the SRR Codes returned from Geosort for the A-, B- and/or E-locations of the First Alert and Blown Solutions of the Site
- (b) the list shall be filtered by the Send Message Levels in the Active Site SRR Table and by the Send Codes in the SAR Routing Table
- (c) "Echo Destinations" from the SAR Routing Table shall be added for each SRR Code in the list
- (d) the resultant list shall be screened for redundancies, Send Message Levels and Send Codes.
- (e) each SRR Code on the list shall be converted to a destination Com Site Name via the SAR Table and the NOCR Routing Matrix; the list of destination Com Site Names shall be screened so that
 - no more than one message is sent to any Com Site Name
 - no message is sent if the Com Site Name will receive it from another MCC
 - no message is sent if the Com Site Name corresponds to the source of the input ADI

4.9.3.2.9 Registration List

The Registration List shall consist of the Com Site Names to which the USMCC sends 925 Registration data when an alert has been received for a non-US beacon ID. The Registration List shall be generated in the same way as a First Alert List for the locations of the input Alert, except that routing shall correspond to that for NOCRs rather than for Alerts.

- (a) The list shall be made up of the SRR Codes returned from Geosort for the A-, B- and/or E-locations associated with the input ADI.
- (b) the list shall be filtered by the Send Message Levels in the Active Site SRR Table and by the

Send Codes in the SAR Routing Table

- (c) "Echo Destinations" from the SAR Routing Table shall be added for each SRR Code in the list
- (d) the resultant list shall be screened for redundancies, Send Message Levels and Send Codes.
- (e) each SRR Code on the list shall converted to a destination Com Site Name via the SAR Table and the NOCR Routing Matrix; the list of destination Com Site Names shall be screened so that
 - no more than one message is sent to any Com Site Name
 - no message is sent if the Com Site Name will receive it from another MCC
 - no message is sent if the Com Site Name is the source of the input ADI

4.9.3.2.10 Unlocated List

The Unlocated List shall be derived from the MID Code of the Beacon ID (Bits 27-36) of the input ADI.

- (1) If the Beacon has a US MID Code, then the 406RDB is tested;
 - (a) if the 406RDB returns a SAR Code for the Home Port/Airport the corresponding Com Site Name becomes the Unlocated List, otherwise no message is routed.
- (2) If the beacon MID Code is not US, the destination SRR is taken as the Unlocated Destination SRR in the MID Table.

4.10 SITE MAINTENANCE

4.10.1 Site Frequency Determination - 121.5/243-MHz

The 121.5/243-MHz Active Site data base shall retains an integer indicator of its frequency type:

- 1 = 121.5-MHz Site
- 2 = 243-MHz Site
- 3 = 121.5/243-MHz Site
- 4 = 406-MHz Interferer Site

4.10.2 Site Frequency Determination - 406-MHz

The 406-MHz Active Site data base retains an integer indicator of its frequency type:

- 1 = 406-MHz Test or Demonstration Site
- 0 = 406-MHz Distress Site

4.10.3 Error Ellipse Computation

The error ellipse required for SITs 100-149 and 180-199 shall be computed from US LUT inputs.

4.10.4 Site Summary Report

The Alert Process shall prepare on demand a summary of the Active Site for Active Sites specified by operator input by Site number, location, TCA time span, frequency, Beacon ID and other parameters.

