COSPAS-SARSAT
INSAT GEOSAR PERFORMANCE EVALUATION PLAN

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INSAT PERFORMANCE EVALUATION PLAN

History

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1. INTRODUCTION

The Indian Space Research Organisation (ISRO) has installed 406 MHz Search and Rescue (SAR) repeaters on their INSAT-3 communication and meteorological satellites. In order to enhance the coverage of the Cospas-Sarsat GEOSAR system, the INSAT-3A instrument has been made available for use after the completion of initial satellite on-orbit tests. However, the performance of its SAR instrument has yet to be fully evaluated. The Cospas-Sarsat Council has directed that an INSAT GEOSAR performance evaluation programme be conducted to:

a. establish INSAT GEOSAR / GEOLUT performance;

b. validate specification and commissioning requirements for GEOLUTs which operate with the INSAT-3A GEOSAR payload; and

c. verify the performance and, if appropriate, commission the current INSAT GEOLUT (Bangalore) into the Cospas-Sarsat System.

1.1 Purpose of Document

The purpose of this document is to provide:

a. test procedures for assessing the performance of the INSAT GEOLUT which operate with the INSAT SAR instrument;

b. guidelines for analysing the test results; and

c. guidelines, procedures and schedule for managing the INSAT GEOSAR performance evaluation programme and reporting the results.

1.2 Background

From 1996 to 1998 Cospas-Sarsat conducted a demonstration and evaluation programme to determine the suitability of using satellites in geostationary orbit equipped with SAR instruments to process the signals from Cospas-Sarsat 406 MHz distress beacons. This programme, hereafter referred to as the GEOSAR D & E, was implemented using the GOES series of satellites provided by the USA, the Insat-2 satellites provided by India, and experimental ground segment equipment provided by Canada, Chile, India, Spain and the United Kingdom. The GEOSAR D & E demonstrated that GEOSAR satellites provided a significant enhancement to the Cospas-Sarsat system. Following from this conclusion, in October 1998 the Cospas-Sarsat Council decided that the 406 MHz GEOSAR system components should be incorporated into the Cospas-Sarsat System as soon as possible.

While the GEOSAR D & E was being conducted, new 406 MHz GEOSAR repeaters were developed by EUMETSAT and installed on the MSG meteorological satellite series. Since the technical characteristics of the MSG SAR instrument were different from SAR instruments on the GOES satellites, additional tests were performed to establish MSG GEOSAR / GEOLUT performance, and any special GEOLUT specification and commissioning requirements. The results of these tests were approved by Cospas-Sarsat in October 2004.

Following the deployment of a third type of 406 MHz GEOSAR payload onboard INSAT-3A by the the Republic of India and the signature of an Understanding between the Cospas-Sarsat Programme and the Republic of India on the provision of Cospas-Sarsat GEOSAR services in February 2007, the Cospas-Sarsat Council also decided that the INSAT performance evaluation programme should be based on the technical (T) series of tests defined in the GEOSAR D & E Plan, as amended to address anticipated INSAT performance.

The INSAT GEOLUT (Bangalore) will participate in the INSAT GEOSAR performance evaluation programme. Since the Bangalore terminal is the only Cospas-Sarsat GEOLUT capable of tracking the INSAT-3A payload, the commissioning of the GEOLUT is to be performed as part of the INSAT GEOSAR performance evaluation.

The administrations of France and Turkey have announced that they will participate in the INSAT GEOSAR performance evaluation and provide beacon simulator signals for some of the proposed tests.

1.3 Responsibilities

ISRO is the agency responsible for the implementation and operation of the INSAT GEOSAR system. Therefore, ISRO will be responsible for assessing the performance of the INSAT SAR payload and Bangalore GEOLUT during the INSAT performance evaluation programme. Furthermore, ISRO will ensure that appropriate beacon test signals are transmitted for the testing and that the tests are conducted as described herein. ISRO will produce a report in the format specified at Annex A for the consideration of the Cospas-Sarsat Joint Committee.

1.4 Schedule

The chart at Annex H provides the major milestones of the INSAT GEOSAR Performance Evaluation Programme.

- END OF SECTION 1 -

2. INSAT GEOSAR PERFORMANCE EVALUATION GOALS AND OBJECTIVES

2.1 Performance Evaluation Goals

The goals of the performance evaluation programme are to:

a. characterize the technical performance of the INSAT GEOSAR / GEOLUT system and confirm that the INSAT GEOSAR satellite, and GEOLUT systems effectively provide useful 406 MHz alert data; and

b. validate specification, commissioning requirements and performance for the GEOLUT which operate with INSAT-3 satellites.

As Part of this evaluation programme, the INSAT GEOLUT will have to be tested in accordance with the commissioning requirements detailed in document C/S T.010 and, if appropriate, will be commissioned into the Cospas-Sarsat System.

2.2 Objectives

The programme has been subdivided into specific objectives. Each objective is addressed by conducting specific tests and analysing the results. Some of the tests will be performed with a beacon simulator whose power output and message content can be controlled and varied. The tests will be conducted over several weeks to collect enough data to provide statistically valid results.

An overview of each objective is listed below, the detailed descriptions of these objectives are provided in section 3.2.

T-1 Processing Threshold, System Margin, and Beacon Message Processing Performance
Determine the processing threshold, processing performance, system margin and the performance in respect of long format beacon messages for GEOLUTs which operate with the INSAT payload. The test signals used to assess these parameters do not include beacon messages that collide with each other.

T-2 Time to Produce Valid and Confirmed Messages
Determine the statistical distribution of the time required for the GEOLUT to produce valid and confirmed beacon messages. The test signals used to assess this parameter do not include beacon messages which collide with each other.

T-3 Carrier Frequency Measurement Accuracy
Determine how accurately the beacon carrier frequency can be determined by the INSAT GEOSAR / GEOLUT system. The test signals used to assess this parameter do not include beacon messages which collide with each other.

T-4 INSAT GEOLUT Channel Capacity
Assess the capability of the GEOSAR system to handle multiple simultaneously active distress beacons in a single 406 MHz channel. This parameter is assessed by generating traffic loads which include beacon messages which collide with each other.

T-5 Impact of Interference
Monitor the band for the presence of interference while the tests are being performed, in order to understand any anomalies in the results and to illustrate the ability of the GEOSAR system to provide valid messages in the presence of interference and noise in the frequency bands used by the INSAT GEOSAR system.

T-6 Processing Anomalies
Assess the performance of the GEOLUT in respect of the production of processing anomalies.

T-7 INSAT Coverage
Estimate the geographic coverage of the INSAT GEOSAR system*.

C-1 Commissionning of the INSAT GEOLUT (Bangalore)
Verify the compliance of the INSAT GEOLUT to the Cospas-Sarsat performance and design guidelines (specified in C/S T.009) by performing the tests specified in the GEOLUT Commissionning Standard (C/S T.010) and reporting results in the appropriate format to the Cospas-Sarsat Joint Comittee for evaluation.

2.3 Priorities

It is anticipated that initial effort would focus on completing the most important tests which consist of T-1 (processing threshold), T-2 (time to produce a valid message) and C-1 (commissioning of the INSAT GEOLUT), with the understanding that the other tests would be performed as time permit.

- END OF SECTION 2 -

* Results from previous tests could be used to characterize the INSAT coverage.

3. INSAT PERFORMANCE EVALUATION METHODOLOGY

3.1 General Evaluation Methodology

The INSAT GEOSAR performance evaluation programme is to be conducted and evaluated in accordance with the common set of guidelines and procedures as defined below.

a. ISRO is responsible for scheduling and coordinating all the tests that require the support of a beacon simulator or test beacons.

b. Prior to conducting any tests, the Bangalore GEOLUT operator should verify that there are no reported problems with the satellite which could affect test results.

c. ISRO should produce an INSAT GEOSAR Performance Evaluation Report in the format described at Annex A.

Every effort should be made to ensure that the use of real or simulated beacon signals in support of the INSAT Performance Evaluation Plan will not generate distress alert messages, which might be interpreted in the existing LEOSAR and GEOSAR Systems as real alerts.

3.2 Detailed Description of Objectives

This section provides the following for each objective of the INSAT GEOSAR Performance Evaluation Programme:

a. test procedures,
b. data collection requirements, and
c. data reduction/analysis requirements.

To simplify the testing and to reduce the number of 406 MHz test transmissions, test procedures have been developed which share test transmissions. For example, the output produced by the GEOLUT resulting from the test transmissions for test T-1 is also used for evaluating the performance of the GEOLUT in respect of the time to produce valid and confirmed messages (T-2), and frequency measurement accuracy performance (T-3).

To ensure that the alert messages generated by the GEOLUT can be correlated to the test signal transmissions, the INSAT Bangalore GEOLUT operator should confirm that the time of day setting in the GEOLUT is correct before conducting each test.

3.2.1 T-1: Processing Threshold, System Margin, and Beacon Message Processing Performance

The processing threshold, processing performance and the system margin are "figures of merit" of the GEOLUT.

Processing Threshold
The processing threshold is the value of the minimum carrier to noise density ratio (C/No) in dBHz at the GEOLUT processor for which the GEOLUT is able to produce a valid message for each beacon event 99% of the time (the lower this value the more sensitive the GEOLUT).

System Margin
The system margin is the difference between a nominal beacon, with an EIRP of 37 dBm, and a beacon operating at the GEOLUT threshold.

Valid Message Processing Performance
The processing performance requirement documented in C/S T.009 is that GEOLUTs should be capable of producing valid messages within 5 minutes of beacon activation 95% of the time, for all beacon signals whose C/No as measured at the GEOLUT is greater than 26 dB-Hz. This test will determine the C/No for which the INSAT GEOLUT can produce a valid message for each beacon event within 5 minutes of beacon activation 95% of the time.

Long Message Processing Performance
Document C/S T.009 specifies the processing of long messages and the requirement for comfirmed complete messages. However, at present Cospas-Sarsat has no GEOLUT performance requirement in respect of producing complete and confirmed long messages. Nevertheless, with the increased use of location protocol beacons using the long message format, it is necessary to assess the INSAT system performance in this regard.

3.2.1.1 Methodology and Data Collection

This test assesses the INSAT GEOLUT performance in respect of its ability to produce single valid, complete and confirmed complete distress beacon messages as a function of the beacon power transmitted in the direction of the INSAT satellite (beacon EIRP).

A beacon simulator is used to replicate distress beacons that transmit long format messages at specific EIRPs, for a duration necessary to transmit 20 bursts for each beacon ID. Hereafter the term “beacon event” is used to describe a beacon being active for a period of time. The test is conducted by transmitting 50 beacon events for each EIRP, whilst ensuring that signals from individual beacon events do not overlap in time and frequency with the signals from other beacon events. The output of the GEOLUT is monitored and the information identified in Table E-1 is recorded. The procedure is repeated at EIRP values ranging from 37 dBm to 28 dBm, in one dB increments.

Performance of this test requires the following steps.

a. Use a beacon simulator or a set of controlled test beacons with a variable output EIRP.

b. Program the simulator to provide different long format beacon identification codes for each beacon event. The test scripts used for this test are provided at Annex B, Table B-1.

c. Calibrate the beacon simulator output EIRP and carrier frequency (to an accuracy of 0.2 Hz) to confirm the technical characteristics of the transmitted signals.

d. To avoid interference to the 406 MHz channels currently active for operational use, ensure that the simulator does not transmit in the channels used for operational beacons.

e. Set the simulator EIRP to 37 dBm in the direction of the INSAT-3A satellite.

f. Transmit the 50 beacon events provided at Table B-1 (an event consists of the same beacon message transmitted 20 times), ensuring that individual beacon transmissions do not interfere with each other. To avoid using the capacity of LEOSAR satellite uplinks, this test shall be scheduled to ensure that test signals are not transmitted when INSAT GEOLUTs are in the footprint of a Cospas-Sarsat LEOSAR satellites.

g. Collect the data produced by the GEOLUT for each beacon event as described at Annex D (note that this data will be analysed to provide the results for this test objective, as well as for objectives T-2 and T-3).

h. Repeat the process at the EIRP values listed at Table 3-1, using the associated test scripts described at Table B-1.

3.2.1.2 Data Reduction, Analysis and Results

For each set of 50 beacon events transmitted at a given EIRP as recorded at Annex D Table D-1:

a. Calculate the probability of:

(i) producing at least one valid message for each beacon event as follows:

$$\frac{\textit{number of beacon events for which GEOLUT produced at least one valid message}}{\textit{number of beacon events transmitted at the selected EIRP}}$$

(ii) producing at least one valid message within 5 minutes of beacon activation as follows:

$$\frac{\textit{number of beacon events for which GEOLUT produced a valid message within } 5 \text{ min } \textit{of activation}}{\textit{number of beacon events transmitted at the selected EIRP}}$$

(iii) producing at least one complete beacon message as follows:

$$\frac{\textit{number of beacon events for which GEOLUT produced a correct complete long message}}{\textit{number of beacon events transmitted at the selected EIRP}}$$

(iv) producing a confirmed complete beacon message as follows:

$$\frac{\textit{number of beacon events for which GEOLUT was able to confirm a complete long message}}{\textit{number of beacon events transmitted at the selected EIRP}}$$

b. Calculate the C/No at the GEOLUT processor corresponding to each EIRP. Note that this is a calculated theoretical value of C/No, not the value measured by the GEOLUT.

c. Record the results of the calculations above in sample Table 3-1.

d. Using the data from Table 3-1, produce graphs of the results as depicted at Figure 3-1.

All cases where the GEOLUT was not able to produce a valid message for a beacon event should be analysed to determine if extraordinary external factors (e.g. interference) could have caused the GEOLUT not to detect the beacon. If extraordinary external factors caused the GEOLUT to miss a beacon event, the event should be removed from the statistics and an explanation provided in the report.

EIRP from simulator (dBm)	Calculated C/No at GEOLUT (dBHz)	Number of Beacon Events Used (Valid Msg Sample Set)	Number of Beacon Events for which		Probability of Valid Message	Probability of Valid Message within 5 Min
			Valid Message was Produced	Valid Message was Produced within 5 Min		
28.0						
29.0						
30.0						
31.0						
32.0						
33.0						
34.0						
35.0						
36.0						
37.0		50	50	50	1.00	1.00

EIRP from simulator (dBm)	Number of Beacon Events Used (Complete Msg Sample Set)	Number of Beacon Events Used (Confirmed Complete Msg Sample Set)	Number of Beacon Events for which a Complete Message was Produced	Number of Beacon Events for which a Confirmed Complete Message was Produced	Probability of Complete / Confirmed Complete Msg
28.0					
29.0					
30.0					
31.0					
32.0					
33.0					
34.0					
35.0					
36.0					
37.0	50	50	50	1.00	1.00 / 1.00

Table 3-1: Sample Tables for Objective T-1 Results

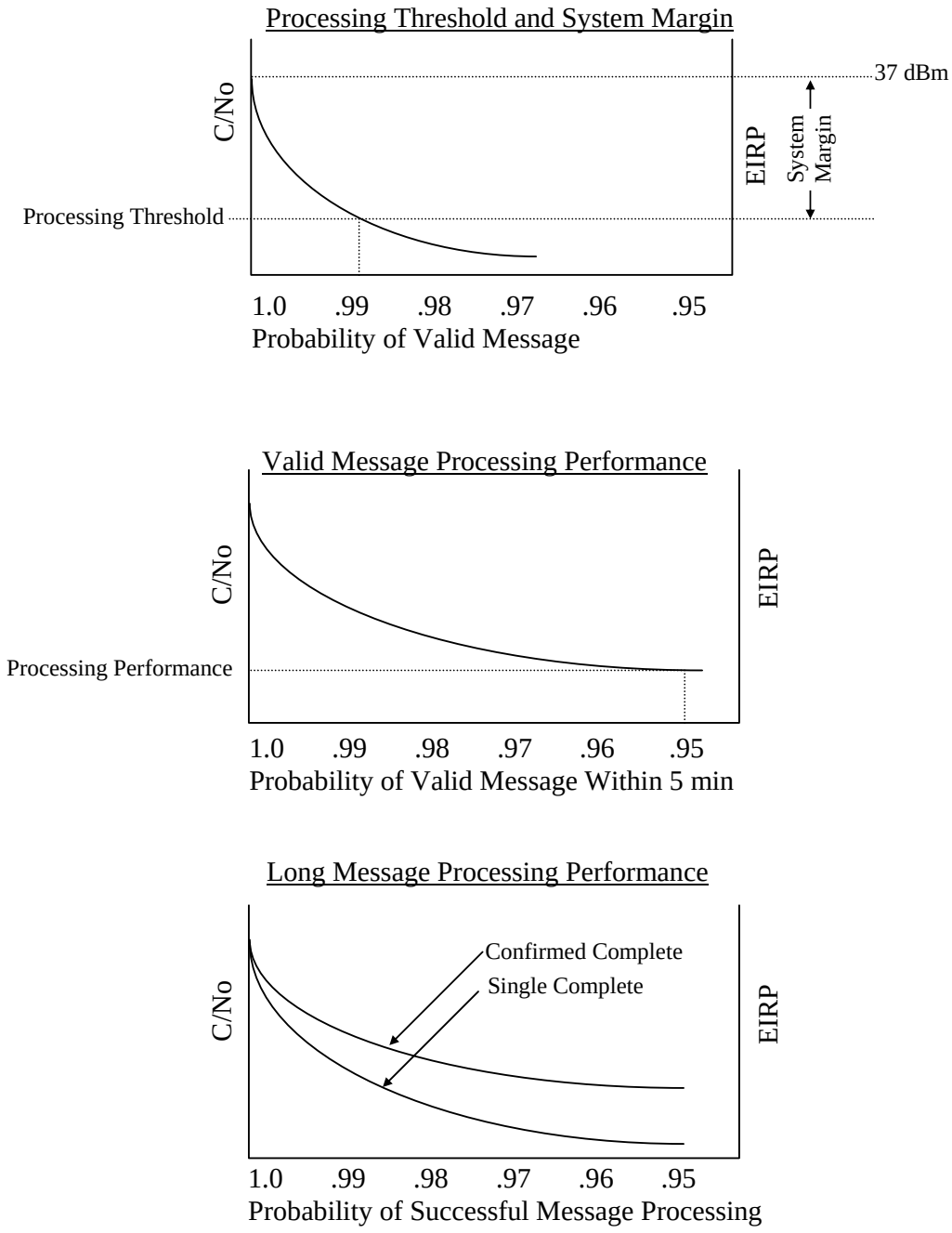

Figure 3-1: Graphs Depicting Processing Threshold, System Margin, Valid Message and Complete Long Message Processing Performance

3.2.2 T-2: Time to Produce Valid, Complete and Confirmed Messages

This test assesses how long it takes the INSAT GEOLUT operating with the INSAT-3A satellite to produce valid beacon messages, complete long messages, and confirmed complete long messages. This information will be used to validate message processing requirements for GEOLUTs which operate with the INSAT satellite, and to determine a figure of merit for the number of bursts required to successfully process a message.

3.2.2.1 Methodology and Data Collection

For simplicity this test is conducted by analysing the data collected for test T-1 (Threshold). Note that the T-1 test scenario is specifically designed not to generate beacon bursts which overlap in time and frequency. Consequently, for operational beacon events, the times to produce valid, complete, and the time to confirm complete messages may differ from those determined during this test.

The following test methodology and data collection requirements apply:

a. Note the EIRP and 15 Hex ID for each beacon event.

b. For each beacon event note the date/time that the GEOLUT produced:
   (i) the first valid message;
   (ii) the first complete message; and
   (iii) the first confirmation of the complete message with an independent integration process.

c. Record the data collected above in tabular format as described at Annex D. The table should have an entry for each beacon event at each EIRP.

3.2.2.2 Data Reduction, Analysis and Results

a. For each EIRP calculate the average time to:

   (i) produce valid messages (ATVM), as follows:

$$ATVM = \frac{\sum \textit{time after first burst in beacon event for GEOLUT to produce valid message}}{\textit{number of beacon events for which at least one valid message produced}}$$

   (ii) produce complete messages (ATCM), as follows:

$$ATCM = \frac{\sum \textit{time after first burst in beacon event for GEOLUT to produce complete message}}{\textit{number of beacon events for which at least one complete message produced}}$$

(iii)confirm a complete messages (ATCCM), as follows:

$$ATCCM = \frac{\sum \textit{time after first burst in beacon event for GEOLUT to confirm complete message}}{\textit{number of beacon events for which at least one complete message was confirmed}}$$

b. In addition, for each EIRP calculate the standard deviation for the time to produce valid, complete and confirmed complete messages.

c. For each EIRP determine the time (duration) required for the GEOLUT to provide 95% and 98% of valid, complete, and confirmed complete messages. These values are determined by normalising the time values by removing the time bias resulting from the requirement to stagger the start times of each beacon event. The normalised values are analysed to identify how long the GEOLUT required to produce the 95th and 98th percentile for valid, complete, and confirmed messages. If the 95th or 98th percentile was not achieved for any given category, this should be designated as Not Available (N/A) in the appropriate cell of the table.

d. Record the results of the above in sample Table 3-2.

e. Using the data from Table 3-2, produce graphs of the results as depicted in Figure 3-2.

EIRP (dBm)	C/No (dBHz)	ATVM (Sec)	Standard Deviation of ATVM	ATCM (Sec)	Standard Deviation of ATCM	ATCCM (Sec)	Standard Deviation of ATCCM
28.0							
29.0							
.							
.							
.							
37.0							

EIRP (dBm)	C/No (dBHz)	95th Percentile			98th Percentile		
		Valid Msg (Sec)	Complete Msg (Sec)	Confirmed Msg (Sec)	Valid Msg (Sec)	Complete Msg (Sec)	Confirmed Msg (Sec)
28.0							
29.0							
.							
.							
.							
37.0							

Table 3-2: Sample Tables for Objective T-2 Results

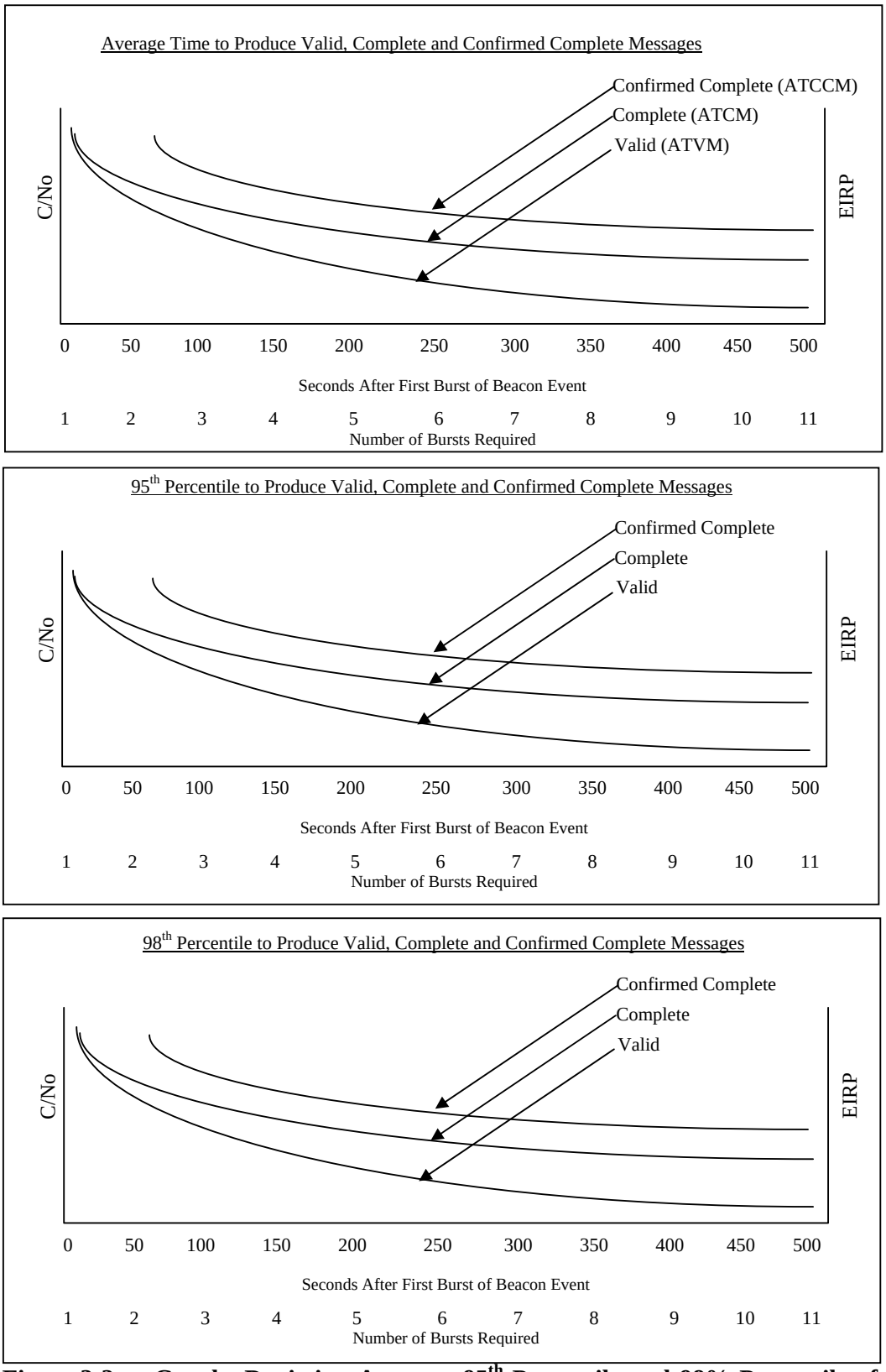

Figure 3-2: Graphs Depicting Average, 95th Percentile and 98% Percentile of Valid, Complete and Confirmed Messages

3.2.3 T-3: Carrier Frequency Measurement Accuracy

The purpose of this objective is to assess how accurately the beacon carrier frequency can be measured by the INSAT GEOSAR / GEOLUT system. This is accomplished by comparing the beacon's carrier frequency for each valid message as measured by the GEOLUT with the known frequency value for the same beacon, provided by the beacon simulator operator. The current GEOLUT specification (C/S T.009) requires a frequency measurement accuracy of 2 Hz.

3.2.3.1 Methodology and Data Collection

For simplicity, this test is conducted by analysing the data collected for test T-1. For each beacon event note the frequency measurement provided by the GEOLUT associated with the first valid message produced, and record this information as described at Annex D.

The measured frequency should be corrected by the GEOLUT, as possible, to account for any calibration that would normally be performed during real GEOLUT operations (e.g. if the GEOLUT includes features for assessing and correcting frequency measurements by applying calibration correction factors, these features should be activated).

3.2.3.2 Data Reduction, Analysis, and Results

Using the data recorded at Annex D the mean and standard deviation of the frequency differences for each EIRP should be calculated and recorded as indicated in sample Table 3-3 and graphed as depicted at Figure 3-3. Measurements which have large differences may be removed from the data set if the measurement error can be explained by a known phenomenon which degraded the GEOLUT's ability to produce a valid measurement.

EIRP (dBm)	Calculated C/No at GEOLUT (dBHz)	Avg Freq Measurement Error (Hz rounded to 1 decimal place)	Std Deviation of Error (Hz)
28.0			
.			
.			
37.0			

Table 3-3: Sample Table for Objective T-3 Results

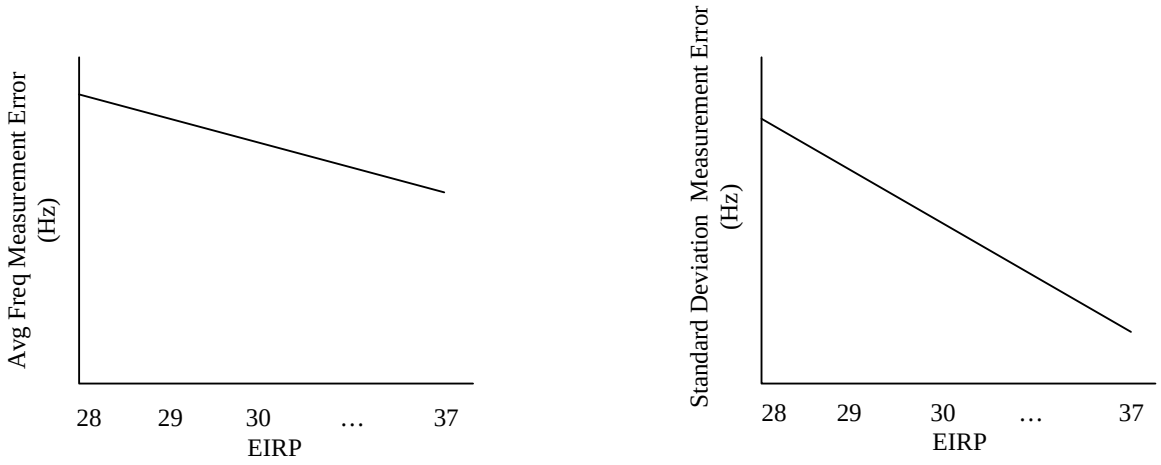

Figure 3-3: Graphs Depicting Frequency Measurement Accuracy Performance

3.2.4 T-4: INSAT GEOLUT Channel Capacity

The definition of capacity in Cospas-Sarsat GEOSAR systems is the number of 406 MHz distress beacons operating simultaneously in the field of view of a GEOSAR satellite, that can be successfully processed by the System to provide a valid beacon message, under nominal conditions, within 5 minutes of beacon activation 95% of the time, and the number of beacons that can be successfully processed within 10 minutes of beacon activation 98% of the time. The applicable nominal conditions are described in document C/S T.012, Cospas-Sarsat 406 MHz Frequency Management Plan, except that the uplink EIRP will be set to 34 dBm.

3.2.4.1 Methodology and Data Collection

The INSAT GEOSAR channel capacity is determined by generating traffic loads equivalent to known numbers of simultaneously active long format beacons in a Cospas-Sarsat 406 MHz channel. The time required for the GEOLUT to produce a valid beacon message, complete message and confirm a complete message for each beacon event is recorded. The number of simultaneously occurring beacon events is changed and the time required for the GEOLUT to produce valid, complete and complete confirmed messages are calculated and recorded for the new 406 MHz traffic load.

The test scripts transmitted by the beacon simulator should conform to the nominal conditions detailed in document C/S T.012, with the exception that the uplink EIRP will be 34 dBm. Specifically, the test shall replicate a number of beacon messages overlapping in time and frequency commensurate with the number of simultaneously active beacons. Further, the beacon events used in the test script shall also replicate the beacon burst repetition period defined in document C/S T.001 (406 MHz beacon specification). The test shall be scheduled to avoid any potential interference caused by Cospas-Sarsat LEOSAR satellite downlink transmissions.

The test will replicate scenarios of 15, 20, and 25 simultaneously active beacons.

Performance of this test requires the following steps**.**

a. A beacon simulator test script is developed which replicates 15 simultaneously active beacons, with each beacon event having a unique ID. The transmitted signals for all beacon events shall conform to the nominal conditions stated in the in the Cospas-Sarsat 406 MHz Frequency Management Plan (C/S T.012), except that the uplink power will be set to 34 dBm. The test signals will be transmitted with a carrier frequency of 406.063 MHz. Since the distribution of beacon event start times and transmit frequencies shall be in accordance with the nominal conditions described document C/S T.012, the test script will include instances where beacon bursts overlap in time and frequency. Each beacon event shall replicate a beacon being active for a 15 minute period.

b. Ensuring that the GEOLUTs will not be in the downlink footprint of a Cospas-Sarsat LEOSAR satellite, the test script is transmitted.

c. For each beacon event the time that the GEOLUT produced the first valid message, first complete message and first confirmed complete message should be recorded in the tabular format provided at Annex E.

d. Repeat test with a different test script which also replicates 15 active beacons, until 10 different test scripts have been transmitted.

e. Repeat the process above for scenarios in which the beacon simulator replicates 20 and 25 simultaneously active beacons.

3.2.4.2 Data Reduction, Analysis and Results

Using the data collected at Annex E, Table 3-4 should be completed for each simulated traffic load (e.g. the 10 repetitions of the test script for 15 active beacons are consolidated to provide the data in a single row of the table).

Channel: 406.063				
# of Active Bcn Events	**% Valid Msg within 5 Min**	**% Valid Msg within10 Min**	**% Valid Msg within 15 Min**	**% Confirmed Complete Msg within 15 Min**
15				
20				
25				

Table 3-4: Sample Table for Capacity Statistics

From the data in Table 3-4, the percentage of beacon events which produced valid messages within 5, 10 and 15 minutes of the start of the beacon event, and also the percentage of confirmed complete messages, should be graphed against the respective beacon channel population as indicated at Figure 3-4. As described below, the capacity of the channel is

determined by evaluating the number of active beacons corresponding to the 95th percentile of the 5 minute curve and the 98th percentile of the 10 minute curve. Since the capacity of the channel must satisfy both the 5 and 10 minute criteria, the lowest of these two figures is the channel capacity.

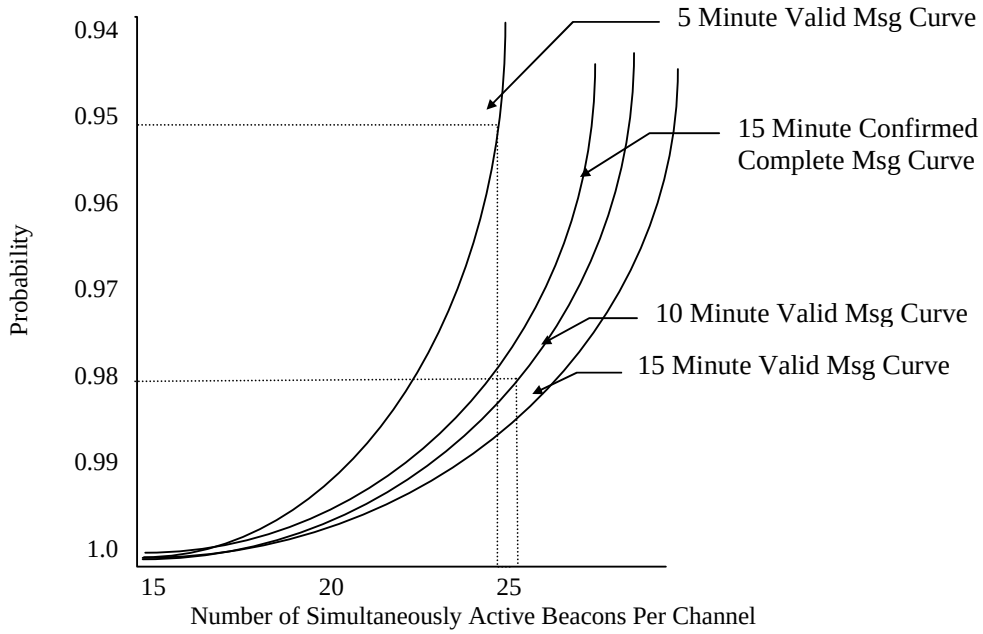

Figure 3-4: Graph Depicting INSAT GEOSAR Capacity

In the fictitious example above, the 0.95 probability in 5 minutes would be the most stringent criteria, and, therefore, defines the capacity as being approximately 26.5 active beacons.

3.2.4.3 Interpretation, Conclusion and Recommendation

The results of these tests will provide an estimate of the capacity a single channel in the INSAT GEOSAR system. It is recommended that these results be used to validate the GEOLUT capacity models being developed for the 406 MHz Frequency Management Plan.

3.2.5 T-5: Impact of Interference

The purpose of this objective is to determine the ability of the GEOSAR system to provide valid messages in the presence of interference and noise. In view of the specialized test equipment required to conduct this objective.

3.2.5.1 Methodology and Data Collection

This objective will use both real alerts and controlled test beacons to determine the impact of actual interferers seen in the GEOSAR field of view when interference is present. It will also examine the relationship between the characteristics of the interfering signals and any changes in the production of valid messages.

The following methodology should be used.

a. Characterize the interference by using a spectrum analyser and a data storage device to permit detailed analysis of the interfering signal at a later time than its occurrence. The following test set up could be used (see Figure 3-5):

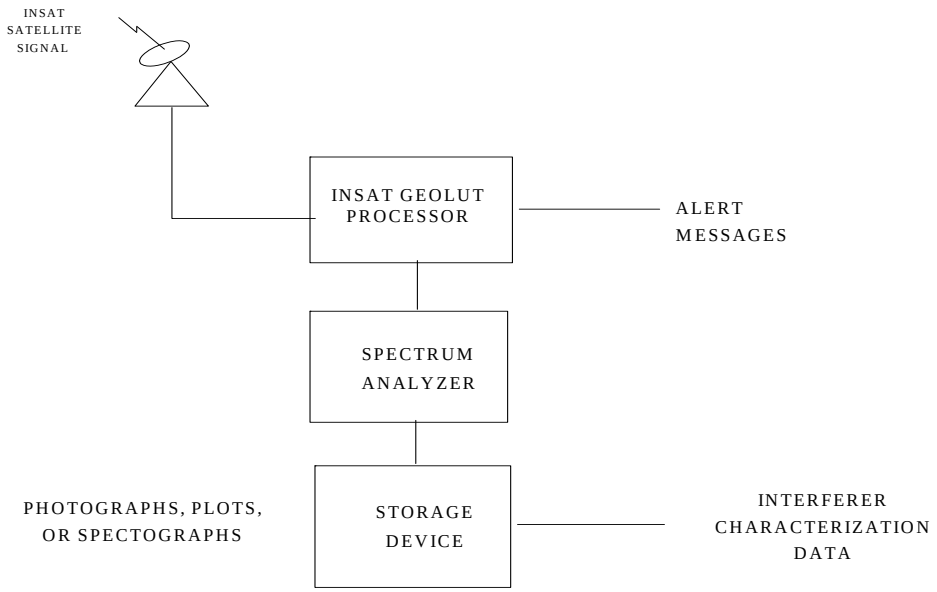

Figure 3-5: Test Set-up for Interference Evaluation

b. Monitor the GEOSAR band using the spectrum analyser. Record the output in a storage device for later detailed analysis. Photographs, data plots, or spectrographs could be used for this purpose.

c. When interference is detected the following parameters concerning the interfering signal should be collected.

i) The identification of the GEOLUT.

ii) Time of occurrence and the duration of the interfering signal.

iii) Spectral occupancy.

iv) Signal strength.

v) Time patterns (e.g. on/off versus continuous, sweeping versus constant, etc.).

vi) Nature of modulation (analogue versus digital).

vii) Location of the interferer (if known).

During periods of interference the production of valid messages by the GEOSAR processor should be evaluated. Any loss of messages, the production of invalid messages or increases in the message transfer time should be noted.

3.2.5.2 Data Reduction, Analysis and Results

When interference is detected, all GEOSAR messages during the period should be examined to determine if there is:

a. a loss of expected messages;

b. a decrease in the number of valid messages from operational and test beacons before and after the occurrence of the interference; and

c. an increase in processing anomalies.

Examine the technical parameters of the interferer and try to relate the impact on the message processing to specific characteristics of the interferer. For example, is there a relationship between the rate of reduction in valid messages to the interferer's signal strength?

3.2.6 T-6: Processing Anomalies (PA)

This test assesses GEOLUT performance in respect of its ability to suppress the processing anomalies produced.

3.2.6.1 Methodology and Data Collection

This test is conducted by monitoring the 406 MHz channel (406.022 MHz) used by Cospas-Sarsat reference beacon from the Kergulian Island[2], and noting instances where the GEOLUT produced valid beacon messages which did not correspond to any of the reference beacons in the coverage area of the INSAT-3A satellite. Since the identifications (IDs) of all reference beacons in view of the INSAT satellite are known, it can be inferred that beacons detected in the 406.022 MHz channel which do not correspond to known reference beacons are processing anomalies. The following test methodology and data collection requirements apply:

a. Note the 15 hexadecimal identification of all the reference beacons in the coverage area of the INSAT satellite.

b. Monitor the 406 MHz channel used by Cospas-Sarsat reference beacons for a 4 week period, and note each instance of the GEOLUT producing a processing anomaly. For each processing anomaly note the date and time that it was produced by the GEOLUT, the 15 Hex ID and the 30 Hex beacon message reported by the GEOLUT, and whether there was interference from a LEOSAR satellite at the time the PA was produced (an example of the table for collecting this data is provided at Annex F).

[2] The details of the Kerguelen Island beacon are as follow: Hex ID: 9C7EC2AACD3590, Country France, Location: 49o21.09’ S 070o15.36’ E, Freq: 406.021856, Tramission interval: 30 sec.

3.2.6.2 Data Reduction, Analysis and Results

a. Identify those valid messages that were processing anomalies (their 15 Hex ID did not correspond to the 15 Hex ID of any of the reference beacons in the coverage area of the INSAT satellite).

b. For each processing anomaly, determine if the GEOLUT was in the coverage area of a LEOSAR satellite at the time the alert was produced. This information will be used to develop statistics which will provide an indication of whether LEOSAR interference impacts upon GEOLUT processing anomaly performance.

c. For each processing anomaly, attempt to determine the source (i.e. reference beacon) of the transmission. This is done by converting the GEOLUT produced message into its binary representation, and comparing it with bit-shifted versions of all the reference beacons in the INSAT coverage area. If the bits of the processing anomaly message correspond to 80% or more of a reference beacon message, then it could be assumed that the processing anomaly was generated from the GEOLUT processing of transmissions from that reference beacon.

d. Record the results in the table provided at Annex F, and copied below:

15 Hex ID Produced by GEOLUT	15 Hex ID of Associated Reference Beacon	Beacon Message Produced by GEOLUT (30 Hex)	Date / Time	LUT in LEO Footprint (Y/N)

e. Calculate the PA rate as a function of beacon bursts in the coverage area of the INSAT satellite. This is calculated with the following equation:

$$\left(\frac{\text{Total Number of PAs}}{\text{Number of Days Observed} * \text{Number of Reference Beacon Bursts per Day in INSAT Coverage Area}} \right)$$

f. Calculate the PA rate when the GEOLUT is in the footprint of a LEOSAR satellite using the following equation.

$$\left(\frac{\text{Total Number of PAs during LEO Cov}}{\text{Total Duration of LEO Cov in Days} * \text{Number of Reference Beacon Bursts per Day in INSAT Coverage Area}} \right)$$

3.2.7 T-7: INSAT Coverage

The coverage of the INSAT GEOSAR system is evaluated using a combination of:

a. technical tests, in which a beacon is activated for a period of time, during which it crosses in or out of the INSAT GEOSAR coverage area; and

b. evaluating real beacon alerts detected by the LEOSAR system, and assessing if the same alerts were detected by the INSAT GEOSAR system.

3.2.7.1 Methodology and Data Collection

Testing Using Beacon Crossing Coverage Area

A beacon will be mounted on a vessel or vehicle which will be crossing the expected INSAT GEOSAR coverage area. After the beacon has been activated, the beacon operator will record its location as a function of time. The INSAT GEOLUT operator will monitor the output of its GEOLUT for the test period, and record the times associated with the production of all valid messages for the test beacon.

Evaluating Coverage Area Using Real Beacon Events of Opportunity

The location and times of real beacon events detected by the LEOSAR system during the period of the INSAT GEOSAR Performance testing are to be identified. Beacon events located within an area enclosed by 80° latitude and longitude should be recorded in the format provided at Annex G. The beacon ID and time of each alert in the sample set are to be compared against the GEOLUT output to determine if the event was also detected by the INSAT GEOSAR system.

3.2.7.2 Data Reduction, Analysis and Results

Testing Using Beacon Crossing Coverage Area

From the data collected, the time that INSAT GEOSAR coverage was lost (or began depending whether the beacon was moving in or out of coverage) is to be recorded. The movement of the beacon during the test period is to be plotted on a map, and the plot is to be annotated to depict GEO coverage / no GEO coverage. From the collected data, the estimated latitude and longitude of the last valid message detected by the GEOLUT before the beacon left coverage, should be provided.

Evaluating Coverage Area Using Real Beacon Events of Opportunity

a. all the LEOSAR alerts detected during the period of the INSAT Performance evaluation that satisfy the criteria for inclusion in the sample set should be recorded in the format provided at Annex G (i.e., situated within an area enclosed by 80° latitude and longitude);

b. each beacon event in the sample set should be checked to determine if it was also detected by the INSAT GEOLUT, and the results recorded as per Annex G;

c. the beacon events are to be grouped into geographic areas of 10° latitude/longitude blocks;

d. for each block, the percentage of LEOSAR beacon events that were also detected by the GEOLUT should be calculated and presented as indicated at Table 3-5 below; and

e. the location of each beacon event should be plotted on two maps, one depicting events that were detected by both the LEOSAR and GEOLUT, and a separate map depicting beacon events detected only by the LEOSAR system.

Block Location		Number of LEOSAR Beacon Events	Number Detected by GEOLUT	% Detected by GEOLUT
Longitude	Latitude			
0/10w	0/10n			
10w/20w	0/10n			
20w/30w	0/10n			
.	.			
.	.			
.	.			
70e/80e	70s/80s			

Table 3-5: Sample Table of Coverage Statistics

3.2.8 C-1: Commissionning of the INSAT GEOLUT

The downlink antennas of the INSAT-3A satellite has directive beams that can be only received in the Indian region. Currently, the only GEOLUT attached to the INSAT satellite is located in Bangalore. Part of the INSAT GEOSAR performance evaluation plan include the verification of the compliance of INSAT GEOLUT with the performance specification (C/S T.009).

Document C/S T.010 provides the detailed testing and reporting requirements for the commissioning of the Cospas-Sarsat INSAT GEOLUT. The annexes of the documents define the test data format requirements and the content and format of the commissioning report which is to be submitted to the Cospas-Sarsat Secretariat.

Commissioning reports are reviewed separately by the Cospas-Sarsat Joint Committee and approved by the Cospas-Sarsat Council.

- END OF SECTION 3 -

4. REPORTING GUIDELINES

The Indian GEOLUT operator participating in the INSAT GEOSAR Performance Evaluation Programme shall submit an individual report to the Cospas-Sarsat Secretariat. The report should follow the structure described in Annex A, using the same section paragraph numbering and annexes.

The Secretariat will retain the complete reports on file for archival purposes, and will format each report into a summarized version for presentation to the Joint Committee. Based upon the recommendations of the Joint Committee, a summary report of the performance of the INSAT System will be produced for the consideration of the Cospas-Sarsat Council.

A separate Commissioning report (C-1) of the INSAT GEOLUT is to be submitted to the Cospas-Sarsat Joint Committee by the appropriate Administration for review and consideration.

- END OF SECTION 4 -

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ANNEXES TO THE COSPAS-SARSAT INSAT GEOSAR PERFORMANCE EVALUATION PLAN

ANNEX A

FORMAT OF INSAT PERFORMANCE EVALUATION REPORTS BY GEOLUT OPERATORS

A.1 INTRODUCTION

Introductory remarks provide information necessary to understand the report. The introduction should identify which test objectives were completed and have been reported in this document and any known deficiencies with the GEOLUT which could affect the results. Furthermore, the introduction shall provide:

a. the dates covered by the test programme;
b. the location of the GEOLUT; and
c. the configuration settings of the GEOLUT which could impact upon its observed performance (e.g. the bandwidth settings of the GEOLUT receiver).

A.2 SUMMARY OF RESULTS

This section will provide summary statements concerning the results of each objective. It should specifically identify any difficulties experienced with the evaluation programme and any recommendations that should be noted by the Joint Committee.

A.3 TEST T-1: PROCESSING THRESHOLD, SYSTEM MARGIN AND BEACON MESSAGE PROCESSING PERFORMANCE

A.3.1 Test Description

This section should include a statement confirming that the tests were conducted and analysed in accordance with C/S R.014, or describe any modifications to the test procedures that were required.

A.3.2 Calculation of C/No

The calculations converting the EIRP of the simulator, to a C/No value at the GEOLUT processor should be provided.

A.3.3 Test Results

The GEOLUT data collected for this test should be included as an annex to the report, and referenced in this section of the report. In addition, the tables below should be produced based on the collected data and provided in this section of the national report.

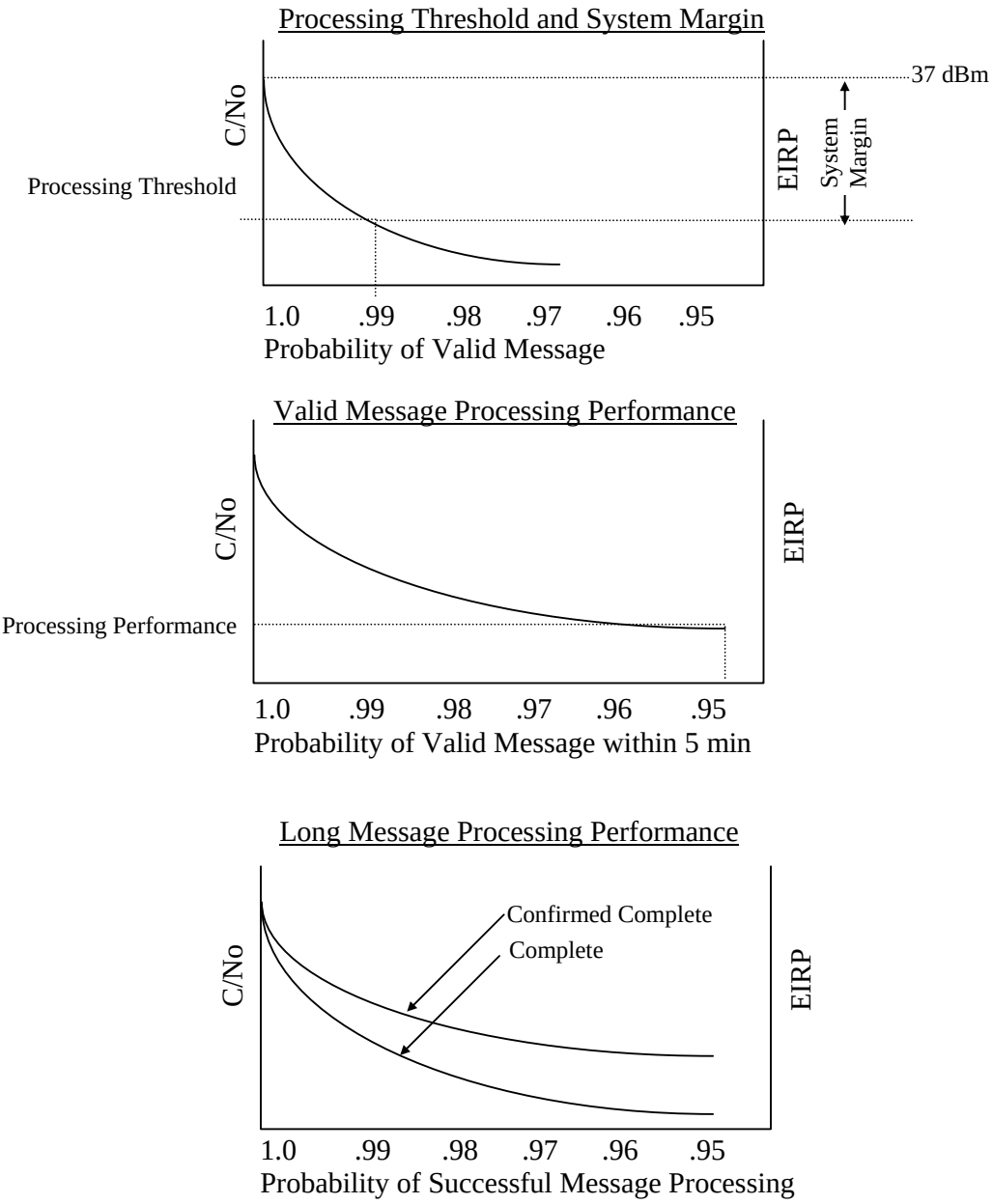
Analysed Data for Test T-1

EIRP from simulator (dBm)	Calculated C/No at GEOLUT (dBHz)	Number of Beacon Events Used (Valid Msg Sample Set)	Number of Beacon Events for which		Probability of Valid Message	Probability of Valid Message within 5 Min
			Valid Message was Produced	Valid Message was Produced within 5 Min		
28.0						
29.0						
30.0						
31.0						
32.0						
33.0						
34.0						
35.0						
36.0						
37.0		50	50	50	1.00	1.00

EIRP from simulator (dBm)	Number of Beacon Events Used (Complete Msg Sample Set)	Number of Beacon Events Used (Confirmed Complete Msg Sample Set)	Number of Beacon Events for which a Complete Message was Produced	Number of Beacon Events for which a Confirmed Complete Message was Produced	Probability of Complete / Confirmed Complete Msg
28.0					
29.0					
30.0					
31.0					
32.0					
33.0					
34.0					
35.0					
36.0					
37.0	50	50	50	1.00	1.00 / 1.00

A.3.4 Processing Threshold and Message Processing Performance

A graph of the results from the tables above should be included (a theoretical example is provided herein). The processing threshold value should be highlighted by noting the value of C/No corresponding to a 0.99 probability of obtaining a valid message as indicated below. Similarly the processing performance is determined from the graph depicting C/No versus the probability of producing a valid message within 5 minutes.



A.3.5 System Margin

The calculations converting the threshold value of C/No to the associated EIRP, and the resulting system margin should be provided.

A.3.6 Test Anomalies

This section should provide information concerning issues which occurred during the test which could affect results. If some data was excluded from the results, an explanation should be provided.

A.3.7 Recommendations

Any proposed recommendations resulting from this test should be detailed in this section.

A.4 TEST T-2: TIME TO PRODUCE VALID, COMPLETE AND CONFIRMED MESSAGES

A.4.1 Test Description

This section should include a statement confirming that the tests were conducted and analysed in accordance with C/S R.014, or describe any modifications to the test procedures that were required.

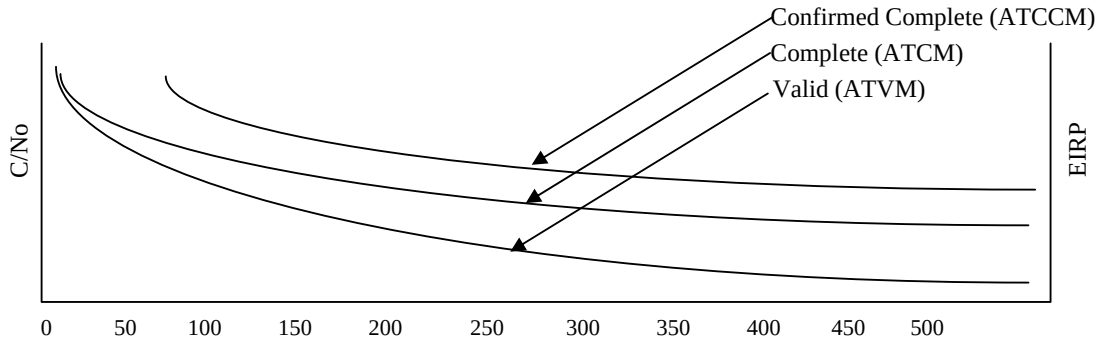
A.4.2 Test Results

The results for this test are obtained by analysing the data that was collected for the T-1 Test. A reference should be provided to indicate the annex of the report where this data is provided. From the data, the table and graphs described below should be produced and included in this section of the report. In addition to the mean time to produce valid, complete and confirmed complete messages for each EIRP, the standard deviation for each of these statistics should also be calculated and provided.

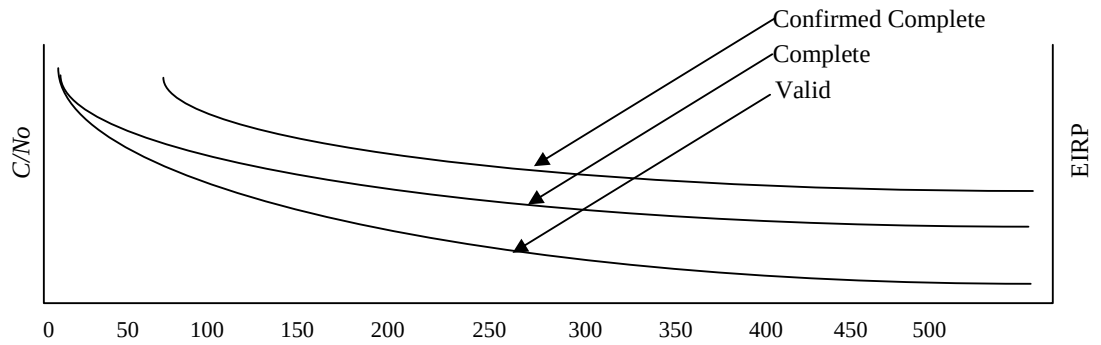
EIRP (dBm)	C/No (dBHz)	ATVM (Sec)	Standard Deviation of ATVM	ATCM (Sec)	Standard Deviation of ATCM	ATCCM (Sec)	Standard Deviation of ATCCM
28.0							
29.0							
.							
.							
37.0							

EIRP (dBm)	C/No (dBHz)	95th Percentile			98th Percentile		
		Valid Msg (Sec)	Complete Msg (Sec)	Confirmed Msg (Sec)	Valid Msg (Sec)	Complete Msg (Sec)	Confirmed Msg (Sec)
28.0							
29.0							
.							
.							
37.0							

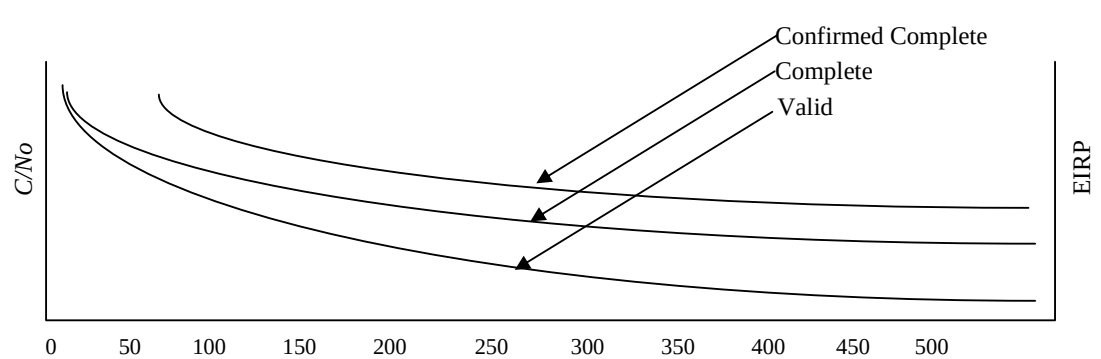
Average Time to Produce Valid, Complete and Confirmed Complete Messages



95th Percentile to Produce Valid, Complete and Confirmed Complete Messages



98th Percentile to Produce Valid, Complete and Confirmed Complete Messages



This section should provide information concerning issues which occurred during the test which could affect results. If some data was excluded from the results, an explanation should be provided.

A.4.4 Recommendations

Any proposed recommendations resulting from this test should be detailed in this section.

A.5 TEST T-3: CARRIER FREQUENCY MEASUREMENT ACCURACY

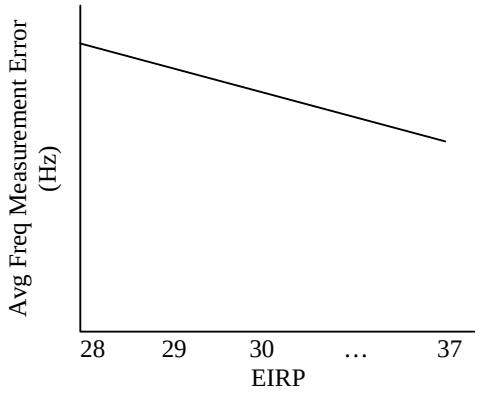
A.5.1 Test Description

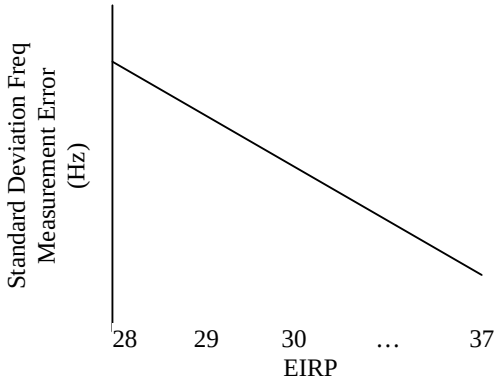
This section should include a statement confirming that the tests were conducted and analysed in accordance with C/S R.014, or describe any modifications to the test procedures that were required.

A.5.2 Test Results

The results for this test are obtained by analysing the data that was collected for the T-1 Test, to obtain the average frequency measurement error and standard deviation of this error, for each EIRP. A reference should be provided to indicate the annex of the report where this data is provided. The results of these calculations should be presented in tabular and graphical formats as indicated below.

EIRP (dBm)	Calculated C/No at GEOLUT (dBHz)	Avg Freq Measurement Error (Hz rounded to 1 decimal place)	Std Deviation of Error (Hz)
28.0			
.			
.			
37.0			





A.5.3 Test Anomalies

This section should provide information concerning issues which occurred during the test which could affect results. If some data was excluded from the results, an explanation should be provided.

A.5.4 Recommendations

Any proposed recommendations resulting from this test should be detailed in this section.

A.6 TEST T-4: INSAT GEOLUT CHANNEL CAPACITY

A.6.1 Test Description

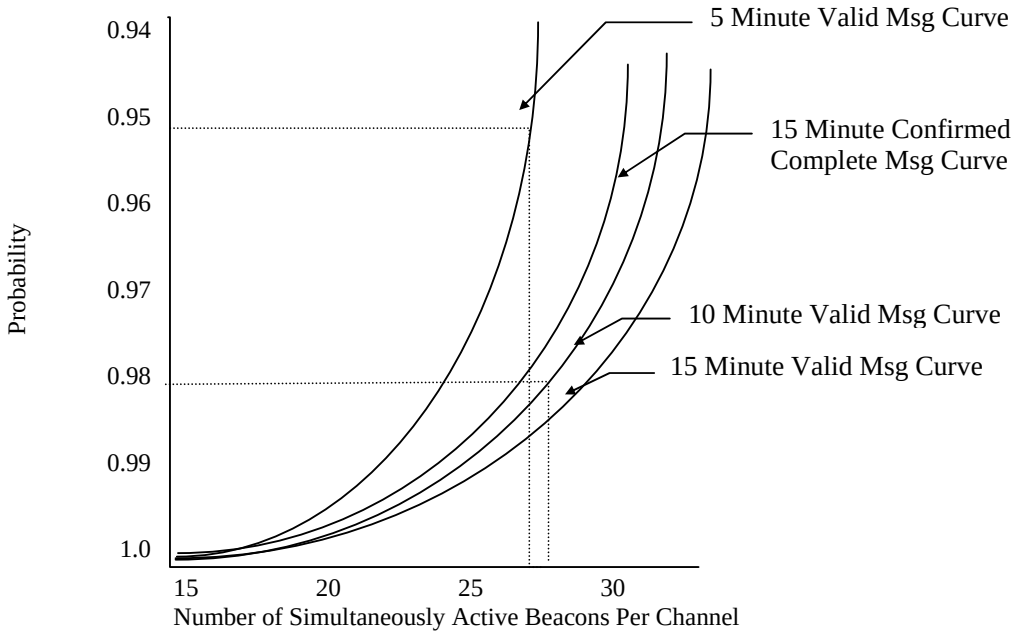
This section should include a statement confirming that the tests were conducted and analysed in accordance with C/S R.014, or describe any modifications to the test procedures that were required.

A.6.2 Test Results

The GEOLUT data collected for this test should be included as an annex to the report, and should be referenced in this section of the report. From the data collected, the table and graph depicted below should be provided, and the capacity calculated and reported in this section of the report.

Channel: 406.063				
# of Active Bcn Events	% Valid Msg within 5 Min	% Valid Msg within10 Min	% Valid Msg within 15 Min	% Confirmed Complete Msg within 15 Min
15				
20				
25				

406.063 MHz Channel Capacity



A.6.3 Test Anomalies

This section should provide information concerning issues which occurred during the test which could affect results. If some data was excluded from the results, an explanation should be provided.

A.6.4 Recommendations

Any proposed recommendations resulting from this test should be detailed in this section.

A.7 TEST T-5: IMPACT OF INTERFERENCE

This objective is not accomplished through a controlled test, but rather by monitoring the performance of the GEOLUT throughout the period of the entire INSAT performance evaluation programme, during which time it is anticipated that there will be periods of interference. In view of the unstructured nature of this process it is not possible to predict what information will be collected, the detailed analysis which will be required, nor define the structure for reporting the results in advance.

In view of the above, for administrations which participated in this test objective, a description of the configuration used to detect and measure interference should be provided. In addition, the data collected for this objective should be provided as an annex to the report. Finally any data reduction and/or analysis conducted should be described and the results reported.

A.8 TEST T-6: PROCESSING ANOMALIES

A.8.1 Test Description

This section should include a statement confirming that the tests were conducted and analysed in accordance with C/S R.014, or describe any modifications to the test procedures that were required.

A.8.2 Test Results

An entry should be made in the table provided at Annex F (a copy of the format of the table is provided below) for each instance when the GEOLUT produced a valid message which satisfied both conditions stated below:

a. the bias frequency calculated by the GEOLUT confirmed the transmission occurred in the channel reserved for reference beacons [406.022 MHz]; and

b. the 15 Hex ID of the valid message produced by the GEOLUT did not match any of the 15 Hex IDs of reference beacons operating in the MSG coverage area.

15 Hex ID Produced by GEOLUT	15 Hex ID of Associated Reference Beacon	Beacon Message Produced by GEOLUT (30 Hex)	Date / Time	LUT in LEO Footprint (Y/N)

Table for Recording 406 MHz Processing Anomalies (extracted from Annex F)

A.8.3 Processing Anomaly Rate (PA)

The PA rate and the PA rate when the GEOLUT was in the footprint of a LEOSAR satellite should be calculated and reported.

A.8.4 Test Anomalies

This section should provide information concerning issues which occurred during the test which could affect results. If some data was excluded from the results, an explanation should be provided.

A.8.5 Recommendations

Any proposed recommendations resulting from this test should be detailed in this section.

A.9 Test T-7: INSAT COVERAGE

A.9.1 Test Description

This section should include a statement confirming that the tests were conducted and analysed in accordance with C/S R.014, or describe any modifications to the test procedures that were required.

A.9.2 Test Results

Beacon Crossing Coverage Area

a. A narrative description of the test should provided, indicating the route taken, the beacon identification, and the times associated with the activation and deactivation of the beacon.

b. The GEOLUT performance in respect of producing valid messages, as a function of time and elevation angle (as indicated below) should be provided.

c. The results provided in the table should be graphically depicted on a map.

Beacon 15 Hex ID:_____ Activation Date / Time:_____ De-activation Date / Time:_____			
Date / Time	Location (Lat/Long)	Beacon to Satellite Elevation Angle	Detected by GEOLUT (Yes/No)

Evaluating Coverage Using Real Beacon Events

a. All beacon events detected by the LEOSAR system in the area enclosed by 80° N/S and 80° E/W, shall be recorded as per Annex G, and an indication of whether the beacon event was also detected by the INSAT GEOLUT.

b. Using the data captured at Annex G, beacon events are to be grouped into geographic locations of 10° latitude/longitude blocks, and the associated statistics calculated as follow.

Block Location		Number of LEOSAR Beacon Events	Number Detected by GEOLUT	% Detected by GEOLUT
Longitude	Latitude			
0/10w	0/10n			
10w/20w	0/10n			
20w/30w	0/10n			
.	.			
.	.			
.	.			
70e/80e	70s/80s			

c. Two maps of the data collected as per Annex G should be produced. One map depicting each beacon event that was detected by the LEOSAR and also by the INSAT GEOLUT, and the second map depicting each beacon event that was only detected by the LEOSAR system.

A.9.3 Test Anomalies

This section should provide information concerning issues which occurred during the test which could affect results. If some data was excluded from the results, an explanation should be provided.

A.9.4 Recommendations

Any proposed recommendations resulting from this test should be detailed in this section.

List of Annexes (electronic copies of annexes to be provided to Secretariat separately)

Annex A GEOLUT Data Collected for Objectives T-1, T-2, and T-3;
Annex B GEOLUT Data Collected for Objective T-4;
Annex C GEOLUT Data Collected for Objective T-6; and
Annex D GEOLUT Data Collected for Objective T-7

- END OF ANNEX A -

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ANNEX B

TEST SCRIPTS FOR OBJECTIVES T-1, T-2 AND T-3

Introduction

This annex provides a description of the test signals that will be transmitted by the French simulator for objectives T-1, T-2 and T-3.

Each script includes 50 different beacons that transmit 20 beacon bursts with a fixed burst repetition interval of 50 sec. In total there are 1000 beacon emissions per script (50 beacon events). The first 50 beacon emissions of the test script for uplink signals with EIRPs of 28 dBm are proved below.

The scripts for the other EIRPs will be identical to this example except that the beacon event IDs transmitted will be coded with the appropriate EIRP value. Copies of the test scripts for EIRP values from 28 to 37 dBm are available from the Cospas-Sarsat Secretariat on request. The 15 Hex ID f each beacon event conforms to the following convention:

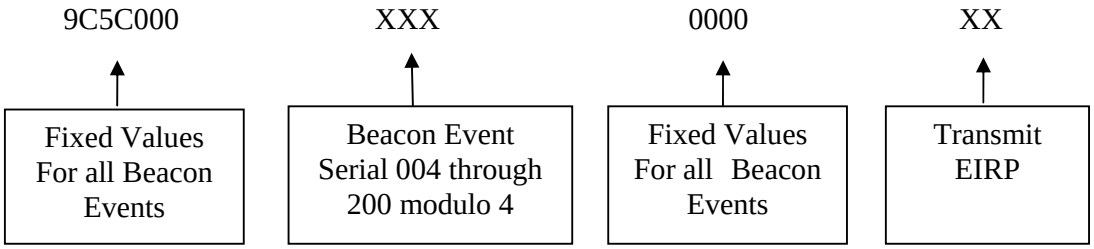

Table B-1: Test script for Test T-1, T-2 and T-3

EIRP 28 dBm			
15 Hex ID of Bcn Event	30 Hex Msg of Bcn Event	Time of First Burst in Bcn Event	Tx Freq (Hz)
9C5C00004000028	CE2E0000200001452F4C00100002C1	To	406062500
9C5C00008000028	CE2E0000400001447A8F40100002C1	To+1	406062600
9C5C00012000028	CE2E0000900001426C6AC0100002C1	To+2	406062700
9C5C00016000028	CE2E0000B0000142A0D400100002C1	To+3	406062800
9C5C00020000028	CE2E000100000143860 4C0100002C1	To+4	406062900
9C5C00024000028	CE2E0001200001434ABA00100002C1	To+5	406063000
9C5C00028000028	CE2E0001400001421F7940100002C1	To+6	406063500
9C5C00032000028	CE2E000190000144099CC0100002C1	To+7	406063400
9C5C00036000028	CE2E0001B0000144C52200100002C1	To+8	406063300
9C5C00040000028	CE2E0002000001409E6600100002C1	To+9	406063200
9C5C00044000028	CE2E00022000014052D8C0100002C1	To+10	406063100
9C5C00048000028	CE2E00024000014107 1B80100002C1	To+11	406063000
9C5C00052000028	CE2E00029000014711FE00100002C1	To+12	406062500
9C5C00056000028	CE2E0002B0000147DD40C0100002C1	To+13	406062600
9C5C00060000028	CE2E000300000146FB9000100002C1	To+14	406062700
9C5C00064000028	CE2E000320000146372EC0100002C1	To+15	406062800
9C5C00068000028	CE2E00034000014762ED80100002C1	To+16	406062900
9C5C00072000028	CE2E000390000141740800100002C1	To+17	406063000
9C5C00076000028	CE2E0003B0000141B8B6C0100002C1	To+18	406063500
9C5C00080000028	CE2E000400000146AEA380100002C1	To+19	406063400
9C5C00084000028	CE2E000420000146621D40100002C1	To+20	406063300
9C5C00088000028	CE2E00044000014737DE00100002C1	To+21	406063200
9C5C00092000028	CE2E000490000141213B80100002C1	To+22	406063100
9C5C00096000028	CE2E0004B0000141ED8540100002C1	To+23	406063000
9C5C00100000028	CE2E000800000143795040100002C1	To+24	406062500
9C5C00104000028	CE2E000820000143B5EE80100002C1	To+25	406062600
9C5C00108000028	CE2E000840000142E02DC0100002C1	To+26	406062700
9C5C00112000028	CE2E000890000144F6C840100002C1	To+27	406062800
9C5C00116000028	CE2E0008B00001443A7680100002C1	To+28	406062900
9C5C00120000028	CE2E0009000001451CA640100002C1	To+29	406063000
9C5C00124000028	CE2E000920000145D01880100002C1	To+30	406063500
9C5C00128000028	CE2E00094000014485DBC0100002C1	To+31	406063400
9C5C00132000028	CE2E000990000142933E40100002C1	To+32	406063300
9C5C00136000028	CE2E0009B00001425F8080100002C1	To+33	406063200
9C5C00140000028	CE2E000A0000014604C480100002C1	To+34	406063100
9C5C00144000028	CE2E000A20000146C87A40100002C1	To+35	406063000
9C5C00148000028	CE2E000A400001479DB900100002C1	To+36	406062500
9C5C00152000028	CE2E000A900001418B5C80100002C1	To+37	406062600
9C5C00156000028	CE2E000AB000014147E240100002C1	To+38	406062700
9C5C00160000028	CE2E000B000001406132801000002C1	To+39	406062800
9C5C00164000028	CE2E000B20000140AD8C40100002C1	To+40	406062900
9C5C00168000028	CE2E000B40000141F84F00100002C1	To+41	406063000
9C5C00172000028	CE2E000B90000147EEAA80100002C1	To+42	406063500
9C5C00176000028	CE2E000BB000014722144010000 2C1	To+43	406063400
9C5C00180000028	CE2E000C000001403401001000 02C1	To+44	406063300
9C5C00184000028	CE2E000C20000140F8BFC0100002C1	To+45	406063200
9C5C00188000028	CE2E000C40000141AD7C80100002C1	To+46	406063100
9C5C00192000028	CE2E000C90000147BB9900100002C1	To+47	406063000
9C5C00196000028	CE2E000CB00001477727C0100002C1	To+48	406063500
9C5C00200000028	CE2E001000000141 60CF00100002C1	To+49	406063400

- END OF ANNEX B -

ANNEX C

TEST SCRIPTS FOR OBJECTIVE T-4
(Channel Capacity)

Introduction

This annex provides a description of the test signals that will be transmitted by the French simulator for objective T-4.

Each script includes 15, 20, or 25 different beacons that transmit 18 beacon bursts with a fixed burst repetition interval of 50 seconds. Each beacon event is comprised of 18 beacon bursts, which may overlap in time. The start of time of the first beacon burst for each beacon event is provided in the table. To obtain sufficient statistics 10 different scripts for each beacon population will be transmitted. The beginning of one script simulating 15 simultaneously active beacons is provided below.

The 15 Hex ID of each beacon event conforms to the following convention:

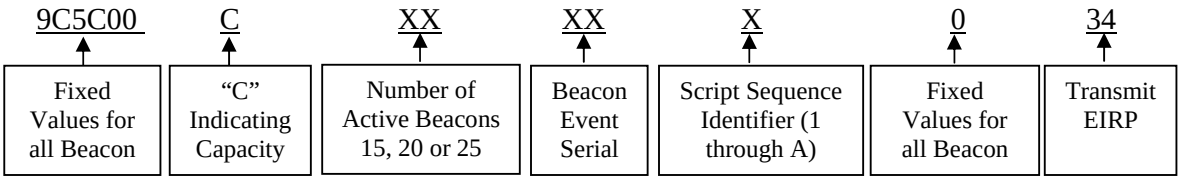

Table C-1: Test script for Test T-4

15 Hex ID of Bcn Event	30 Hex Msg of Bcn Event	Time of First Burst in Bcn Event	Tx Freq (Hz)
9C5C00C15011034	CE2E0060A80881A5224C00100002C1	To	406063000
9C5C00C15151034	CE2E0060A8A881A475A100100002C1	To + 4,14 s	406063000
9C5C00C15041034	CE2E0060A82081A577B740100002C1	To + 7,62 s	406063000
9C5C00C15101034	CE2E0060A88081A4205A40100002C1	To + 8,28 s	406063000
9C5C00C15061034	CE2E0060A83081A555D3C0100002C1	To + 8,72 s	406063000
9C5C00C15071034	CE2E0060A83881A544E180100002C1	To + 10,85 s	406063000
9C5C00C15031034	CE2E0060A81881A5002880100002C1	To + 11,92 s	406063000
9C5C00C15081034	CE2E0060A84081A5BAEC40100002C1	To + 12,05 s	406063000
9C5C00C15111034	CE2E0060A88881A4316800100002C1	To + 16,38 s	406063000
9C5C00C15021034	CE2E0060A81081A5111AC0100002C1	To + 18,22 s	406063000
9C5C00C15091034	CE2E0060A84881A5ABDE00100002C1	To + 20,02 s	406063000
9C5C00C15051034	CE2E0060A82881A5668500100002C1	To + 24,51 s	406063000
9C5C00C15131034	CE2E0060A89881A4130C80100002C1	To + 33,13 s	406063000
9C5C00C15141034	CE2E0060A8A081A4649340100002C1	To + 42,73 s	406063000
9C5C00C15121034	CE2E0060A89081A4023EC0100002C1	To + 45,31 s	406063000

- END OF ANNEX C -

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ANNEX D

DATA TO BE COLLECTED FOR OBJECTIVES T-1, T-2 AND T-3

Introduction

This annex provides a description of the data to be recorded for each beacon even transmitted by the simulator for objectives T-1, T-2 and T-3. This information provides the foundation for the analysis and conclusions provided in the body of the report.

The table below combines information obtained from the simulator operator, with data collected by the GEOLUT under test. Each row in the table represents a single beacon event. It should be included as an annex in the INSAT Performance Evaluation Report provided by the INSAT GEOLUT operator.

Table E-1: Results for Test T-1, T-2 and T-3

EIRP (dBm)_____Date/Time of First Busrt in Test Script Run 1_____									
15 Hex ID Tx by Simulator	Time of First Burst in Bcn Event	Time GEOLUT provided first Valid Msg	First Valid Msg C/No Measured by GEOLUT (dBHz)	Time GEOLUT provided first Complete Msg	First Complete Msg C/No Measured by GEOLUT (dBHz)	Time GEOLUT Confirmed Complete Msg	Confirmed Complete Msg C/No Measured by GEOLUT (dBHz)	Freq. Transmitted (Hz)	Calibrated freq. Measured by GEOLUT for first Valid Msg (Hz)

- END OF ANNEX D -

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ANNEX E

DATA TO BE COLLECTED FOR OBJECTIVE T-4

Introduction

This annex provides a description of the data which should be recorded for each beacon event transmitted by the simulator for objective T-4. This information provides the foundation for the analysis and conclusions provided in the body of the report.

The table below combines information obtained from the simulator operator, with data collected by the GEOLUT under test. Each row in the table represents a single beacon event.

A separate table should be provided for each run of a test script (i.e. there should be 10 tables for each simulated traffic load).

These tables should be included as an annex in the INSAT Performance Evaluation Report provided by the INSAT GEOLUT operator.

Simulated Traffic Load (Number of simultaneously occurring beacon events)_____ Script Number ___ Date/Time of First Burst in Test Script Run 1_____								
15 Hex ID Tx by Simulator	Time of First Burst in Bcn Event	Time GEOLUT provided First Valid Msg	First Valid Msg C/No Measured by GEOLUT (dBHz)	Time GEOLUT provided first Complete Msg	First Complete Msg C/No Measured by GEOLUT (dBHz)	Time GEOLUT Confirmed Complete Msg	Confirmed Complete Msg C/No Measured by GEOLUT (dBHz)	Frequency

- END OF ANNEX E -

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ANNEX F

DATA TO BE COLLECTED FOR OBJECTIVE T-6

Introduction

This annex provides a description of the data which should be recorded for each processing anomaly noted in the 406 MHz channel reserved for reference beacons.

This table should be included as an annex in the INSAT Performance Evaluation Report provided by the INSAT GEOLUT operator.

15 Hex ID Produced by GEOLUT	15 Hex ID of Associated Reference Beacon	Beacon Message Produced by GEOLUT (30 Hex)	C/No of Message as Measured by GEOLUT (dBHz)	Date / Time	LUT in LEO Footprint (Y/N)

_____ = Total duration that the GEOLUT was in the footprint of a LEOSAR satellite during the 4 week period of observation.

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ANNEX G

DATA TO BE COLLECTED FOR OBJECTIVE T-7

Introduction

This annex provides a description of the data which should be recorded for test T-7 (INSAT Coverage), for the test using beacon events of opportunity.

This table should be included as an annex in the INSAT Performance Evaluation Report provided by the INSAT GEOLUT operator.

15 Hex ID	Location Determined by LEOSAR System	LEOSAR Detection Time	Detected by GEOLUT (Yes / No)

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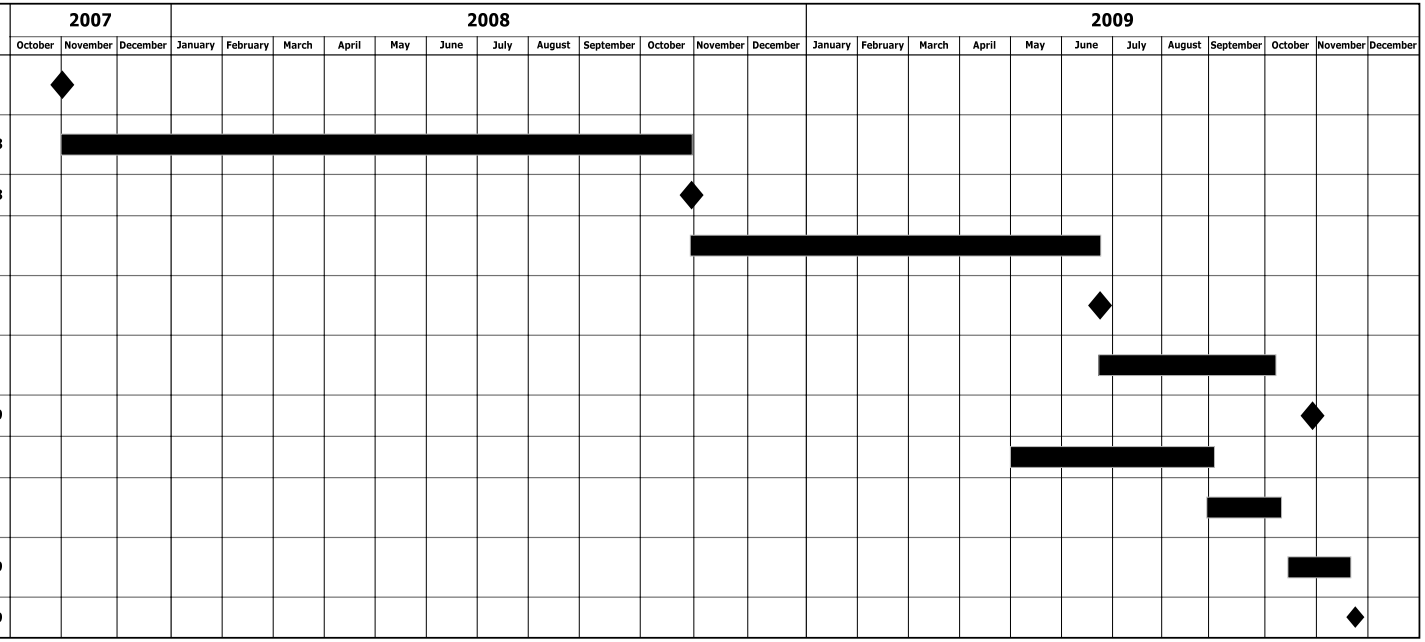
ANNEX H

INSAT GEOSAR Performance Evaluation Programme Schedule

Number	Task	Start	End
1	Decision to proceed with formal Commissioning of INSAT GEOSAR and Ground Segment	1/11/2007	1/11/2007
2	Preparation of INSAT GEOSAR test outline and submission to CSC-41	1/11/2007	30/10/2008
3	Approval of INSAT GEOSAR Test Outline by CSC-43	30/10/2008	30/10/2008
4	Preparation of Preliminary INSAT GEOSAR Performance Evaluation Plan, document C/S R.014	30/10/2008	23/6/2009
5	Preliminary INSAT GEOSAR Performance Evaluation Plan reviewed and accepted by JC-23	23/6/2009	23/6/2009
6	Preparation of final version of INSAT GEOSAR Performance Evaluation Plan.	23/6/2009	30/9/2009
7	Approval of document R.014 by CSC-43	29/10/2009	29/10/2009
8	INSAT GEOSAR Test preparation and Coordination	1/5/2009	31/8/2009
9	INSAT GEOSAR Main Test campaign, data collection and compilation	31/8/2009	6/10/2009
10	INSAT GEOSAR TEST Report preparation and internal review (document C/S R.015)	15/10/2009	20/11/2009
11	INSAR GEOSAR Test Report ready for final review by Cospas-Sarsat	23/11/2009	23/11/2009



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