

Agenda Item 4.2

LUCKNOW LEOLUT COMMISSIONING REPORT

1. ACTION REQUIRED

The Lucknow LUT hardware and software were upgraded in 2005, and hence commissioning test as per Cospas-Sarsat procedure was carried out to ensure that the LUT meets all the Cospas-Sarsat LUT specifications.

The Joint Committee is invited to:

- a) review the Lucknow LEOLUT commissioning test results presented at Attachment 1, which is provided in the format specified in C/S T.005 (LEOLUT commissioning);
- b) note that the data required by C/S T.005 Annex E have been supplied in electronic file format to the Secretariat; and
- c) recommend that the Lucknow LEOLUT located in Lucknow, India be commissioned into the Cospas-Sarsat System.

INDIA Lucknow LEOLUT Commissioning Report

Technical File

1. GENERAL

This annex defines general technical information for the Local User Terminal (LUT) installed at Lucknow in India.

2. LUT HARDWARE DESCRIPTION

2.1 Antenna Characteristics

- a) Type and number of antennas
One 1.53 meter parabolic dish operating in a radome.
- b) Gain/temperature ratio (G/T) at 5⁰ elevation angle
4.17 dB/K at 5⁰ elevation angle.
- c) Operational limitations
None.
- d) Dedicated or shared
Dedicated.

2.2 General LUT Indoor Equipment Description

- a) Equipment complement
Antenna
Antenna Control Unit
Receiver
121.5 MHz Processor
243 MHz Processor
2.4kb and 406 MHz Processor
Master Control Processor
GPS Receiver
- b) Stand alone, shared, or collocated with MCC

The LUT is stand-alone operating fully automatic and unattended for indefinite periods of time without any intervention from the operator or the MCC.

- c) LUT manufacturer and model number

TSI Fourth-Generation Ground Station, Model I.

- d) Status and alarm functions

The LUT provides to MCC its complete status and all its alarms constantly.

2.3 General Capabilities

- a) Processing capability (121.5 MHz, 243 MHz, 406 MHz SARP and SARR)

All available bands are processed including 121.5 MHz, 243 MHz, 406 MHz SARP, and 406 MHz SARR.

- b) Interference-monitoring capability

Capable of interference monitoring in all bands including full 80 KHz of 406 MHz SARR band.

- c) Redundancy/Availability

Parallel processing for redundancy and availability in excess of 99.7 %.

3. **PROCESSING**

- a) Specific-performance capability

Parallel architecture that enables efficient utilization of algorithms and concurrent 121.5 MHz, 243 MHz, 406 MHz SARP, and 406 MHz SARR processing with average processing time of less than 60 seconds.

- b) Manufacturer specifications

All requirements of the Cospas-Sarsat LUT performance specifications are exceeded.

- c) Bit error rate on PDS channel at Eb/No of 13 dB

A bit error rate less than one bit error in 10^6 .

- d) List of orbitography beacons used for orbit updating during the global-mode test.

<u>Beacon ID</u>	<u>Latitude</u>	<u>Longitude</u>
9C6000000000001	43.561	1.481

- f) G-SARP parameters (processing bandwidth, signal sensitivity and beacon processing capacity).

The LUT processes full 80 kHz bandwidth of 406 MHz G-SARP. It is able to detect and located 406 MHz interferer signals that are received with a C/No. of 18 dB-Hz

at the satellite. A maximum of 100 beacons per pass is the G-SARP beacon capacity.

4. COMMUNICATIONS CAPABILITY

- a) Primary-mode configuration: Satellite Link
- b) Backup-mode configuration: Modem Link

5. COVERAGE

- a) Site-horizon profile

The antenna visibility is clear to 2.0 degrees above horizon in any directions, except for:

Vegetation:	Azimuth: 00-50°	Elevation: 4.0°
VHF Receive Antenna:	Azimuth: 100-105°	Elevation: 4.3°
10m Antenna:	Azimuth: 105-114°	Elevation: 8.0°
VHF Trans. Antenna:	Azimuth: 149-179°	Elevation: 30.0°
Bioteck Park:	Azimuth: 173-191°	Elevation: 3.2°
Old Boresite tower:	Azimuth: 213-214°	Elevation: 7.0°
New Boresite tower:	Azimuth: 218-219°	Elevation: 8.0°
11m Reflector:	Azimuth: 226-241°	Elevation: 5.0°
AQ Horn:	Azimuth: 231-235°	Elevation: 18.0°
Test Probe str:	Azimuth: 263-264°	Elevation: 10.0°
Vegetation:	Azimuth: 263-360°	Elevation: 4.0°

- b) Operational-tracking (elevation) limits.

Full tracking from 0 to 90 degrees of elevation.

6. LOCATION

- a) Latitude and longitude (of antenna)
- b) Altitude

Latitude: 26.913° North
 Longitude: 80.956° East
 Altitude: 85 meters above sea level

LEOLUT Commissioning Report

Country or national Administration: India

Location of LEOLUT: Lucknow

Cospas-Sarsat Identifier: 4192

Operational Configuration 121.5, 243, SARP, SARR (see Note)

Start of Commissioning Period: 01-16-2006

End of Commissioning Period: 02-01-2006

Section 1.0 contains a summary of the commissioning results as well as the declarations (D) and verifications (V), by the national Administration, for requirements not specifically measured.

The organization of the summary table follows the requirements contained in document C/S T.002. Section 2.0 contains the measurements (M) to support the results presented in section 1.0, a copy of the associated data is provided in ASCII format as required by document C/S T.005. A technical description of the LEOLUT is presented in Appendix 1.

Note: When combined LEO/GEO processing is implemented, the sources (i.e. satellite and GEOLUT) of any GEOSAR data used by LEOLUT shall be identified.

1. Summary Table

Paragraph in C/S T.002	Requirement or Test	Pass Criteria	Result	Pass / Fail	Method of Compliance	Declaration/ Verification or Comments
3.1	LEOLUT Data Availability	$A \geq 95$	99.38	Pass	M	
3.2	Data Requirements	N/A	N/A	Pass	V	Verified
3.3	Data Channels	Minimum 406 MHz Channel	N/A	Pass	V	121.5, 243 MHz 406 MHz SARP, SARR
3.4	Satellite Tracking Capability	ST>99	100	Pass	M	
3.5	Satellite Visibility/Signal Lock	L=0	L=0	Pass	M	
3.6	Status and Alarm	N/A	N/A	Pass	D	Include description in technical file
3.7	RF Radiation/Emissions	N/A	N/A	Pass	D	Declared
3.8	Data Archiving	N/A	N/A	Pass	D	Declared

Paragraph in C/S T.002	Requirement or Test	Pass Criteria	Result	Pass / Fail	Method of Compliance	Declaration/ Verification or Comments
4.1.1	Antenna and RF Subsystem	N/A	N/A	Pass	V	Verified
4.1.2	Time and Frequency Reference Subsystem	N/A	N/A	Pass	V	Verified
4.1.3	Orbit Maintenance Subsystem	Maintenance for up to 8 Satellites. Update using 2 Methods.	N/A	Pass	D	Verified
4.1.4	MCC Interface	N/A	N/A	Pass	V	Verified
4.2.2.1	406 MHz SARP Channel Data Recovery	N/A	N/A	Pass	V	Verified Ability to recover global and local-mode PDS data
4.2.2.2	406 MHz SARR Channel Data Recovery	Exact Match on 9 Bit Frame Synch	N/A	Pass	D	Declared Achieve identical match on 9 bit frame synchronization
4.2.3	Bit Verification Test – BV1	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
	Bit Verification Test – BV2	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
4.2.4	Beacon Message Validation Test – MV1	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
	Beacon Message Validation Test – MV2	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
	Beacon Message Validation Test – MV3	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
	Beacon Message Validation Test – MV4	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
4.2.5	Beacon Message Validation Test – LP1	See Annex D to C/S T.005	N/A	Pass	M	French Simulator
	Beacon Message Validation Test – LP2	See Annex D to C/S T.005	N/A	Pass	M	French Simulator
	Beacon Message Validation Test – LP3	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
	Beacon Message Validation Test – LP4	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
	Beacon Message Validation Test – IV1	See Annex D to C/S T.005	N/A	Pass	M	French Simulator
4.2.6	Time and Frequency Requirements	N/A	N/A	Pass	D	Declared
4.2.7	Doppler Processing and Validation Test – DP1	N/A	N/A	Pass	M	French Simulator
4.2.7.1	Selection of Data Points	--	--	--	--	Requirement the same as requirement 4.2.4 in C/S T.002
4.2.7.2	Rejection of Data Points Test – DP2	See Annex D to C/S T.005	N/A	Pass	M	USA Simulator
4.2.7.3	Combining Global/Local-mode SARP Data	N/A	N/A	Pass	D	Declared

Paragraph in C/S T.002	Requirement or Test	Pass Criteria	Result	Pass / Fail	Method of Compliance	Declaration/ Verification or Comments
4.2.7.4	Combining SARR/SARP Data	N/A	N/A	--	D	Declared
4.2.7.5	Combining LEO/GEO Data	--	--	--	V	Alert msg to MCC shall include sources of GEO data & indicate beacon freq. Stability.
4.2.7.6	Validation of Doppler Locations	N/A	N/A	Pass	D	Declared
4.2.7.7	Beacon Message Assignment	--	--	--	--	Requirement the same as requirement 4.2.5 in C/S T.002
4.2.8	Transmission of alert Data	--	--	--	--	Requirement the same as requirement 3.2 in C/S T.002
4.3.1	121.5 MHz Signal Detection and Doppler Location	N/A	N/A	Pass	D	Declared
4.3.2	121.5 MHz Doppler Processing	N/A	N/A	Pass	D	Declared
5.1.1	RF Signal Margin	N/A	N/A	Pass	D	Declared
5.1.2	Processing Time	PT<15 min for 99% of passes	PT < 1 min	Pass	M	Requirement applicable to all processing combinations
5.1.3	Orbit Determination	Error \leq 2 km	N/A	Pass	D	Declared
5.1.4	Ambiguity Resolution	A + B = 100	100	Pass	V	Verified
5.1.5	406 MHz SARP Error Ellipse Nominal Solutions	M/N > 0.40 and M/N < 0.60	0.418	Pass	M	
	406 MHz SARP Error Ellipse Marginal Solutions	M/N > 0.40 and M/N < 0.60	0.580	Pass	M	
	406 MHz SARR Error Ellipse Nominal Solutions	M/N > 0.40 and M/N < 0.60	0.577	Pass	M	
	406 MHz SARR Error Ellipse Marginal Solutions	M/N > 0.40 and M/N < 0.60	0.429	Pass	M	
	121.5 MHz Error Ellipse	M/N > 0.40 and M/N < 0.60	0.571	Pass	M	
5.2.1	406 MHz SARP Data Recovery	DR \geq 1.0	1.17	Pass	M	
5.2.2	406 MHz SARP Time and Frequency Calculation	1 millihertz and 1 millisecond resolution	Complied	Pass	D	Declared
5.2.3	406 MHz SARP Beacon Capacity	90 Beacons in local-mode 200 beacons in global-mode	Complied	Pass	D	Declared

Paragraph in C/S T.002	Requirement or Test	Pass Criteria	Result	Pass/Fail	Method of Compliance	Declaration/ Verification or Comments
5.2.4	406 MHz SARP Location Accuracy Nominal Solutions	$M/N \geq 0.95$ (5km)	0.976	Pass	M	
		$M/N \geq 0.98$ (10km)	1.00	Pass	M	
	406 MHz SARP Location Accuracy Marginal Solutions	$M/N \geq 0.60$ (5km)	0.903	Pass	M	
		$M/N \geq 0.80$ (20km)	0.979	Pass	M	
5.2.5	406 MHz SARP Ambiguity Resolution Nominal Solutions	$M/N \geq 0.90$	0.999	Pass	M	
	406 MHz SARP Ambiguity Resolution Marginal Solutions	$M/N \geq 0.60$	0.956	Pass	M	
5.3.1	406 MHz SARR Signal Sensitivity	Signal Sensitivity better than 36dB-Hz	27-28 dB-Hz	Pass	D	Declared
5.3.2	406 MHz SARR Beacon Message Throughput	$T \geq 0.75$	0.844	Pass	M	
5.3.3	406 MHz SARR Probability of Doppler Location	$PDL \geq 0.95$	1.00	Pass	M	
5.3.4	406 MHz SARR Time and Frequency Calculation	350 millihertz and 10 ms	Complied	Pass	D	Declared
5.3.5	406 MHz SARR Beacon Capacity	10 beacons	$\gg 10$	Pass	D	Declared
5.3.6	406 MHz SARR Location Accuracy Nominal Solutions	$M/N \geq 0.95$ (5km)	.993	Pass	M	
		$M/N \geq 0.98$ (10km)	1.00	Pass	M	
	406 MHz SARR Location Accuracy Marginal Solutions	$M/N \geq 0.60$ (5km)	0.833	Pass	M	
		$M/N \geq 0.80$ (20km)	1.00	Pass	M	
5.3.7	406 MHz SARR Ambiguity Resolution Nominal Solutions	$M/N \geq 0.90$	0.987	Pass	M	
	406 MHz SARR Ambiguity Resolution Marginal Solutions	$M/N \geq 0.60$	0.786	Pass	M	
5.3.8	406 MHz False Alert Prevention	False Alerts Caused by Processing Anomalies $< 1 \times 10^{-4}$	None	Pass	D, V	Declared & Verified
5.3.9	406 MHz Processing Bandwidth	406.010 to 406.090 MHz	Full 80kHz	Pass	D	Verified

Paragraph in C/S T.002	Requirement or Test	Pass Criteria	Result	Pass/Fail	Method of Compliance	Declaration/ Verification or Comments
5.4	Combined SARP and SARR Processing	As per document C/S T.002	--	Pass	D, M	Capable of combining SARP and SARR data
5.4.a	Combined SARP and SARR Location Accuracy Nominal Solutions	$M/N \geq 0.95$ (5km)	1.00	Pass	M	
		$M/N \geq 0.98$ (10km)	1.00	Pass	M	
	Combined SARP and SARR Location Accuracy Marginal Solutions	$M/N \geq 0.60$ (5km)	0.667	Pass	M	
		$M/N \geq 0.80$ (20km)	.1.00	Pass	M	
5.4.b	Combined SARP and SARR Ambiguity Resolution Nominal Solutions	$M/N \geq 0.90$	0.990	Pass	M	
	Combined SARP and SARR Ambiguity Resolution Marginal Solutions	$M/N \geq 0.60$	0.867	Pass	M	
5.4.c	Combined SARP and SARR Error Ellipse Nominal Solutions	$M/N > 0.40$ And $M/N < 0.60$	0.587	Pass	M	
	Combined SARP and SARR Error Ellipse Marginal Solutions	$M/N > 0.40$ And $M/N < 0.60$	0.533	Pass	M	
5.5	Combined SARP/GEO SAR or SARP/SARR/GEOSAR Processing	As per document C/S T.002	--	--	D	Only applicable to LEOLUTs which combine LEOSAR and GEOSAR data
5.5.1.a	Combined SARP/GEOSAR or SARP/ SARR/GEOSAR Processing Location Accuracy Nominal Solutions	$M/N \geq 0.95$ (5km)	--	--	M	Only applicable to LEOLUTs which combine LEOSAR and GEOSAR data
		$M/N \geq 0.98$ (10km)	--	--	M	
	Combined SARP/GEOSAR or SARP/ SARR/GEOSAR Processing Location Accuracy Marginal Solutions	$M/N \geq 0.60$ (5km)	--	--	M	
		$M/N \geq 0.80$ (20km)	--	--	M	
5.5.2	Combined SARP/GEOSAR or SARP/ SARR/GEOSAR Processing Location Accuracy Minimum Point Solutions	$M/N \geq 0.60$ (5km)	--	--	M	Only applicable to LEOLUTs which combine LEOSAR and GEOSAR data
		$M/N \geq 0.80$ (20km)	--	--	M	
5.5.1.b	Combined SARP/GEOSAR or SARP/ SARR/GEOSAR Processing Ambiguity Resolution Nominal Solutions	$M/N \geq 0.90$	--	--	M	Only applicable to LEOLUTs which combine LEOSAR and GEOSAR data
	Combined SARP/GEOSAR or SARP/ SARR/GEOSAR Processing Ambiguity Resolution Marginal Solutions	$M/N \geq 0.60$	--	--	M	

Paragraph in C/S T.002	Requirement or Test	Pass Criteria	Result	Pass/Fail	Method of Compliance	Declaration/ Verification or Comments
5.5.1.c	Combined SARP/GEOSAR or SARP/ SARR/GEOSAR Processing Error Ellipse Nominal Solutions	M/N > 0.40 And M/N < 0.60	--	--	M	Only applicable to LEOLUTs which combine LEOSAR and GEOSAR data
	Combined SARP/GEOSAR or SARP/ SARR/GEOSAR Processing Error Ellipse Marginal Solutions	M/N > 0.40 And M/N < 0.60	--	--	M	
5.5	Combined SARR/GEOSAR Processing	as per document C/S T.002	--	--	D	Only applicable to LEOLUTs which combine SARP and GEOSAR data
5.5.1.a	Combined SARR/GEOSAR Location Accuracy Nominal Solutions	M/N ≥ 0.95 (5km)	--	--	M	Only applicable to LEOLUTs which combine SARP and GEOSAR data
		M/N ≥ 0.98 (10km)	--	--	M	
	Combined SARR/GEOSAR Location Accuracy Marginal Solutions	M/N ≥ 0.60 (5km)	--	--	M	Only applicable to LEOLUTs which combine LEOSAR and GEOSAR data
		M/N ≥ 0.80 (20km)	--	--	M	
5.5.2	Combined SARR/GEOSAR Location Accuracy Minimum Point Solutions	M/N ≥ 0.60 (5km)	--	--	M	Only applicable to LEOLUTs which combine LEOSAR and GEOSAR data
		M/N ≥ 0.80 (20km)	--	--	M	
5.5.1.b	Combined SARR/GEOSAR Ambiguity Resolution Nominal Solutions	M/N ≥ 0.90	--	--	M	Only applicable to LEOLUTs which combine SARR and GEOSAR data
	Combined SARR/GEOSAR Ambiguity Resolution Marginal Solutions	M/N ≥ 0.60	--	--	M	
5.5.1.c	Combined SARR/GEOSAR Error Ellipse Nominal Solutions	M/N > 0.40 And M/N < 0.60	--	--	M	Only applicable to LEOLUTs which combine SARR and GEOSAR data
	Combined SARR/GEOSAR Error Ellipse Marginal Solutions	M/N > 0.40 And M/N < 0.60	--	--	M	
5.6.1	121.5 MHz SARR Signal Sensitivity	Locate Signals with C/No 23 dB-Hz	<< 23 dB-Hz	Pass	D	Declared
5.6.2	121.5 MHz SARR Beacon Capacity	10 beacons	N/A	Pass	D	Declared

Paragraph in C/S T.002	Requirement or Test	Pass Criteria	Result	Pass/ Fail	Method of Compliance	Declaration/ Verification or Comments
5.6.3	121.5 MHz SARR Location Accuracy Nominal Solutions	$M/N \geq 0.70$ (20km)	0.775	Pass	M	
		$M/N \geq 0.95$ (40km)	0.973	Pass	M	
5.6.4	121.5 MHz SARR Ambiguity Resolution	$M/N \geq 0.70$	0.764	Pass	M	

Statistics for Operational Requirements

B.1 LEOLUT Data Availability (A)

LEOLUT data availability measures the probability of receiving complete and accurate LEOLUT data at the MCC. Whenever a LEOLUT does not perform any of its functions, downtime (DT) is measured from LOS of the last successful satellite pass to AOS of the next successful satellite pass. Availability (A) is expressed as a percentage and is calculated by dividing the amount of operational time (OT) by the time required to be in operation (OTR). The time required to be in operation (OTR), expressed in hours, is 24 times the number of days in the commissioning period inclusive of all maintenance downtime. Downtime is that period of time when the LEOLUT fails to perform any of its basic functions. Therefore:

$A = (OT / OTR) * 100 = (1 - (DT / OTR)) * 100$ and shall be greater than 95.

$A = 99.38\%$ with $OTR = 17 * 24 = 408$, $DT = 2.51$ hrs for maintenance and backup

B.2 Satellite Tracking (ST)

$ST = N/M * 100$ and shall be greater than 99, where M = number of non-conflicting passes visible to the LEOLUT with a maximum elevation angle of 5° above the horizon during the commissioning period, and N = number of successfully tracked passes.

$301 = 301$

$M = 301$

$ST = 301 / 301 = 100 \%$

B.3 Satellite Visibility/Signal Lock (L)

L = number of passes that the LEOLUT lost carrier lock on the satellite downlink carrier signal while the satellite was above a 5° elevation angle (except where local obstructions prevent this). L shall be equal to 0.

$L = 0$

Statistics for Performance Requirements

C.1 SUMMARY

Lucknow LEOLUT performed very well. It exceeded all the requirements of the Cospas-Sarsat LEOLUT performance specifications. They are listed briefly here.

- 1.1 121.5 MHz data (Nominal Solutions): Lucknow LEOLUT showed location accuracy of 77.5% and 97.3% within 20 km and 40 km, respectively. The Cospas-Sarsat specification requires 70% within 20 km and 95% within 40 km.
- 1.2 406 MHz G-SARP (Nominal Solutions): Lucknow LEOLUT exhibited location accuracy of 99.3% and 100.0% within 5 km and 10 km, respectively. The LUT specification requires 95.0% within 5 km and 98.0% within 10 km.
- 1.3 2.4KB Local PDS (Nominal Solutions): Lucknow LEOLUT had location accuracy of 99.4% and 100.0% within 5 km and 10 km, respectively. The specification is for 95% within 5 km and 98% within 10 km.
- 1.4 2.4KB Global PDS (Nominal Solutions): Lucknow LEOLUT exhibited location accuracy of 97.6% and 100.0% within 5 km and 10 km, respectively. The specification requires 95% within 5 km and 98% within 10 km.
- 1.5 406 MHz G-SARP (Marginal Solutions): Lucknow LEOLUT exhibited location accuracy of 83.3 and 100.0% within 5 km and 20 km, respectively. The LUT specification requires 60% within 5 km and 80.0% within 20 km.
- 1.6 2.4KB Local PDS (Marginal Solutions): Lucknow LEOLUT had location accuracy of 88.0% and 100.0% within 5 km and 20 km, respectively. The specification is for 60% within 5 km and 80% within 20 km.
- 1.7 2.4KB Global PDS (Marginal Solutions): Lucknow LEOLUT exhibited location accuracy of 90.3% and 97.9% within 5 km and 20 km, respectively. The specification requires 60% within 5 km and 80% within 20 km.
- 1.8 406 MHz Combined SARP/G-SARP (Nominal Solutions): Lucknow LEOLUT exhibited location accuracy of 100.0% within 5 km. The LUT specification requires 95.0% within 5 km and 98.0% within 10 km.
- 1.9 406 MHz Combined SARP/G-SARP (Marginal Solutions): Lucknow LEOLUT exhibited location accuracy of 66.7 and 93.3% within 5 km and 20 km, respectively. The LUT specification requires 60% within 5 km and 80.0% within 20 km.

The detailed results are provided in the following sections.

C.2 2.4 KB PDS STATISTICS (SARP)

Number of processed passes = 197
 Number of processed solutions = 11307

Minimum processing time = 2.81 seconds
 Average processing time = 12.17 seconds
 Maximum processing time = 21.15 seconds

Data Recovery (DR) = 1.17

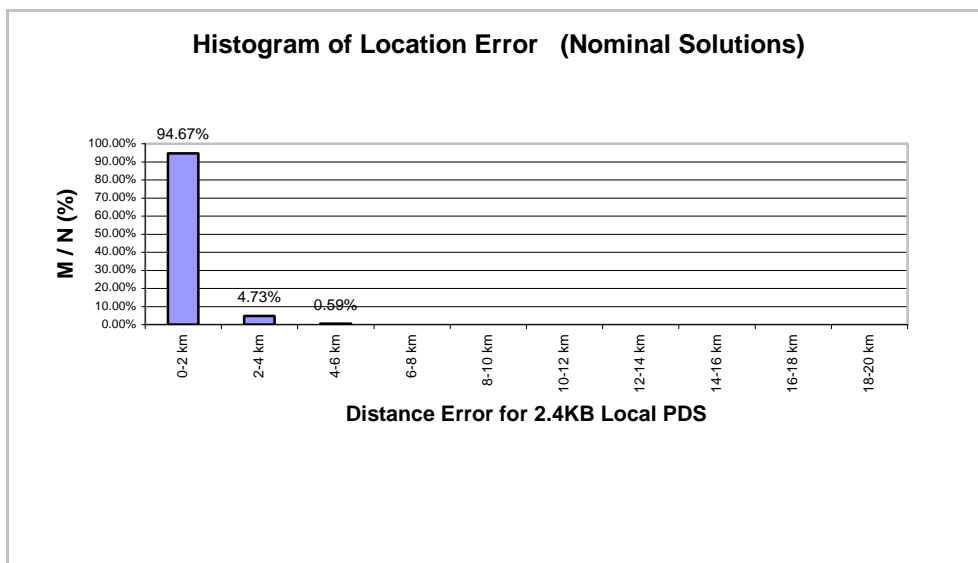
Beacon IDs and Locations :

Beacon ID	Latitude	Longitude
ADC268F8E0D3780	-77.846	+166.712
9B62197CA703590	+77.465	-69.218
9C7FEC2AACD3590	-49.351	+70.256
B47C121212121	+26.913	+80.956
347E00023F81FE0	+26.913	+80.956

2.1 Nominal Solutions

Local Mode

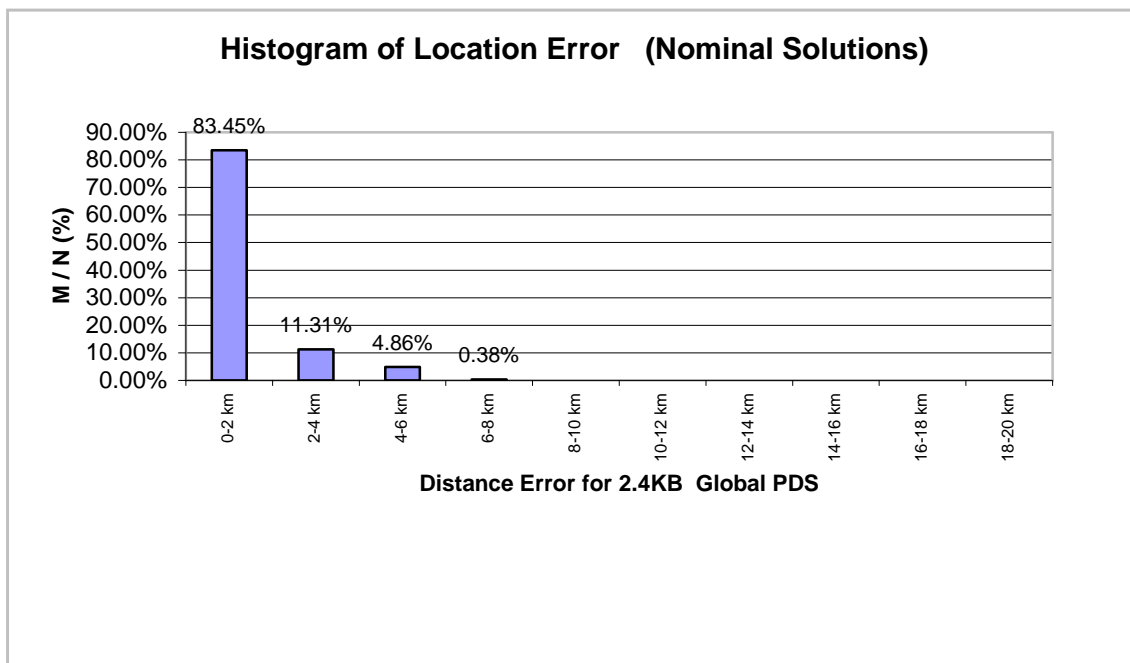
Number of Solutions = 169
 Number of solutions within 5 km = 168
 Number of solutions within 10 km = 169
 Location accuracy = 168 / 169 = 0.994 within 5 km
 Location accuracy = 169 / 169 = 1.0 within 10 km
 Ambiguity resolution = 168 / 169 = 0.994
 Error Ellipse = 77/169 = 0.456



2.2 Nominal Solutions

Global Mode

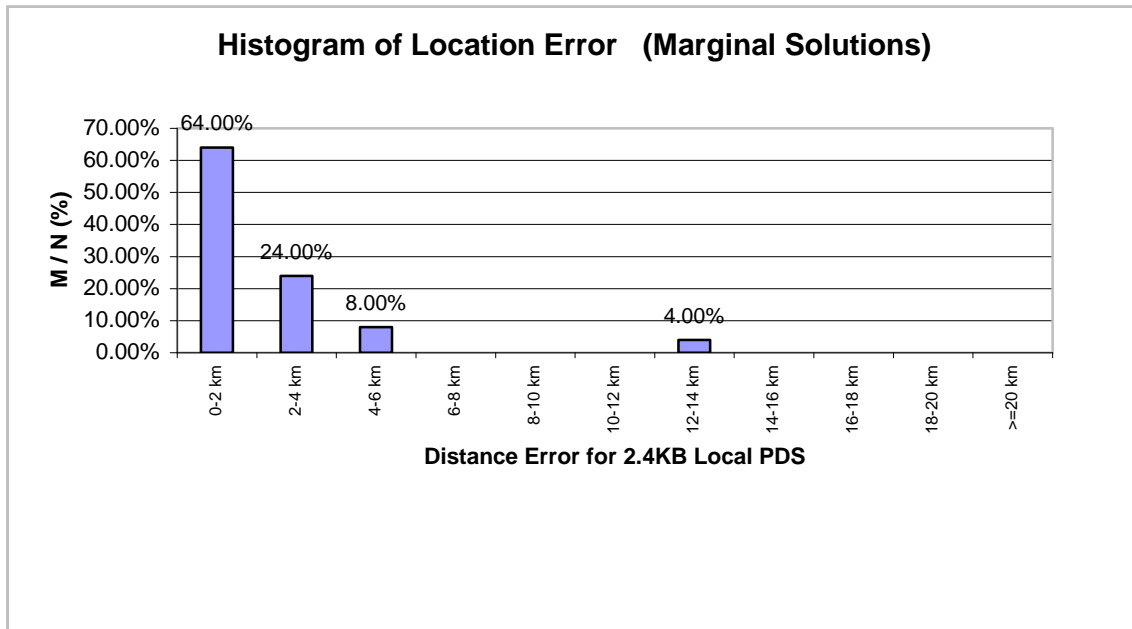
Number of Solutions = 1317
Number of solutions within 5 km = 1298
Number of solutions within 10 km = 1317
Location accuracy = $1298 / 1317 = 0.976$ within 5 km
Location accuracy = $1317 / 1317 = 1.00$ within 10 km
Ambiguity resolution = $1316 / 1317 = 0.999$
Error Ellipse = $550 / 1317 = 0.418$



2.3 Marginal Solutions

Local Mode

Number of Solutions = 25
 Number of solutions within 5 km = 22
 Number of solutions within 10 km = 24
 Location accuracy = 22 / 25 = 0.880 within 5 km
 Location accuracy = 24 / 25 = 0.960 within 10 km
 Location accuracy = 25 / 25 = 1.0 within 20 km
 Ambiguity resolution = 21 / 25 = 0.840
 Error Ellipse = 14 / 25 = 0.560



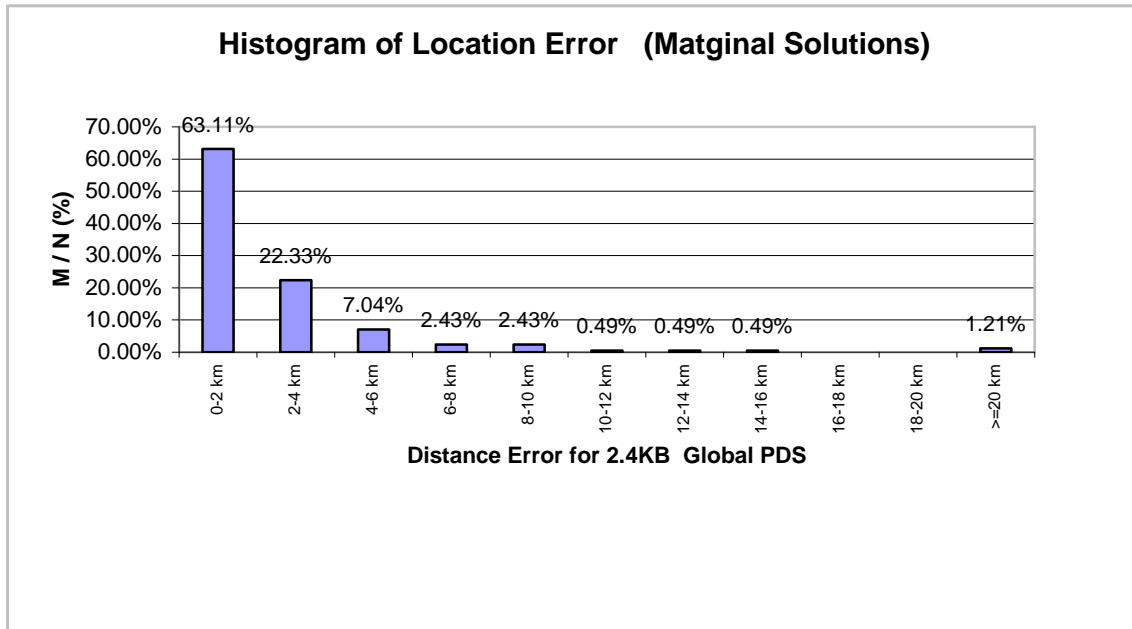
Locations with distance errors greater than 50 km:

N Beacon ID Latitude Longitude CTA Pnts Error Comments.....

2.4 Marginal Solutions

Global Mode

Number of Solutions = 412
 Number of solutions within 5 km = 372
 Number of solutions within 10 km = 401
 Location accuracy = 372 / 412 = 0.903 within 5 km
 Location accuracy = 401/ 412 = 0.973 within 10 km
 Location accuracy = 407/ 412 = 0.979 within 20 km
 Ambiguity resolution = 394/412 = 0.956
 Error Ellipse = 239/ 412 = 0.580



Locations with distance errors greater than 50 km:

N	Beacon ID	Latitude	Longitude	CTA	Pnts	Error	Comments.....
1	ADC268F8E0D3780	-78.39	164.71	-0.02	34	75.961	Overhead pass
2	ADC268F8E0D3780	-78.35	168.44	-0.02	30	68.479	Overhead pass
3	9B62197CA703590	-49.28	71.53	-28.33	3	92.776	Low number of points

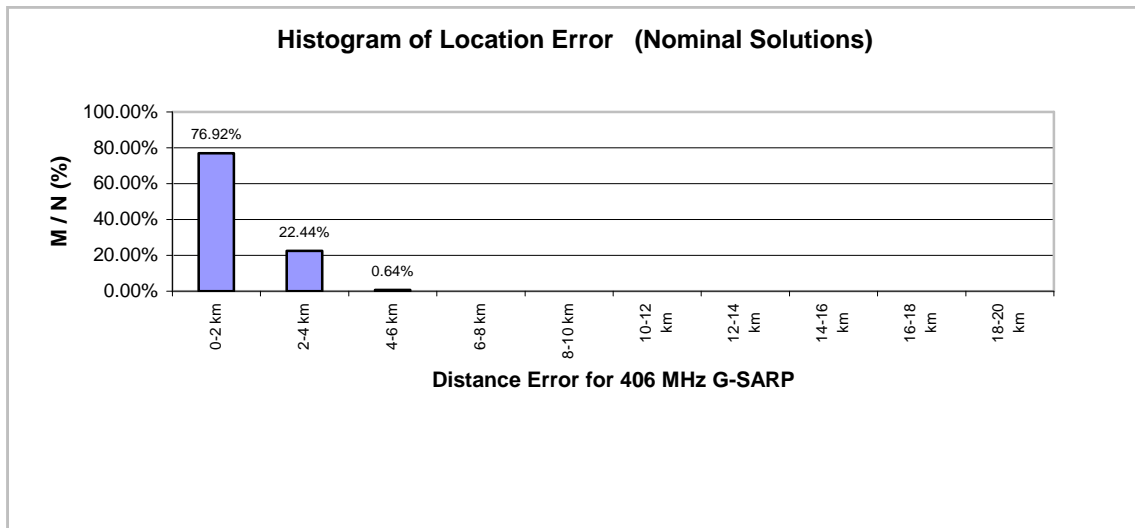
C.3 406 MHZ G-SARP STATISTICS

Test Beacon ID and Location :

Beacon Id	Latitude	Longitude
B47C12121212121	+26.913	+80.956
347E00023F81FE0	+26.913	+80.956

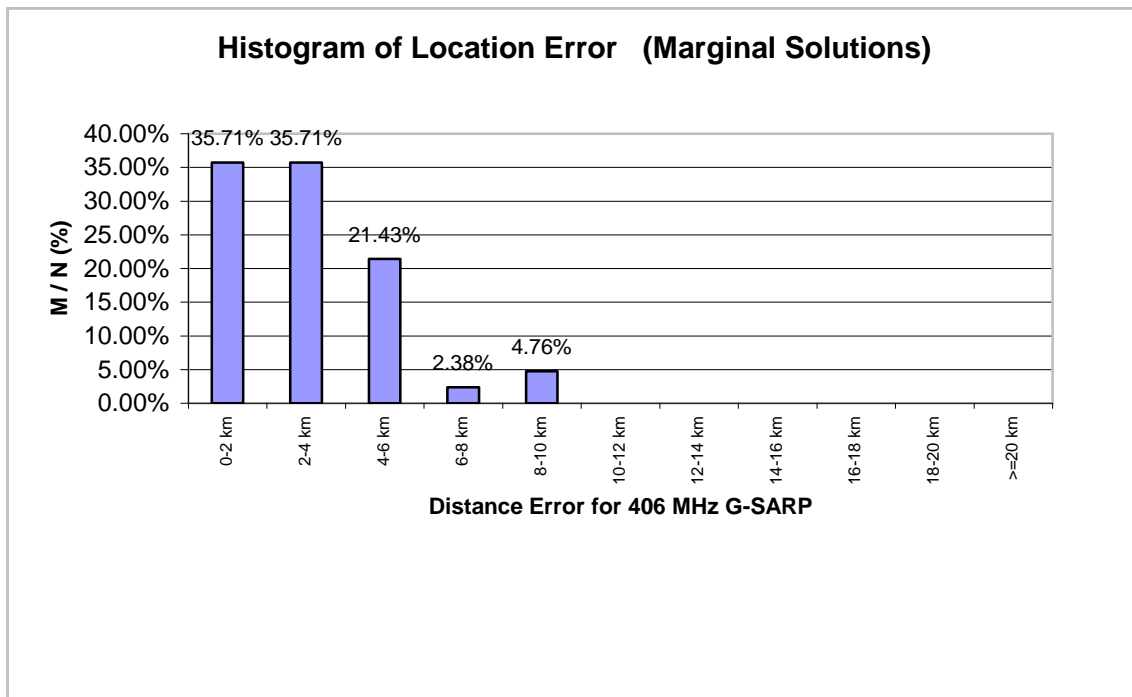
3.1 Nominal Solutions

Number of Solutions	= 156
Number of solutions within 5 km	= 155
Number of solutions within 10 km	= 156
Location accuracy = 155 / 156	= 0.993 within 5 km
Location accuracy = 156 / 156	= 1.0 within 10 km
Ambiguity resolution = 154 / 156	= 0.987
Error Ellipse = 90 / 156	= 0.577
SARR Throughput	= 0.844
Probability of Doppler Location	= 1.00
Minimum processing time	= 8.13 seconds
Average processing time	= 17.32 seconds
Maximum processing time	= 31.21 seconds



3.2 Marginal Solutions

Number of Solutions	= 42
Number of solutions within 5 km	= 35
Number of solutions within 10 km	= 42
Location accuracy = 35 / 42	= 0.833 within 5 km
Location accuracy = 42 / 42	= 1.0 within 10 km
Location accuracy = 42 / 42	= 1.0 within 20 km
Ambiguity resolution = 33/42	= 0.786
Error Ellipse = 18/ 42	= 0.429
SARR Throughput	= 0.796



Locations with distance errors greater than 50 km:

N Beacon ID Latitude Longitude CTA Pnts Error Comments.....

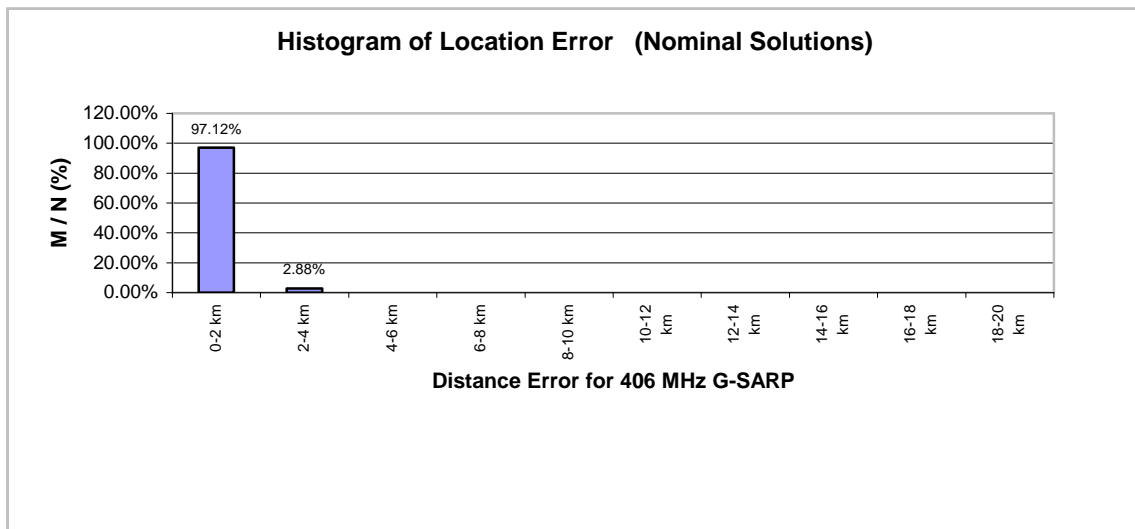
C.4 406 MHZ G-SARP/SARP COMBINED STATISTICS

Test Beacon ID and Location :

Beacon ID	Latitude	Longitude
B47C12121212121	+26.913	+80.956
347E00023F81FE0	+26.913	+80.956

4.1 Nominal Solutions

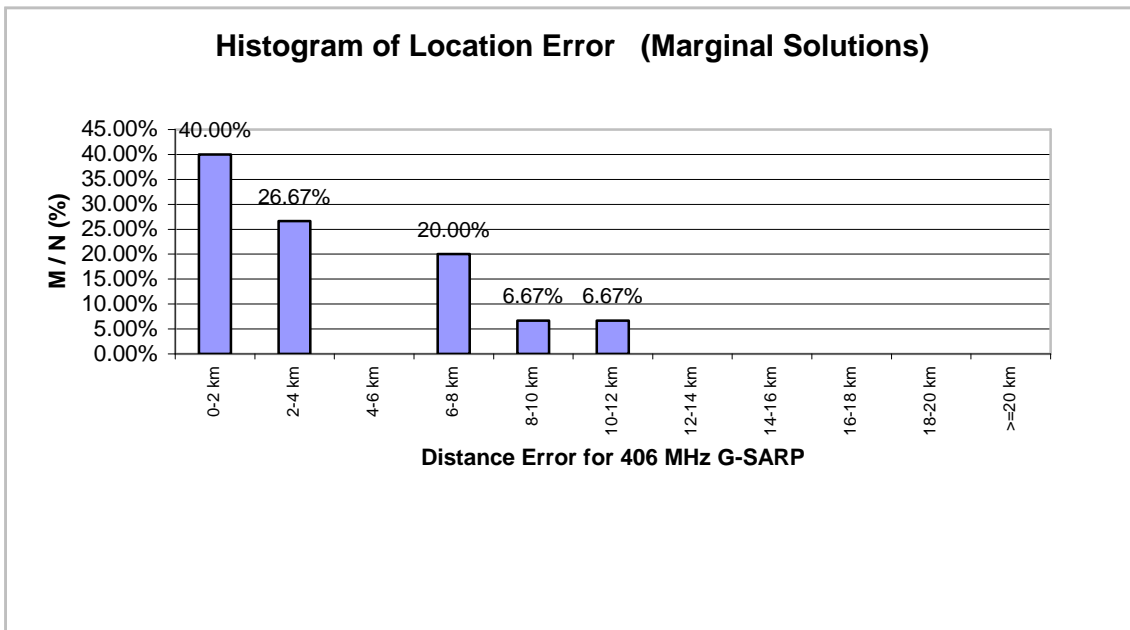
Number of Solutions	=	104
Number of solutions within 5 km	=	104
Number of solutions within 10 km	=	104
Location accuracy = 104 / 104	=	1.0 within 5 km
Location accuracy = 104 / 104	=	1.0 within 10 km
Ambiguity resolution = 103 / 104	=	0.990
Error Ellipse = 61 / 104	=	0.587
SARR Throughput	=	0.908
Probability of Doppler Location	=	1.00
Minimum processing time	=	9.11 seconds
Average processing time	=	23.62 seconds
Maximum processing time	=	39.93 seconds



4.2 Marginal Solutions

Number of Solutions = 15
 Number of solutions within 5 km = 10
 Number of solutions within 10 km = 14
 Location accuracy = 10 / 15 = 0.667 within 5 km
 Location accuracy = 14 / 15 = 0.933 within 10 km
 Location accuracy = 15 / 15 = 1.0 within 20 km
 Ambiguity resolution = 13/15 = 0.867
 Error Ellipse = 8/ 15 = 0.533

 SARR Throughput = 0.911



Locations with distance errors greater than 50 km:

N Beacon ID Latitude Longitude CTA Pnts Error Comments.....

C.5 121.5 MHZ STATISTICS

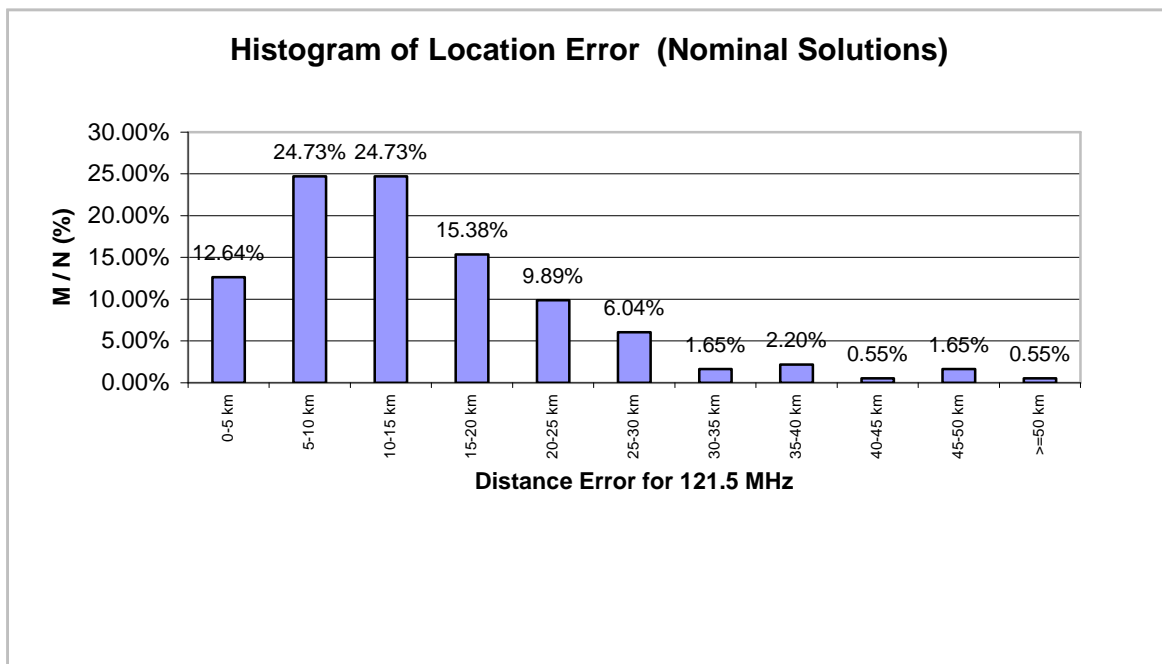
5.1 Nominal Solutions

Number of processed passes	= 182
Number of processed solutions	= 934
Minimum processing time	= 12.39 seconds
Average processing time	= 14.47 seconds
Maximum processing time	= 45.30 seconds

Test Beacon Location = +26.913, +80.856

Number of Solutions	= 182
Number of solutions within 20 km	= 141
Number of solutions within 40 km	= 177
Location accuracy = 141 / 182	= 0.775 within 20 km
Location accuracy = 177 / 182	= 0.973 within 40 km
Ambiguity resolution = 139 / 182	= 0.764
Error Ellipse = 104 / 182	= 0.571

The 121.5 MHz test beacon used for these tests satisfied the requirements stated in document C/S T.005.



Beacon Simulator Test Script

The simulator data were used for this test script.

Test Code Sequence	Message Transmitted by LEOLUT	Calculated Doppler Position	Encoded Position	Pass/Fail
BV1	56EE000000000037E54000000000	N/A	N/A	Pass
BV2	D6E10E1A4324920458B9D55555555	N/A	N/A	Pass
MV1	D6EE000000000265F1424FFFFFFFF	N/A	N/A	Pass
MV2	96EE0000002729A5E22BB61B842E0A	39.010, -76.851	38.884,-76.931	Pass
MV3	N/A	N/A	N/A	Pass
MV4	N/A	N/A	N/A	Pass
LP1	8E32000002B8036568C768E010B65	43.557, 1.481	43.559, 1.483	Pass
LP2	8E380000AE20177ECCB360F380F6B	43.550, 1.481	43.559, 1.482	Pass
LP3	D6EE1E1E1E1E1E06A383E4FFFFFFFF	38.996,-76.852	40.000,-256.00	Pass
LP4	96EF000049C14CD260D5F608380389	38.992,-76.839	38.996,-76.851	Pass
IV1	8E3FF0004AE2017493D436FFFFFFFF	43.564, 1.487	43.633, 1.533	Pass
DP1	4E3EAAAAAAAAAAAA057FD800000000	43.548, 1.513	N/A	Pass
DP2	56EE000000000477BEAC00000000	38.963,-76.811	N/A	Pass

Data Format

The India Lucknow LEOLUT commissioning data format provided on two electronic zip files to the Cospas-Sarsat Secretariat is in full compliance with the C/S T.005 Specification, Annex E. The two files were for the data sets 121.5 MHz and 406 MHz, respectively.

- END OF DOCUMENT JC-20/4/9 -