PROPOSAL FOR STRATEGIC THURAYA MONITORING SYSTEM
Supply, Installation, Training, and Maintenance

1. Introduction

1.1. General

This document has been prepared in response to Request for Proposal about the Thuraya Monitoring System (TMS).

This Proposal describes the TMS that provides demodulation and processing of the Thuraya satellite communication sessions within a group of spot beams on a single Thuraya-2. The system is designed to monitor the links of the Thuraya satellite communication, including the content and all call types: Voice, SMS, Fax and Data.

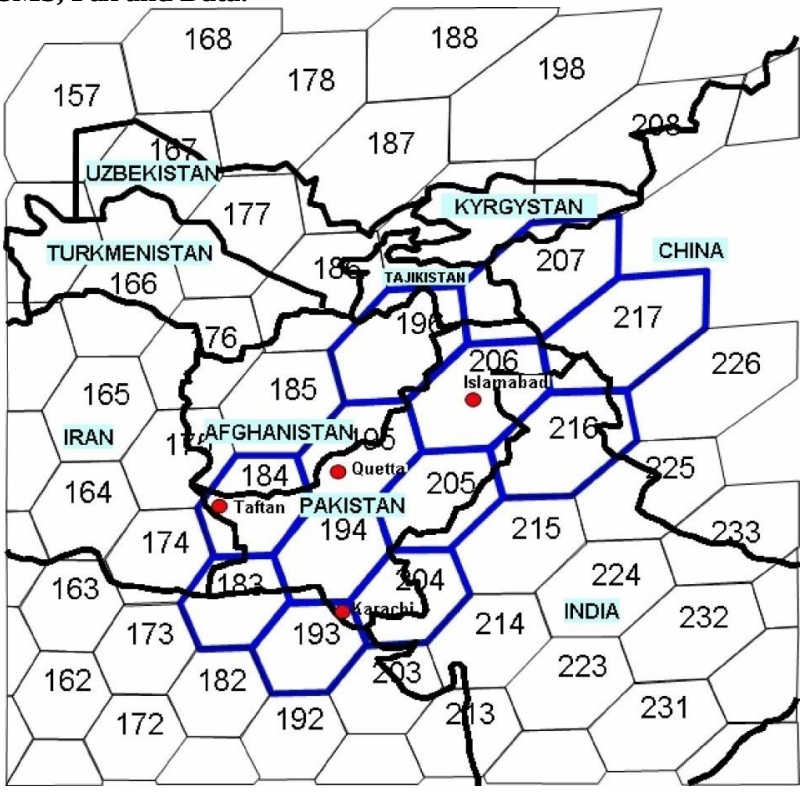


Figure 1-1 – Thuraya coverage map for the Islamic Republic of Pakistan

This element of the Proposal should be read in conjunction with the attached quotation.

1.2. Structure of the Proposal

Section 1	**(this section) provides an introduction to the purpose and structure of the technical proposal.**
Section 2	**provides a description of the TMS.**
Section 3	**provides details and specifications for the proposed system and its components.**
Section 4	**contains details of the functionality for the TMS.**
Section 5	**provides details of the maintenance schedule and the after sales support available from the Company.**
Section 6	**provides details of the system technical specification.**

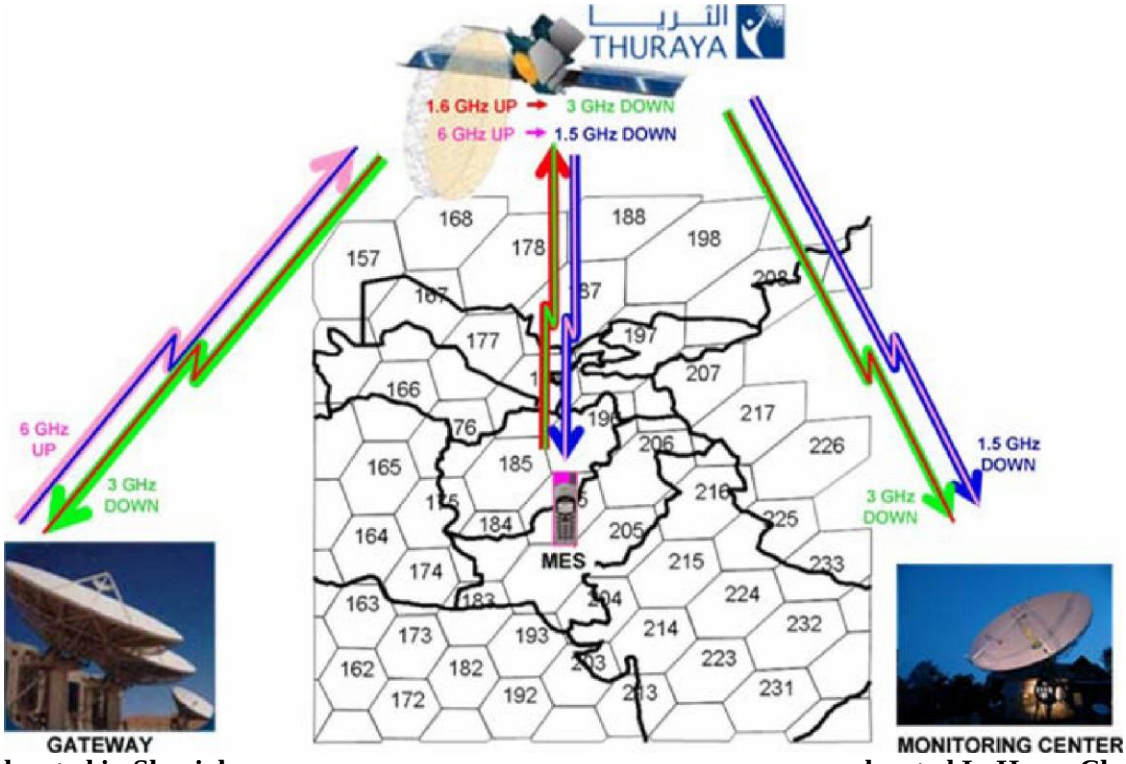
2. System Description

2.1. Principles of the TMS Operation

The Thuraya-2 satellite provides world-wide communications capability through the use of a geostationary satellite, strategically located to provide coverage of the earth's surface to latitudes in excess of 70° North and 25° South of the equator.

Communication between the satellite and Mobile Earth Station (MES) or Thuraya handset is effected using frequencies in L-band, around 1.6GHz and 1.5GHz for the uplink and downlink frequencies respectively. The Primary Gateway Earth Station (GATEWAY) that provides connections to the terrestrial communications network communicates with the satellite using frequencies around 6GHz and 3GHz for the uplink and downlink frequencies. The GATEWAY also acts as the Satellite Operation Centre, providing all tracking, telemetry and command functions for the satellite as well as its Uplink Beacon.
The Thuraya satellite uses a number of spot beams for communication with the MES which can be combined and reconfigured from the ground for optimum performance against changing operational needs. The network uses a GPS position provided by the MES to register it in the correct spot beam. However, for security reasons, the accuracy of the GPS position is deliberately limited to around 30m.

The TMS offered by the Company. Is designed to passively intercept downlinks from the Thuraya satellite at C-Band and L-Band.



located in Sharjah **located In Home Cluster**

Figure 2-1 - Principle of TMS Operation

An L-Band antenna receives transmissions from the network to the MES, and a C-band antenna receives transmissions from the MES to the network via the satellite.
Each spot beam in the Thuraya network is designated a pair of signaling channels. One signaling channel is transmitted at L-Band by the satellite and is received by all MESs in the spot beam. This

signaling channel is known as the Broadcast Control Channel (BCCH). In addition to the BCCH, the following channels are also Time Division Multiplexed onto the same carrier: Access Grant Channel (AGCH), Paging Channel (PCH), Frequency Correction Channel (FCCH) and Basic Alerting Channel (BACH). The other signaling channel is known as the Random Access Channel (RACH). The RACH is a channel that provides ad hoc access to the network for the MESs. All MES units within a spot beam transmit bursts at L-Band on the RACH channel; these bursts are relayed to the PGW at the C-Band by the satellite.

At L-Band, the BCCH resides on a single carrier frequency, which is one of a group of 5 contiguous carrier frequencies assigned to the spot beam. The other 4 carrier frequencies in the group are available to carry dedicated Normal Traffic (NT) channels, which are shared by Traffic Channel (TCH) bursts and their matching fast or Slow Associated Control Channels (FACCH or SACCH).

At C-band the RACH channel resides on one of a group of 5 carrier frequencies, with the other four carriers containing call traffic. The four L-band traffic carriers are paired with the four C-Band traffic carriers.

When a telephone call is established on the Thuraya network, regardless of whether it is a Mobile Originated (MO) call or a Fixed Originated (FO) call, a dedicated traffic channel (TCH3) and an associated control channel (FACCH3) are established for the call. This dedicated channel allocation is achieved by the MES transmitting a Channel Request message as a burst on the Random Access Channel (RACH) and the network responding with an Immediate Assignment message on the Access Grant Channel (AGCH). The TMS is able to receive both of these messages, the Channel Request from the C-band, and the Immediate Assignment from the L-Band.

The Immediate Assignment message includes frequency and timing information needed by the MES to tune to its dedicated traffic channel. The traffic channel assigned will be 3 consecutive time slots on one of the four traffic channels associated with the BCCH/RACH pair. The TMS uses this information to receive the L-band half of the call and from this information and other knowledge of the system it extrapolates the channel assignment for the matching C-Band half of the call, enabling it to intercept both sides of the full duplex call.

2.2 Configuration

The Company offers to supply, installation and local support the following:

- **Main Stationary System monitors the global C-band beam as well as the local L-band spot beams C/L-band subsystem**
- **Two Remote Spot Beam sensors used to increase the system's coverage area, and enable duplex interception of calls in spot beams not under the coverage of the main site. In general, remote site with L-Band antenna can be connected to the main site. The Remote Spot Beam Sensor usually connected to the stationary main system through a WAN link or SAT link.**
- **The system is managed and controlled from the Administrator workstation.**
- **A "Communication Link" linking the Main Stationary System with Remote Spot Beam Sensor.**
- **Provide comprehensive training.**

RF-over-Fibre system provides transporting of L-band signals (from C-band and L-band antennas) to indoor equipment with minimum signal loss.

The fully integrated system has the capability to passively intercept activities and traffic in the Thuraya satellite communication system.

The TMS designed to be extremely flexible in implementation. Accordingly, the TMS designed to be expanded and modified by the addition of extra hardware and software as a Customer's requirements change and new services become available.

2.3. Location and Coverage

The System will enable the Customer to monitor Thuraya communication system activity and to specifically monitor call content of Thuraya handsets located within the covered Thuraya spot-beams.
The C-Band coverage includes the entire Thuraya network.
The L-Band coverage is restricted to the spot-beams where the L-Band antennas are located, and the spot-beams surrounding them.
In order to enhance the system coverage in L-Band one additional L-Band system will installed at remote spot-beam.
The system covers total of 21 Spot-Beams with L-Band interception. The standard spot-beam diameter is about 450KM.
The Main C-band and L-band subsystems are to be located together at a single site – Main Stationary System. Remote L-band sensor is located in the different places named Remote Spot beam.

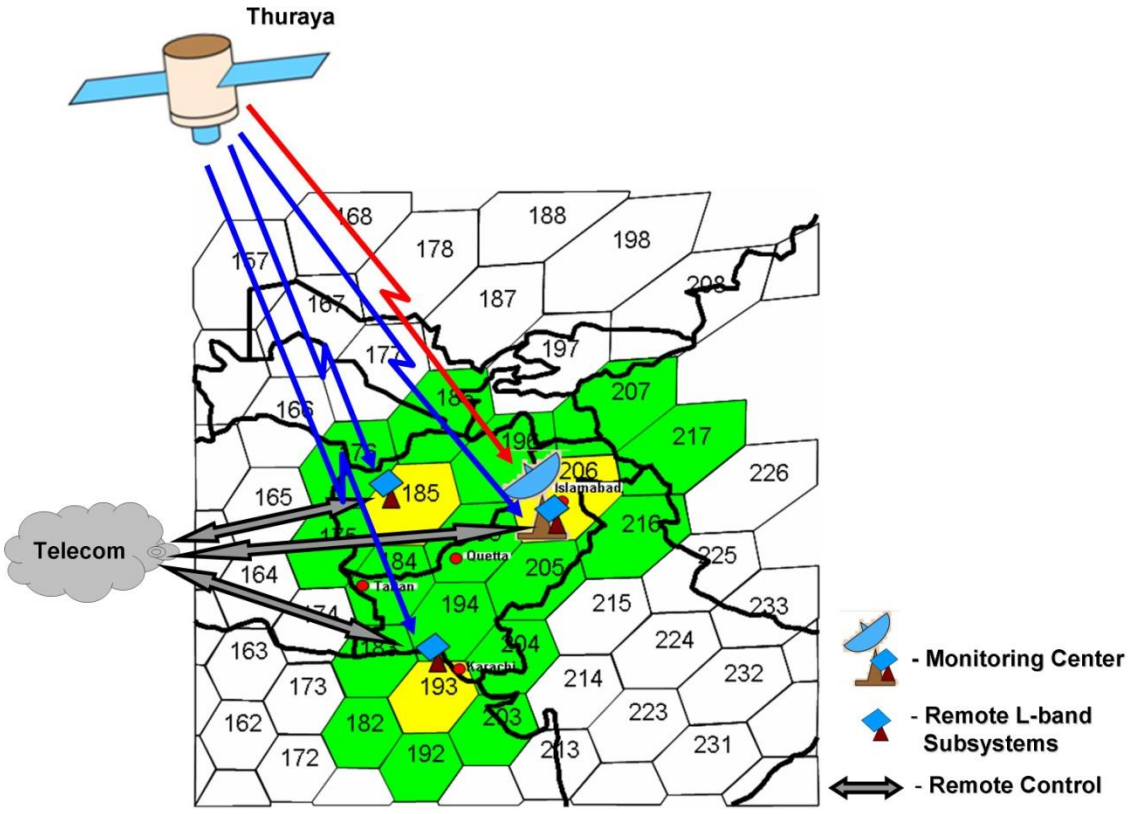


Figure 2-2 – Abstract example of the monitoring system location

2.4. Monitoring capabilities

The system will monitor sessions between Thuraya terminal and any of the following:

- **PSTN / mobile network subscriber**
- **Thuraya terminal – via satellite or regular GSM**
- **Other satellite subscriber, such as Inmarsat, Iridium, etc.**

The intercepted information includes CDRs of Thuraya sessions, including full session details from the system L-Band coverage area and partial details from C-Band signaling that does not have the corresponding L-Band channels.

The system provides the User with the following information about every call on every monitored spot beam:

- **Call Content including Voice, SMS, Fax and Data**
- **Date and Time of Call**
- **IMEI (International Mobile Equipment Identity)**
- **IMSI (International Mobile Subscriber Identity)**
- **TMSI (Temporary Mobile Subscriber Identity)**
- **The phone number dialed by the MES**
- **The phone number of call originator (CLIP)**
- **GPS position of the MES, Country / Region.**
- **Event Type (Mobile or Fixed Originated Call, which can be either Voice, Fax or Data, SMS, etc) which can be initiated by either the MES or the Network.**
- **Terminal Type**
- **Current Thuraya Spot Beam ID, GPS-position (co-ordinates) of geographic centre, and operating frequency. List of adjacent Spot Beams, their GPS-positions and operating frequencies**
- **Random Reference Number (call ID)**
- **Ciphering Key Sequence Number, RAND and SRES, Cipher Algorithm: A5/1/2/3.**

The system supports monitoring in the following interception modes:

- **C/L Duplex sessions – both L-Band and C-Band links are available**

NoNo	SB	Type	Dir.	Date/Time	Duration	TMSI	CLIP/ Dialed No	IMSI	Region	Latitude	Longitude

- **L-Half-duplex sessions – only L-Band data is available**

NoNo	SB	Type	Dir.	Date/Time	Duration	TMSI	CLIP/ Dialed No	IMSI	Region	Latitude	Longitude

- **C-Half-duplex sessions – only C-Band data is available**

NoNo	SB	Type	Dir.	Date/Time	Duration	TMSI	CLIP/ Dialed No	IMSI	Region	Latitude	Longitude

The system enables to passively monitor the Thuraya communications of handsets operating on SATELLITE mode. Thuraya handsets, which are working on the regular GSM mode, will not be detectable by the system.

3. Technical Issues

The system is comprised of the following subsystems:

- **AQS for main site – Acquisition Subsystem comprised of C/L-band antennas & RF-chain equipment**
- **AQS for remote site – Acquisition Subsystem comprised of L-band antenna & RF-chain equipment**
- **RF-over-Fibre system – provides transporting of L-band signals (from C-band and L-band antennas) to indoor equipment with minimum signal loss**
- **Demodulation Subsystems – demodulation (for each site) subsystem for C/L-band traffic, including signaling and call content**
- **Analysis subsystem – 5 operator workstations and 1 administrator workstation are proposed.**

The Demodulation System is comprised of three demodulation subsystems:

- **Signaling Interception Subsystem (SIS) – performs the Thuraya signaling collection and analysis, identifies Thuraya calls and performs the L-C band channels correlation.**
- **Central Traffic Interception Subsystem (CTIS) – generates the call content files by demodulation of the L and C Band data streams**
- **Remote Traffic Interception Subsystem (RTIS) – Remote L-band system, collects L-Band links of remote spot beams to be forwarded back to the central system.**

3.1. Main Stationary System

The Main Stationary System includes the fixed L/C-band subsystem.

The following technical characteristics are provided:

3.1.1. The ability to do collecting and storing of all Thuraya-2 call related information (CRI) for up to 180 millions sessions – mass CRI collection from all 3200 C-band frequencies (Scanner 3200 Unit). It guarantees immediate recognition of C-band frequency plan changing and monitoring without any Thuraya terminals activity loss.
3.1.2. The ability to provide full interception for the system L-Band coverage area, and practically 100% of the network events beyond that area.
3.1.3. The ability to monitor every call within the spot beam that the Main System resides in and the four immediately adjacent spot beams in duplex mode. Following information will be presented in DB:

NoNo	SB	Type	Dir.	Date/Time	Duration	TMSI	CLIP/ Dialed No	IMSI	Region	Latitude	Longitude

3.1.4. The ability to monitor every call within 21 spot beams of Thuraya-2 coverage area in C-band simplex mode. Full session content recording of targets located under the system L-Band coverage area will be presented in DB:

NoNo	SB	Type	Dir.	Date/Time	Duration	TMSI	Dialed No	IMSI	Latitude	Longitude

3.1.5. Complete information about every call on every monitored spot beam. (A comprehensive list of such information is presented in p. 2.4 above).
3.1.6. The ability to do recording of up to 64 sessions simultaneously in real time.
3.1.7. The ability to support collecting and storing of all the Target's on-line calls in the covered spot beams for a period of 30 days. Retention time – 30 days for the target traffic and 120 days for mass CRI.
3.1.8. The ability to support collecting and storing of raw data in the covered spot beams for a period of 30 days. This is enabling Call Content (CC) on demand of non Target's calls, and in retroactive mode, in the covered spot beams for a period of 5 days.

3.1.9. Intercepted content processing automatically.
3.1.10. Short-time and long-time archive of intercepted and processed calls.
3.1.11. A rack mounted Uninterruptible Power Supply capable of powering the system for 30 min.
3.1.12. Lightning protection for all indoor and outdoor equipment.
3.1.13. Water Proofing: All connectors are filled with dielectric grease and sealed with a waterproofing kit.
3.1.14. All required antennas are mounted on concrete foundations.

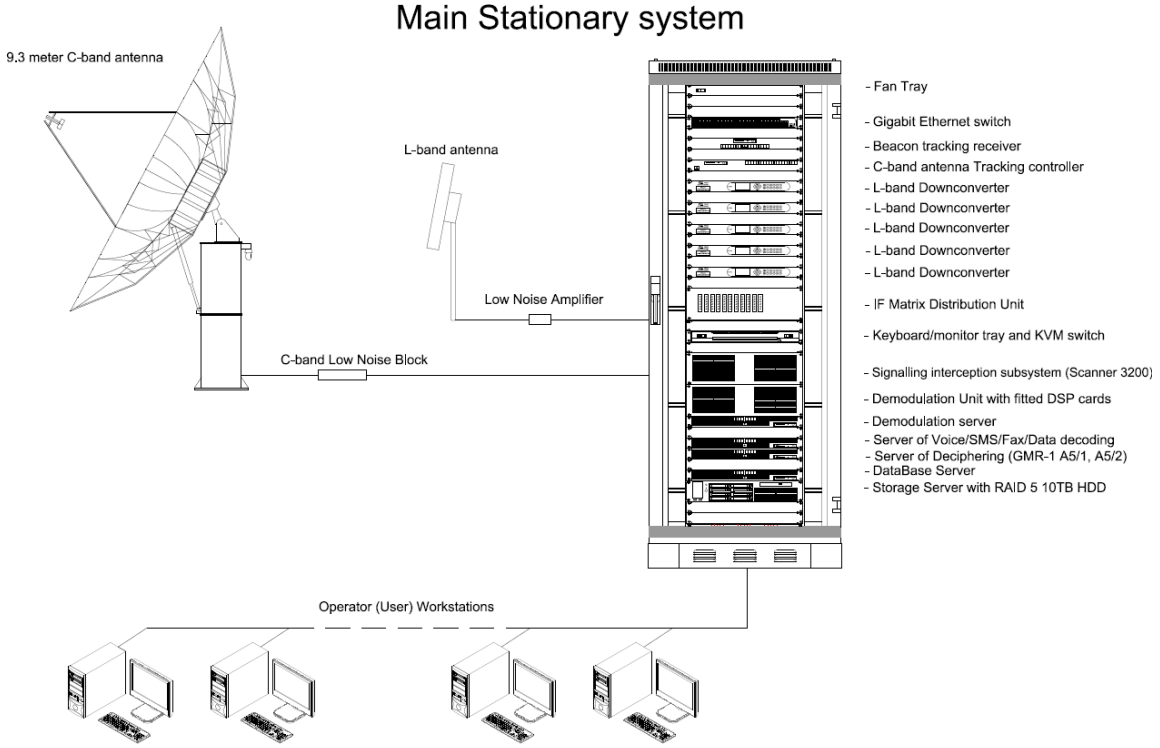
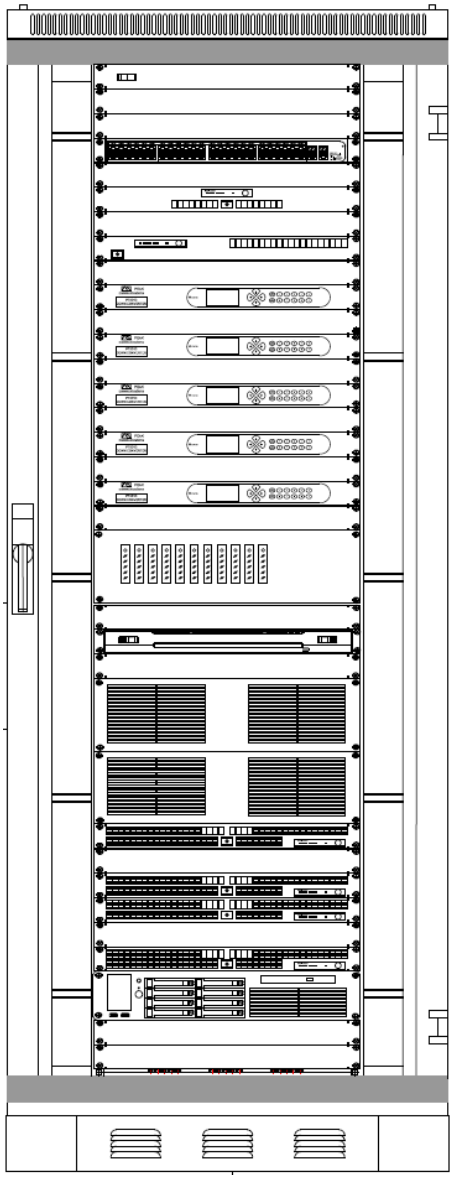


Figure 3-1 – Main Stationary System (Functional Diagram)



- Fan Tray
- Gigabit Ethernet switch
- Beacon tracking receiver
- C-band antenna Tracking controller
- L-band Downconverter
- L-band Downconverter
- L-band Downconverter
- L-band Downconverter
- L-band Downconverter
- IF Matrix Distribution Unit
- Keyboard/monitor tray and KVM switch
- Signalling interception subsystem (Scanner 3200)
- Demodulation Unit with fitted DSP cards
- Demodulation server
- Server of Voice/SMS/Fax/Data decoding
- Server of Deciphering (GMR-1 A5/1, A5/2)
- DataBase Server
- Storage Server with RAID 5 10TB HDD

Figure 3-2 – Main Stationary System Rack

3.2. Remote L-band Sensor

The system includes Remote L-band Sensors that are remotely operated from the Main subsystem. The Main subsystem to Remote Sensor data link is via some form of communication link. The communication between the Remote Sensor and the Main subsystem can be provided over E1 unit, which is connected to the Remote Sensor by means of an Ethernet interface.
All operation, control and configuration of equipment can be performed locally and/or at the Main subsystem. In case of a communication failure between the Main subsystem and the Remote L-band subsystem, the subsystem can continue to operate up to 2 hours but with less functionality.
The following technical characteristics are provided:
3.2.1. The ability to monitor every call within the spot beam that the Remote Sensor resides in and the three immediately adjacent spot beams.
3.2.2. Complete information about every call, CRD, on every monitored spot beam mentioned in p.3.2.1. (A comprehensive list of such information is presented in p. 2.4 above).
3.2.3. The ability to intercept a total of 64 concurrent sessions on Remote Site.

Note: one-side content (forward direction of MES) from Remote Sensor is associated with one-side content (return direction of MES) from Main System, forming full duplex content. Intercepted content processing automatically.

3.2.4. The optional ability to expand the number of simultaneous call intercepts.
3.2.5. An Uninterruptible Power Supply capable of powering the system for 30 min.
3.2.6. Lightning protection for all indoor and outdoor equipment.
3.2.7. Water Proofing: All connectors are filled with dielectric grease and sealed with a waterproofing kit.
3.2.8. L-band antenna is mounted on concrete foundation or roof.

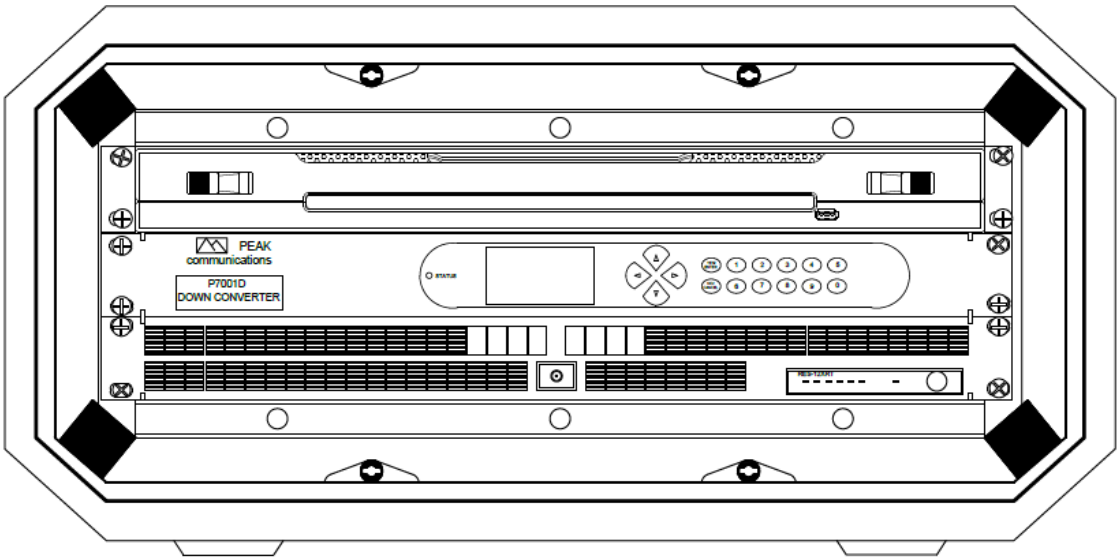


Figure 3-3 – Remote L-band Sensor

3.3. Requirements to communication link

In order that the Main and the Remote subsystem may share the channel allocation information, and hence ensure that both stations intercept matching communication channels, the Remote Sensor should be connected to the Main System via live data connection. The connection needs to be of high bandwidth, and should have minimum delay. For example, such a connection may to be realized by 2 Mbps link, for example E1 link. If impossible to have required link, the Company can provide a measurement of the needed link for the interesting territory and advice to the customer the link with less bandwidth and delay 300-400msec in accordance to the information about peak activity and Remote Sensor location.

Communication links for bulk migration of files may be secured via external means (e.g. link encryption). In case of a communication failure between the Main and the Remote subsystem, the system can continue to operate up to 2 hours but with less functionality (in this way some types of the transmissions as Fax, Data and Thuraya-to-Thuraya Voice calls will not have the content). When the link is recovered, one-side of the content (Satellite to MES direction) from Remote Sensor will be transferred to the Main System and be associated with one-side content (MES to Satellite direction) from Main System, forming full duplex content.

3.4. Uninterruptible Power Supply subsystem

An Uninterruptible Power Supply (UPS) subsystem is provided with the TMS, to provide power conditioning and support for the system during brownouts and power outages up to 30 minutes.
The UPS subsystem comprises 16 kVA UPS, distributed to match the system load requirements. The UPS communicate with the computer system via serial interfaces. The UPS subsystem is

configured so that the supply driving the system rack and its server determine the power status of the whole TMS. If a primary power failure occurs, the UPS subsystem provides power for a pre-determined time. If primary power is not restored during this period, the system is shut down in a controlled manner to avoid loss of data.
The system may be configured to re-start automatically, and a time delay may be incorporated to overcome problems of temporary of primary power and subsequent failure.

3.5 Equipment shedule

The equipment and software proposed for the TMS is shown below.
Table 3-1 – Schedule of the Company deliverables for TMS (every component of the system, the full system description, list of software deliverables)

ITEM	Description	Qty
	Thuraya Monitoring System	**1**
	Complete Turnkey Solution including configuration, system and solution integration and Factory Acceptance testing. Full on-site implementation including C-Band & L-Band antennas testing and equipment installation, commissioning, Site Acceptance testing and training.	
	Main Stationary System	**1**
	Comprising:	
1	**Antenna and RF Subsystem**	**1**
1.1	**L-band antenna system comprising:**	
	L-band antenna with mounting and Low Noise Amplifier	**1**
1.2	**C-band antenna system comprising**	
	9 meter C-band antenna system, with motorised pedestal and rotary angle sensors	**1**
	C-band Low Noise Block	**1**
	C-band Antenna installation and commissioning	**1**
1.3	**RF/IF Rack equipment comprising:**	
	RF-over-Fibre system	**1**
	RF Splitters Set	**1**
	C-band antenna Tracking controller	**1**
	Beacon tracking receiver	**1**
	L-band Downconverter	**5**
	IF Matrix Distribution Unit	**1**
2	**Demodulator subsystem**	**1**
	Comprising:	
2.1	**Signalling interception subsystem (Scanner 3200)**	**1**
2.2	**Demodulation Unit with fitted DSP cards (Voice, Fax, Data services)**	**1**
2.3	**Demodulation Server**	**1**
2.4	**Gigabit Ethernet switch**	**1**
2.5	**Software including:**	
	Servers Operation System	
	TMS software bundle	
3	**System Servers**	**1**
	Including:	
3.1	**Server of Voice/SMS/Fax/Data decoding**	**1**

3.2	**Server of Deciphering (GMR-1 A5/1, A5/2)**	**1**
3.3	**DataBase server**	**1**
3.4	**42U 19" Cabinet, fully wired, with mains circuit breaker**	**1**
3.5	**Keyboard/monitor tray and KVM switch**	**1**
3.6	**Software including:**	
	Servers Operating System	
	TMS decoding software bundle	
	MySQL Community Server	
4	**Storage subsystem**	**1**
4.1	**Storage Server with RAID 5 10TB HDD**	**1**
4.2	**Software including:**	
	Server Operation System	
	TMS storage software	
5	**Analysis subsystem**	**1**
5.1	**Administrator workstation**	**1**
5.2	**Operator workstation**	**5**
5.3	**Software including:**	
	Workstations Operation System	
	TMS analysis software	
6	**Spare Items**	
6.1	**C-band Low Noise Block**	**1**
6.2	**L-band Low Noise Amplifier**	**1**
6.3	**Demodulator Server**	**1**
6.4	**DSP card for Demodulation Unit**	**2**
7	**Site Items**	**1**
7.1	**System shutdown software**	**1**
7.2	**16KVA UPS Subsystem for Rack equipment**	**1**
8	**Support Items 1)**	**1**
8.1	**Turnkey Installation and Commissioning**	
8.2	**Factory Acceptance Testing**	
8.3	**Site Acceptance Testing**	
8.4	**Training & documentation including:**	
	TMS Operation and Maintenance Course	
	TMS User Guide in English	
	TMS Maintenance Manual in English	
	Factory Acceptance Test documents	
	Site Acceptance Test documents	
	Remote Spot Beam sensor	**2**
	Complete Remote L-band Subsystem for extended coverage. **Full on-site implementation including antenna and equipment installation, commissioning, Site Acceptance testing and full training along site Main Site.** **Note: Assumes Customer Furnished inter-site link.**	
	Comprising:	
9	**Antenna subsystem**	**1**
9.1	**L-band antenna system comprising:**	

	L-band antenna system with fixed pedestal	**1**
	L-band low noise amplifier	**1**
	L-band downconverter	**1**
10	**Demodulator subsystem**	**1**
	Comprising:	
10.1	**Demodulator Server with fitted DSP card (Voice, Fax, Data services)**	**1**
11	**Remote System Items**	**1**
	Including:	
11.1	**Monitor and keyboard tray**	**1**
11.2	**Rack Case, fully wired, with remote power cycling**	**1**
11.3	**Software including:**	
	Server Operating System	
	TDM Remote Subsystem Software bundle	
	MySQL Community Server	
12	**Remote Site Items**	**1**
12.1	**Uninterruptible power supply**	**1**
13	**Support Items**	**1**
13.1	**System Packing and Shipping (CIP)**	
13.2	**Turnkey Installation and Commissioning**	
13.3	**Factory Acceptance Testing**	
13.4	**Site Acceptance Testing**	
13.5	**Training & documentation included in Master Site with additional:**	
	TMS Remote subsystem User Guide in English	
	TMS Remote subsystem Maintenance Manual in English	
	TMS Remote subsystem Factory Acceptance Test documents	
	TMS Remote subsystem Site Acceptance Test documents	

3.6 System Testing

The test plan includes each major type of equipment and software as a separate test and includes all RFP mandated features and functions of each type of equipment, a list of tests to be performed and how these tests are administered.

The Company submits for approval a detailed system test plan and individual equipment test procedures within fifteen working days following Customer sign-off of the final system design. Official execution of the test plan and procedures will not begin without written Customer approval of the plans and procedures.

The test plan include a list of tests to be performed, a narrative describing how each test is performed, and a management plan detailing how these tests are administered. It includes proof of performance of RFP mandated features and functions, contractually negotiated system features and functions, figure of merit analysis data, and critical design review agreed items.

The Company guarantees overall system and equipment performance in accordance with RFP mandated and contractually negotiated requirements for a period of one calendar year following the date of final system acceptance at no additional cost to Customer.

4. TMS FUNCTIONALITY

4.1. System configuration

The following technical characteristics are provided:

4.1.1. The ability to define all important and necessary filtering criteria for target recording / interception e.g. CLIP/Dialed number, Conferee ID, Target ID, Location, Date, Time.
4.1.2. The ability to perform corrective calibration on any subsystem.
4.1.3. The ability to monitor the Database server status.
4.1.4. The ability to monitor all systems and subsystems to insure proper operation and performance.
4.1.5. Built In Test for all provided systems and devices.
4.1.6. Thuraya Interception Criteria as follows:

- **Thuraya handset identification – TMSI/IMSI/IMEI/MSISDN (any of them, if available)**
- **Dialed number in outgoing calls, including wildcard (e.g. country code)**
- **Calling number in incoming calls (if available)**
- **Spot Beam number**
- **Geographic area - filtering done according to handset GPS position**
- **Communication types (Voice, Fax, Data)**
- **Time and Period of Interest**

4.1.7. Location tracking system with maps and geographical tools is provided.

A target can be assigned a priority level. Sessions of high-priority targets will receive priority in interception resources allocation. Up to 200 concurrent active targets are provided.

After a filter is defined, future traffic matching the filter's interception criteria is recorded, processed, indexed and forwarded to operators for monitoring.

4.2. Real-time Calls and Traffic Monitoring

All activities, standby and shutoff (last known position) events are saved in the appropriate fields of DB and file. This information includes:

- **MES categorization: Targeted, Known, Unknown**
- **MES ID (IMEI, IMSI, TMSI)**
- **Phone number if known**
- **Name if given**
- **GPS coordinates**
- **Call duration, and number contacted**
- **Spot beam ID**

4.3. Deciphering Items

Communications over the Thuraya network encrypted to provide security to the users of the system. All the information present on the common signaling channels transmitted in clear, but encryption implemented on the dedicated channels.
On Thuraya, the A5/2-GMR-1 algorithm is used to encrypt the contents of all voice calls, SMS, fax and data transmissions, and the A5/1- GMR-1 algorithm is used to encrypt the Location Update (IMSI Attach) process.
Appropriate decrypt analysis solution is necessary. The Company provides it.
With the decrypt analysis solution installed and integrated with the monitoring system, the following information becomes available from calls intercepted:

- **Call Content including Voice, SMS, Fax and Data.**
- **The IMEI of the MES.**

Calling Line Identity Presentation (CLIP).

4.4. Processing and Analysis

The following technical characteristics are provided:
4.4.1. The ability of the operator to add transcription and comments upon call processing.
4.4.2. The ability to query call and MES history.
4.4.3. The ability to playback intercepted audio.
4.4.4. The ability to view intercepted faxes.
4.4.5. The ability to view intercepted SMS messages.
4.4.6. The ability to view data traffic.
4.4.7. The ability to view data in its raw format.
4.4.8. The ability to view mobile terminal location on the map.

4.5. Voice playback

If a target call contains voice telephony, the call maybe played back by the operator. Both forward and return links of a duplex conversation are available for monitoring, presented on separate loudspeakers or headset earpieces.
The operator may fast forward and move back through a recording by positioning a slider in the display. This also allows phrases in the recording to be repeatedly played for analysis.
The output level and balance between speakers (headphones) may be adjusted, and may be muted by a single action from mouse or keyboard.
The voice recording may be saved as a .WAV file, which can then be exported for further analysis outside TMS.

5. SUPPORT

The Company provides site survey, FAT, shipment, installation, customer reviews, SAT, training and warranty. FAT is based on internal the Company testing methodology.

5.1. Training

The text below describes a general approach to the Training and Maintenance Procedures.

All training courses and training materials are presented in the English language.
Two training courses are offered with the TMS, these cover:

- **TMS Administration**
- **TMS Maintenance**

The training courses are generally held at the customer site upon successful completion of the system installation. Table 5-1 lists the different training courses available along with their duration, and recommended number of attendees. Greater numbers of attendees may be accommodated on the on-site training course by agreement at an early stage.

Table 5-1 – Typical Training Course Arrangements

Course	Attendees	Typical Duration
TMS Administration	Up to 4 persons	2 days
TMS Maintenance	Up to 4 persons	2 days

5.2. Maintenance Procedures

During the warranty period, the system is maintained to the following level of availability:

- **Major disruptions include an inoperable Processing Center.**

- **Minor disruptions include single equipment failures and feature problems, which do not affect system operability.**

Maintenance philosophy is to replace faulty equipments after quick analysis of monitoring and alarm indications. Actual repair is undertaken at a repair base.

The Company establishes a methodology for providing maintenance service, to be approved by Customer, including: 24-hour support, trouble reporting forms, trouble reporting procedures, telephone numbers, and maintenance organizational chart showing supervision and key personnel, and escalation procedures, including named personnel and their office and home telephone number. The trouble reporting procedures includes the ability for the Customer to elevate any failure to critical level, requiring a response as a major disruption as defined above. The Company provides repair reports to the Customer throughout the warranty period detailing specific failures, repairs, and response times.

5.3 Spares

Table 5-2 provides a list of the spare parts that are included in the system package.

Table 5-2 – List of Spare Parts for the TMS

Description	Qty
Spare Items	**1**
C-band Low Noise Block	**1**
L-band Low Noise Amplifier	**1**
Demodulation Server	**1**
DSP card for Demodulation Unit	**2**

5.4. Documentation

The Company provides standard operational and maintenance documentation, testing evaluation procedures in English language.

5.5. Warranty and Repairs

The equipment is delivered with a standard one year warranty, unless otherwise specified. Opening the equipment during the warranty period will void the warranty. It is recommended that defective or damaged equipment is returned to the Company unopened for repair or replacement.

The routing and documentation for returned equipment is country specific, and is detailed in the Technical Manual delivered with the system.

Computer equipment failure should, in general, be addressed to the in-country support facilities of the computer manufacturer. The arrangements for specific installations are detailed in the Technical Manual delivered with the system.

TMS is delivered on the base of Export License that requests End-User Certificate.

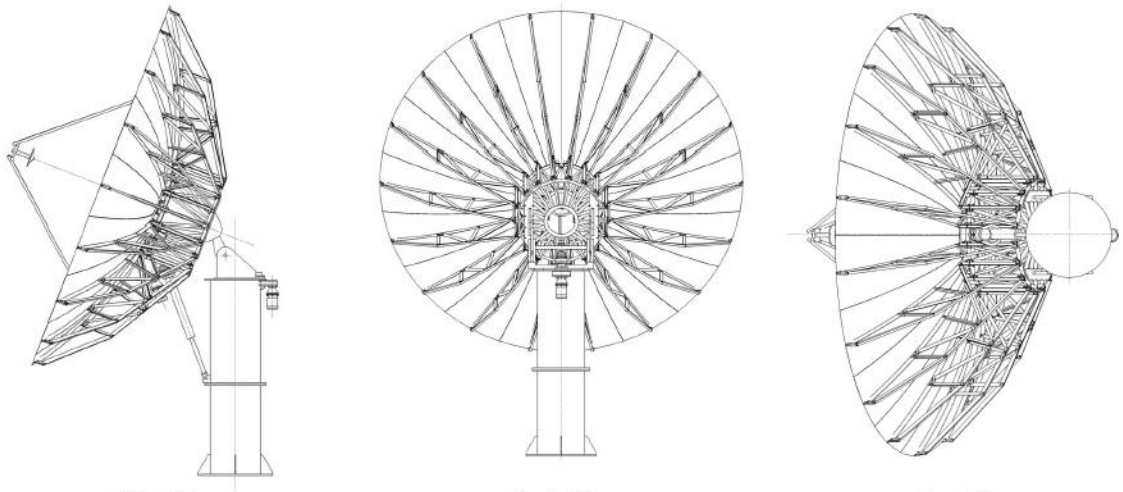
6. APPENDICES

A. Technical specification

A.1 C-band Antenna

S.No.	Parameter	Specification
1	**Diameter of reflector (m)**	**9.3**
2	**Frequency band (GHz)**	**3.5 - 4.2**
3	**Amplification of transmission of feed element (db):**	**49.3**
4	**Beamwidth, 3 dB, mid-band, Degrees**	**0.32**
5	**First Sidelobe Level (Typical)**	**-14.5**
6	**Noise temperature (K) when elevation is**	**36**

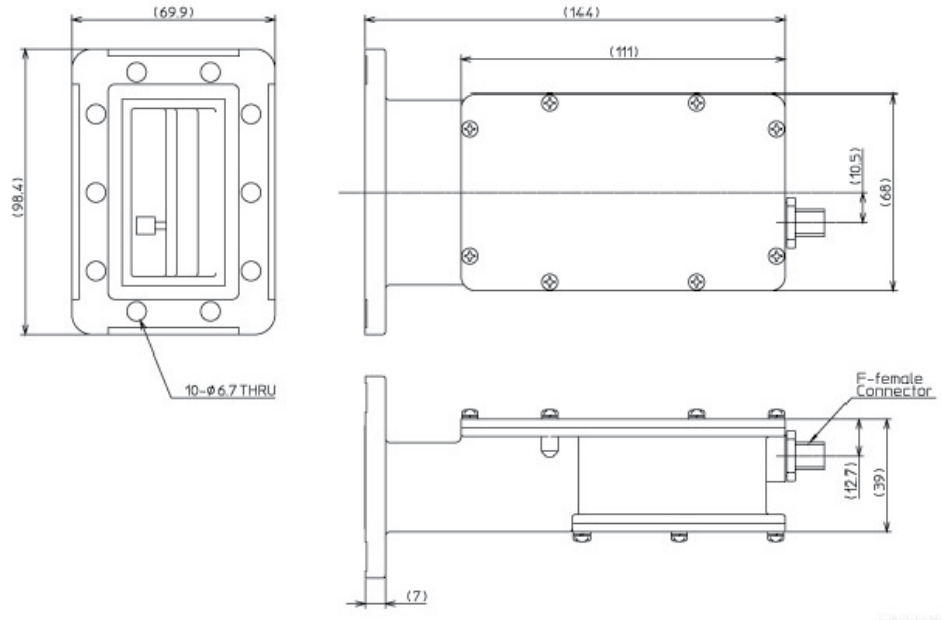
	-10 degrees: **-30 degrees:**	**24**
7	**Cross-polarization antenna isolation in 1-db zone (db)**	**-40**
8	**Losses of pointing in auto tracking mode (db)**	**0.2**
9	**Losses**	**0.8**
10	**Suspension bracket**	**El., Az.**
11	**Antenna Pointing Range** **-Elevation:** **-Azimuth:**	 **50-900** **2000**
12	**Operational Winds, m/sec**	**15**
13	**Survival Winds, m/sec**	**50**
14	**Ambient Temperature, ° C**	**-450C..+500C**
15	**Antenna mount**	**Galvanized Steel Mount**



Side View Back View Top View

A.2 Low Noise Block

S.No.	Parameter	Specification
1	Input frequency (GHz)	3.40 to 4.20 GHz
2	L.O. frequency (GHz)	5.15 GHz
3	Output frequency (MHz)	950 to 1750 MHz
4	Noise temperature maximum	15K
5	L.O. stability maximum	±5 kHz (over temperature)
6	Phase noise	-73 dBc/Hz at 1 kHz -83 dBc/Hz at 10 kHz -93 dBc/Hz at 100kHz
7	Input VSWR maximum	2.2 : 1
8	Output VSWR maximum	2.2 : 1
9	Conversion gain	55 dB min 70 dB max
10	Output P1dB minimum	9 dBm
11	Power requirements	+15 to +24 V supplied through Centre conductor of IF cable
12	Current drain maximum	350 mA



A.3 L-band Antenna

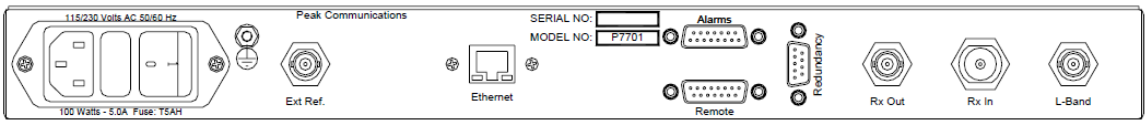
S.No.	Parameter	Specification
1	Frequency Range	1.525 GHz – 1.660 GHz
2	Pattern	Directional
3	Polarization	LHCP
4	Gain	15 dBic
5	Beam width (deg.)	35
6	VSWR	1.5:1
7	Output Impedance	50 ohms
8	Output Connector	N-type female
9	Type	Flat plate.

A.4 Low Noise Amplifier

S.No.	Parameter	Specification
1	Frequency Band	1.525GHz – 1.559GHz
2	Gain at mid band	35 dB
3	Gain flatness	± 1 dB over full band
4	Gain stability	± 0.5 dB from 0°C to +50°C
5	VSWR	Input and Output VSWR ≤ 1.30:1
6	Noise Figure	0.6 dB
7	DC power from RF signal output	+(18…24)V
8	Input and Output Connectors	N-type female

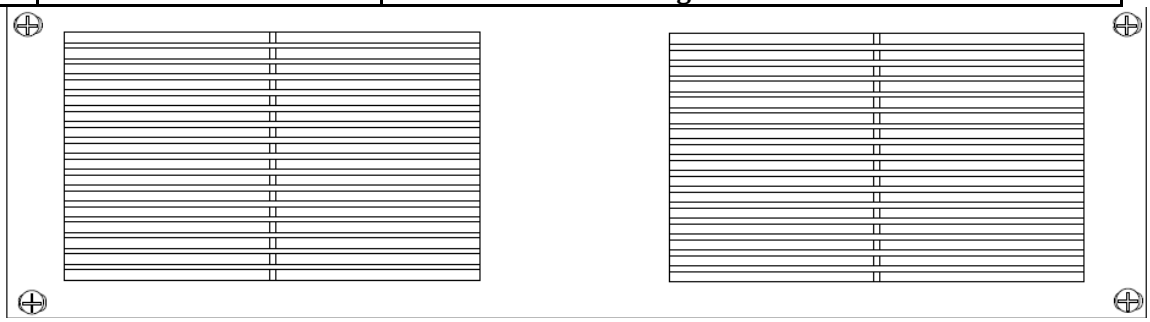
A.5 L-band down converter

S.No.	Parameter	Specification
1	Input	950 - 1750 MHz
2	Output	70 ± 18 MHz or option 140 ± 36MHz
3	Group delay response	Linear 0.025nS, Parabolic 0.015nS/MHz2 , Ripple 1nS p-p.
4	Conversion gain	0 to 30dB step size 0.1dB
5	Gain flatness	± 0.5 dB, across any 36MHz in band
6	1 dB comp. point	Output +15 dBm, Input -10 dBm
7	Frequency resolution	1 Hz
8	Phase noise (dBc/Hz)	-73 @ 100 Hz; -76 @ 1 kHz; -85 @ 10 kHz; -93 @ 100 kHz; -110 @ 1 MHz
9	Auxiliary DC output	+22.5 volts regulated @ 0.5 amps, switchable
10	Noise Figure	20dB nominal @ maximum gain
11	Stability	1 second <5 x 10-11, ageing <7.5 x 10-8 per yr, 5 x 10-10 per 12 hrs
12	Environmental Operating temperature range	-10 to 500C
13	Remote Control	Ethernet



A.6 Demodulation Unit with fitted DSP cards

S. No.	Parameters	Specification
1	Type of demodulator	CBPSK, CQPSK, QPSK. FPGA based
2	Type of DSP cards	Delta "Cyclone IV"
3	Number of DSP cards	2
4	Number of channels (demodulated frequencies)	180
5	Function	To demodulate C and L bands signal is down converted to extract base band signals.
6	Demodulation Type	Possible to demodulate digitally modulated signal for voice, data, fax, SMS etc. in common control channel, dedicated control channel and traffic channel.
7	Burst Support	Thuraya broadcast, control (dedicated and common) and traffic burst.
8	Input Frequency	70 MHz±18 MHz
9	Input Impedance	50 Ω
10	Input Connector	SMA type Female
11	Remote control	Gigabit Ethernet



A.7 Decoding subsystem

Following types of calls is decoded:

- **Thuraya fixed/ MES to Thuraya fixed/ MES call**
- **Fixed land line, PLMN, other GMPCS originated call to Thuraya MES/ fixed telephone.**
- **Thuraya MES/ fixed telephone to fixed land line, PLMN, other GMPCS telephone.**

a. Voice Decoder

Sr. No.	Parameter	Specification
1	Function	To decompress 5.2 kbps voice traffic
2	Decoding algorithm	CVC AMBE + used over Thuraya network

b. Fax Decoding

Sr. No.	Parameter	Specification
1	Function	To decode fax calls intercepted by the system
2	Protocols	Group 3 and Group 4 fax – 2.4 kbps, 4.8 kbps and 9.6 kbps rate

c. Data Decoding

Sr. No.	Parameter	Specification
1	Function	To decode data calls intercepted by the system
2	Protocols	Data – 2.4 kbps, 4.8 kbps and 9.6 kbps rate

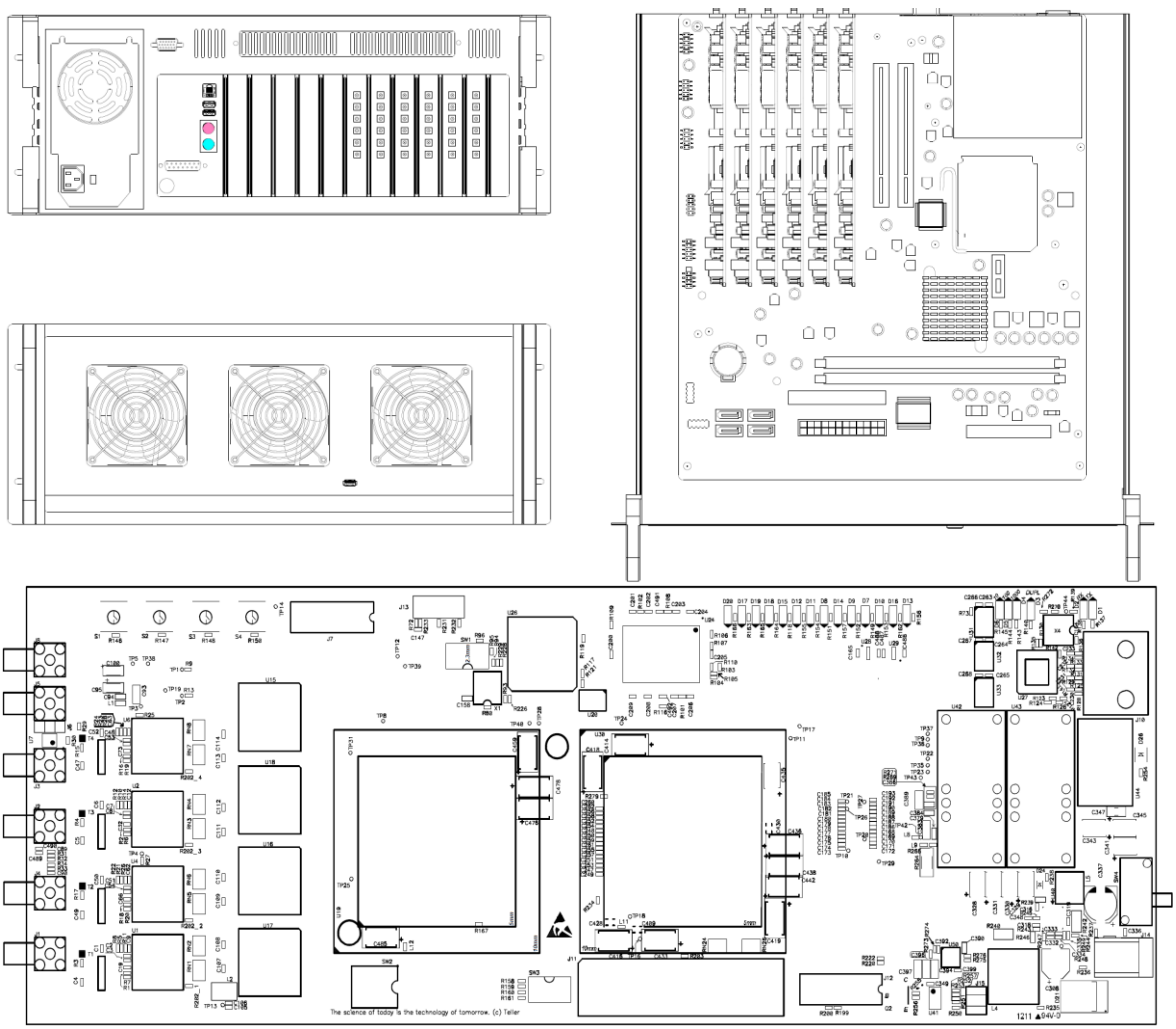
d. SMS Decoding
The system is able to decode SMS intercepted by the system.

A.8 Database subsystem

Sr. No.	Parameter	Specification
1	Call Record Format	The system collects and stores in the data base all important and necessary information which are received from a common signaling channel or extracted from the call recording e.g. reference number, type of call, MES ISDN No., IMEI, IMSI, TMSI, country code, area code, Spot beam ID number, RAND, SRES, Ciphering Algorithm type, Call duration, Called or Calling Number, Target Name/group etc.
2	Filtering Criteria	The system gives possibility to define the all important and necessary filtering criteria for recording / interception e.g. CLIP/Dialed number, Conferee ID, Target ID, Location, Date, Time.
3	Search Facility	The system provides various search options including wild card search for search the ID records data bases and communication data including SMS by defining all the important and necessary search criteria e.g. reference number, MES ISDN No., IMEI, IMSI, etc.
4	Database Management Software	MySQL based having original licensed service pack server.

A.9 Signalling interception subsystem (Scanner 3200)

S. No.	Parameters	Specification
1	Type of demodulator	CQPSK. FPGA based
2	Type of DSP cards	Delta “Cyclone IV”
3	Number of DSP cards	6
4	Number of channels (demodulated frequencies)	3200
5	Function	To demodulate C band RACH signals.
6	Burst Support	RACH burst.
7	Input Frequency	70 MHz±18 MHz
8	Input Impedance	50 Ω
9	Input Connector	SMA type Female
10	Remote control	Gigabit Ethernet



B. DATA VIEWER

The increasing use of communications systems for transfer of data files has led to a wide range of communications protocols and file formats. The Company provides an Analysis program with TMS to retrieve the raw data files embedded within a range of file transfer and communications protocols. This program is called SeePro.

It also de-embeds files from a wide range of communications protocols that are used for data transfer through the Thuraya system.

SeePro has been designed to integrate seamlessly with the TMS, where it augments the standard data viewer significantly.

SeePro analysis program has been developed as pure software based solution to decode information that has been transmitted via Thuraya network during Internet (Email, Web Mail, HTTP, Messengers, Chats, FTP, Videoconference, VoIP, FoIP, Telnet) session that has been recorded by the TMS.

The result of analysis may be viewed and/or stored for future reference or export for off-line analysis. Embedded data files may be opened and manipulated as the SeePro internal viewer as a range of viewers, many of which are available at little or no cost.

B.1 Facsimile viewer

Facsimile data in proprietary Thuraya format is recognized and converted into a .TIF file, and automatically invokes the TMS facsimile viewer. This results in the facsimile being displayed without further operator intervention.

Following facsimile protocols are supported:

Facsimile rates:	**2.4 kbit/sec, 4.8 kbit/sec, 9.6 kbit/sec**
Demodulation and Layer1 decoding:	**TCH6/TCH9 traffic channels in accordance with GMR-1 05.03;**
Radio interface adaptation:	**GMR-1 04.21/GSM 04.21;**
Facsimile signaling information:	**ITU-T T.30;**
Image decoding:	**ITU-T T.4 (MH, MR, MMR, ECM), T.81 (JPEG), T.82 (JBIG).**

B.2 Data Analysis

The structure of a data transfer may be considered as a series of layers, working from the source information outward to the transfer protocols. For example, a report may be prepared, containing text and pictures, using a word processing package such as Microsoft Word. The text and its formatting and the pictures are embedded in the resulting file using techniques peculiar to the word processing package.

The report and other files may be attached to an email containing text and other information. On sending, the email acquires header and footer information that contains address and routing details and further layers may be added if the email is aggregated with others before transmission as a message.

The SeePro analysis program works from the outer layers of the message towards the Centre, peeling layers away like those of an onion.

The data recovered by analysis from file transfers or e-mails with or without attachments can be viewed using the SeePro internal viewer or other appropriate viewer or application.

Following data protocols are supported:

Data rates:	**2.4 kbit/sec, 4.8 kbit/sec, 9.6 kbit/sec**
Demodulation and Layer1 decoding:	**TCH6/TCH9 traffic channels in accordance with GMR-1 05.03;**
Radio interface adaptation:	**GMR-1 04.21/GSM 04.21;**
Radio Link Protocol (RLP) decoding:	**GSM 04.22;**
Data Link Layer decoding:	**X, Y, Z modem, PPP, SLIP, CSLIP, LCP, NCP, Van Jacobson, IPCP, CCP, MS PPC;**
Transport Layer decoding:	**TCP, UDP (RTP/RTCP, UDPTL);**
Network Layer decoding:	**IPv4;**
Session Layer decoding:	**HTTP, SMTP, POP3, IMAP4, Web Mail, ICQ, MSN, IRC, FTP, Telnet.**

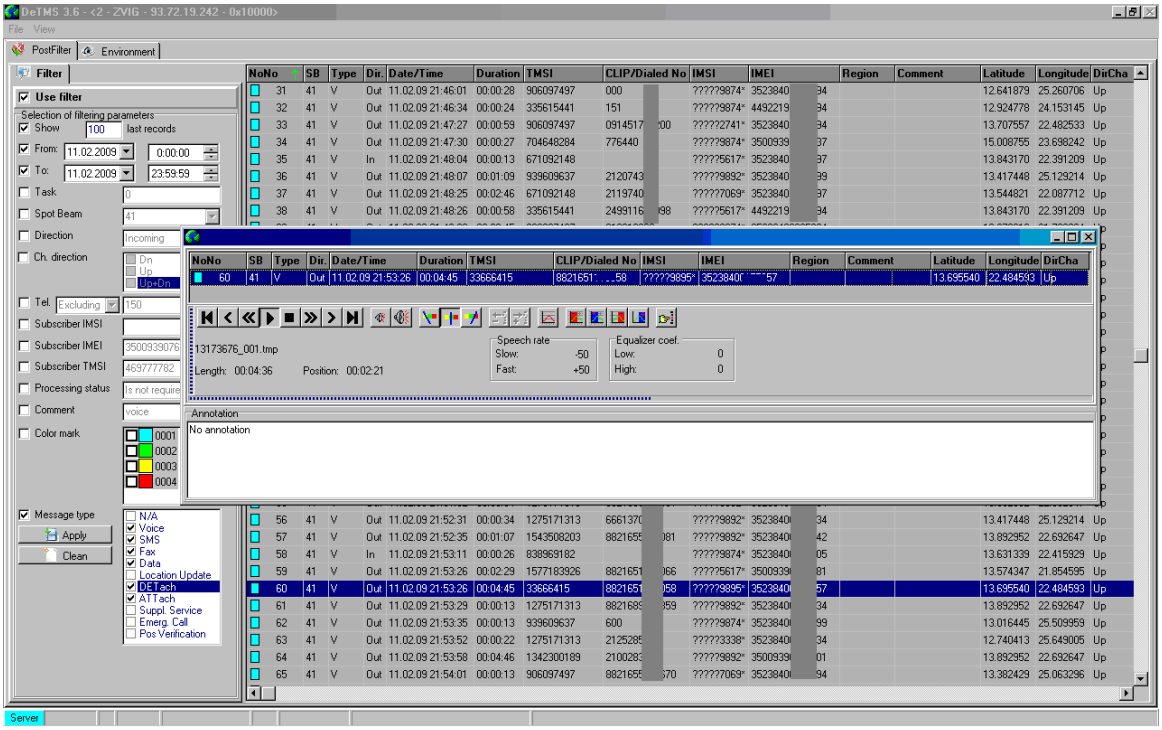
C. The TMS Software

Following types of TMS software are used in the system.

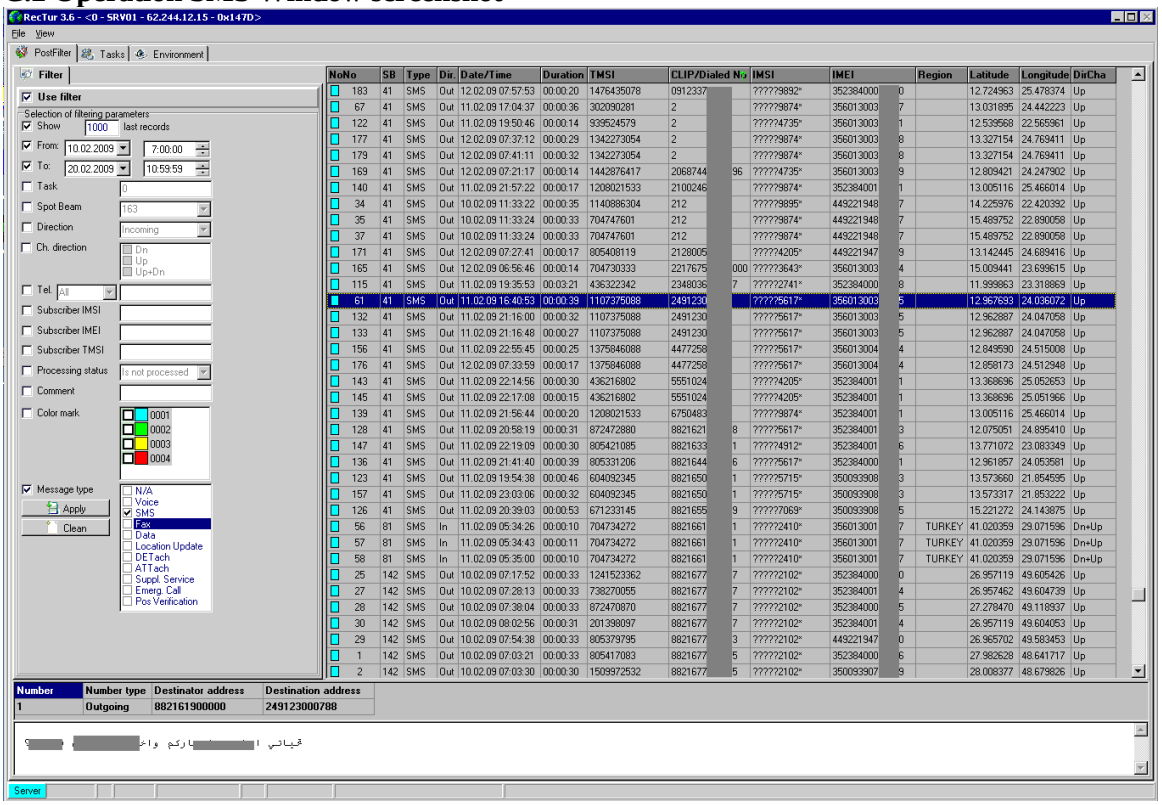
Analysis Subsystem	▪ **Server Applications** • **Controls the monitoring of calls** • **Server Application for Thuraya Service** ▪ **GUI** • **User Interface to control Server Software and view/re-play data recorded** ▪ **Database** • **each element of the TMS software communicates via the database**
Server Applications	▪ **Demodulation** ▪ **Decoding** ▪ **FAX Converter** ▪ **DATA Converter**
Client Applications	▪ **GUI** • **Main GUI application for viewing calls and adding targets**

	▪ **Vocoder** • **Digital voice player** ▪ **FAX Viewer** • **FAX viewer, can use Windows viewer** ▪ **DATA viewer** • **Data file viewer** ▪ **Configuration** • **Used to configure Servers** ▪ **Status Monitor** • **Monitors the health of the system**
Database	▪ **MySQL Server Database** ▪ **Holds configuration of system, Targets profiles, call details** ▪ **Password protected** • **knowledge of password restricted to Administrator** • **prevents unnecessary access by Operators** ▪ **Call data stored in separate files on the system** • **Directory structure: type/year/month/day/filename** • **Voice - VOC and WAV** • **FAX – TIF** • **Data – BMD**

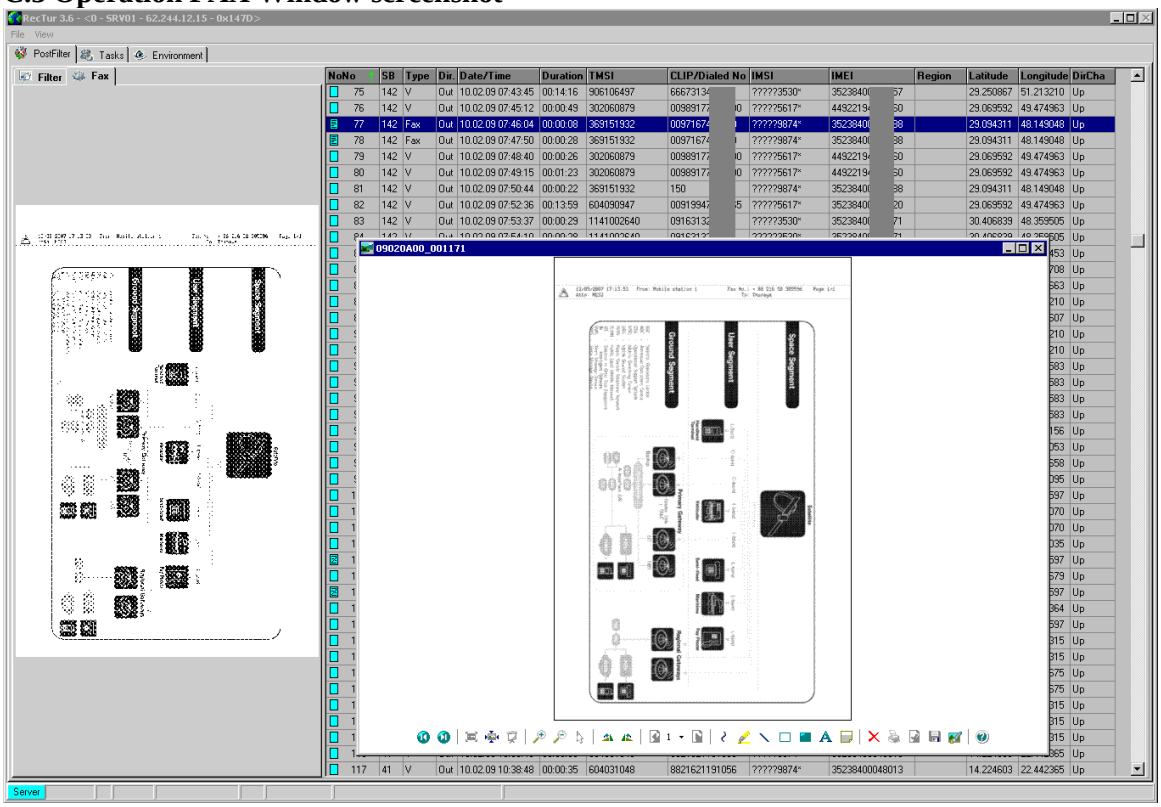
C.1 Operation Voice Window screenshot



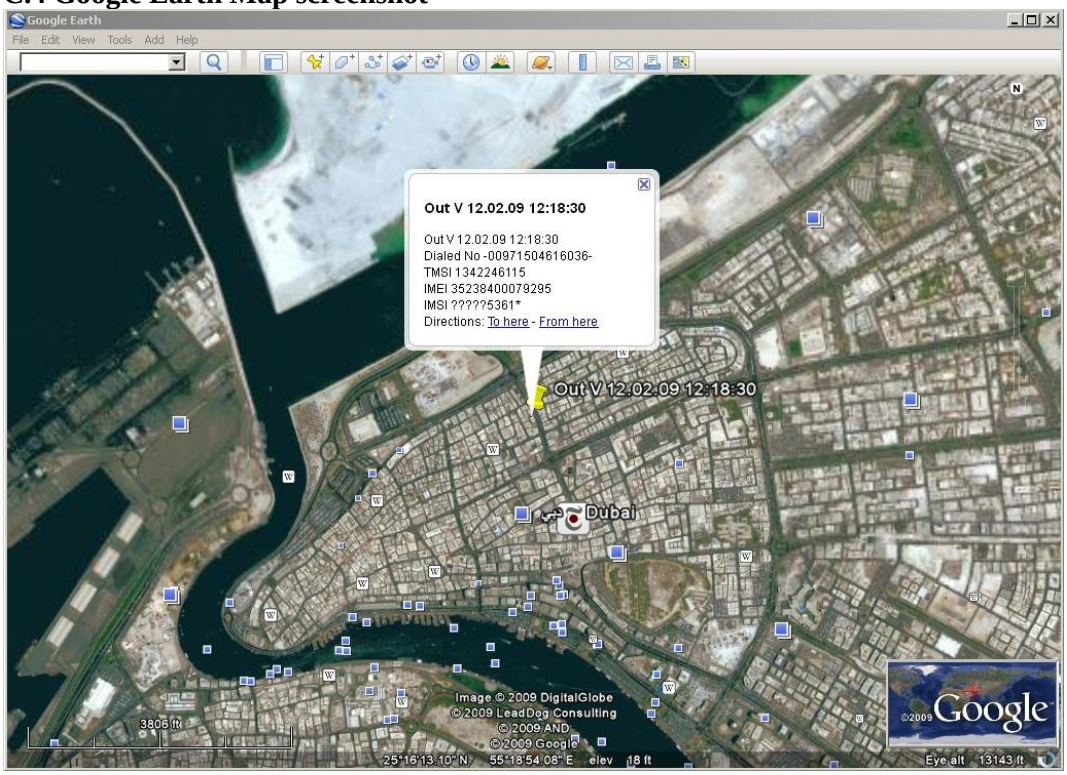
C.2 Operation SMS Window screenshot



C.3 Operation FAX Window screenshot



C.4 Google Earth Map screenshot

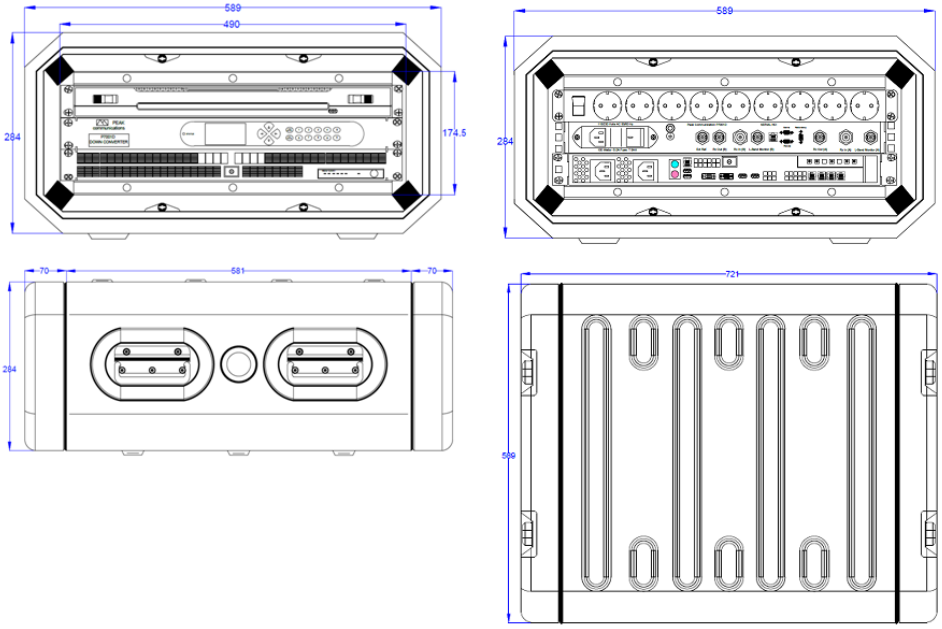


D. Main Stationary System Rack

Dimensions: H x W x D, mm = 1988 x 600 x 1000

E. Remote L-band Sensor

Dimensions: H x W x D, mm = 284 x 589 x 721;
Approx. weight: 30kg



PROPOSAL FOR TACTICAL THURAYA MONITORING SYSTEM
Supply, Installation, Training and Maintenance

1.1. General

This document has been prepared in response to Request for Proposal about the Tactical Thuraya Monitoring System.
This Proposal describes a Tactical Thuraya monitoring system that provides automated interception and recording of calls within a group of spot beams on a single satellite. The two-side interception (uplink+downlink) is possible only when the target in on direct line-of-sight. In other cases, one-side (downlink) interception is provided. In 5-8% of cases an echo of uplink signal is present in downlink signal that makes possible to listen both sides of communication.
The system is designed to be tailored to specific customer requirements, or easily expanded after installation.
This element of the Proposal should be read in conjunction with the attached the Company quotation.

1.2. Structure of the Proposal

Section 1	**(this section) provides an introduction to the purpose and structure of the technical proposal.**
Section 2	**provides a description of the Company Tactical Thuraya Monitoring System (TTMS).**
Section 3	**provides details and specifications for the proposed system and its components.**
Section 4	**contains details of the functionality for the Tactical Thuraya monitoring system. The section includes a system management, data processing and analysis.**
Section 5	**provides details of the maintenance schedule and the after sales support available from the Company.**
Section 6	**provides details of the system technical specification and contains the TTMS screen shots.**

2. SYSTEM DESCRIPTION

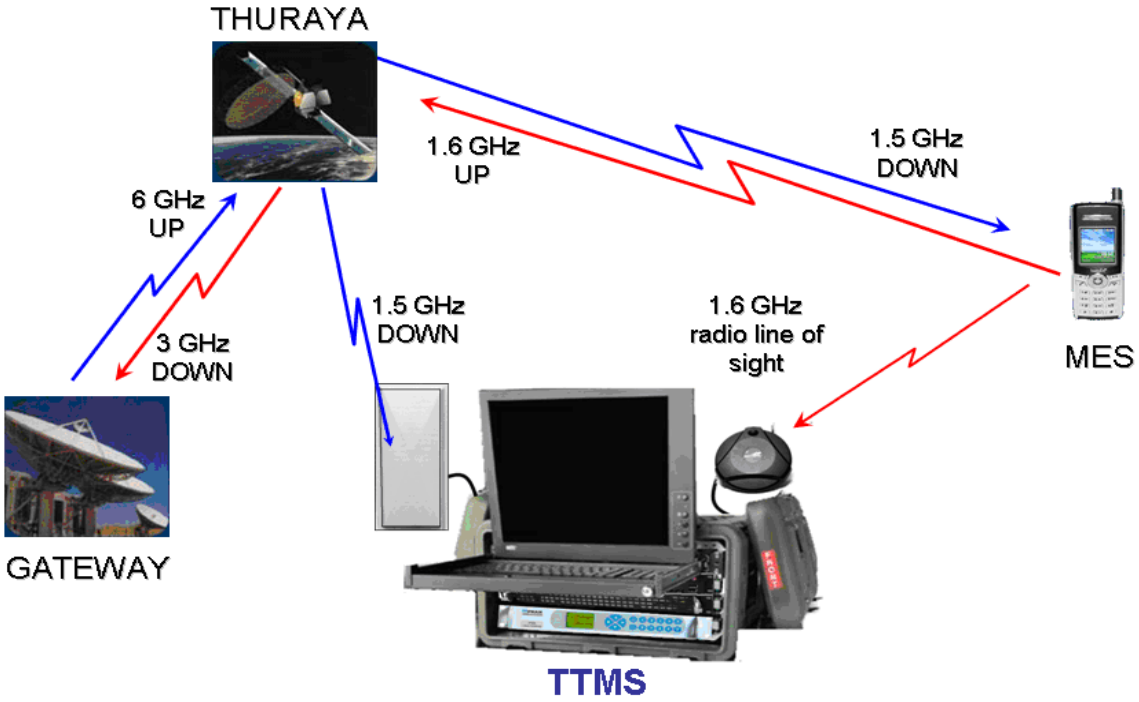
2.1. Principles of the TTMS Operation

The Thuraya satellite provides world-wide communications capability through geostationary satellite, strategically located to provide coverage of the earth's surface to latitudes in excess of 55° North and 45° South of the equator.
Communications between the satellite and Mobile Earth Station (MES) is effected using frequencies around 1.6GHz and 1.5GHz for the uplink and downlink frequencies respectively. The Primary Gateway Earth Station (GATEWAY) that provides connections to the terrestrial communications network communicates with the satellite using frequencies around 6GHz and 3GHz for the uplink and downlink frequencies. The GATEWAY also acts as the Satellite Operation Centre, providing all tracking, telemetry and command functions for the satellite as well as its Uplink Beacon.
The Thuraya satellite uses a number of spot beams for communication with the MES which can be combined and reconfigured from the ground for optimum performance against changing operational needs. The network uses a GPS position provided by the MES to register it in the correct spot beam. However, for security reasons, the accuracy of the GPS position is deliberately limited to around 30m.
The Tactical Thuraya Monitoring System offered by the Company is designed to passively intercept any Thuraya calls made within the coverage of its target antenna. It captures the L-band

downlink (forward channel) and the L-band uplink (return channel) by direct line of sight reception.

In TTMS demodulation and decoding of the intercepted signals is realized entirely in software contributing the small size of the tactical system. With the line of sight range for intercept of up to 18 km. This distance may be increased if the uplink antenna is raised above the ground while maintaining line of sight conditions.

Note: the Company has experience in two-side target interception when it was located at 300 km distance from TTMS. In this case TTMS was placed on 200 m hill at sea shore.



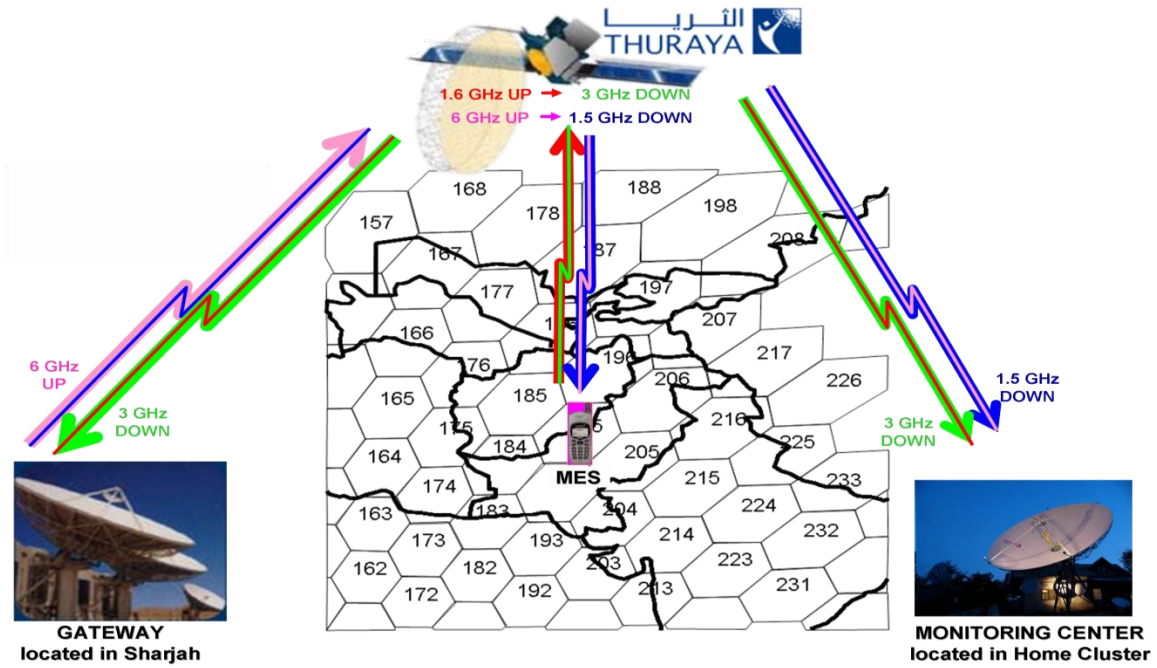


Figure 2-1 - Principle of TTMS Operation

Each of the spot beams in the Thuraya network has a pair of signaling channels. One signaling channel is transmitted at L-Band by the satellite and is received by all MESs in the spot beam. This signaling channel is known as the Broadcast Control Channel (BCCH). In addition to the BCCH, the following channels are also Time Division Multiplexed onto the same carrier: Access Grant Channel (AGCH), Paging Channel (PCH), Frequency Correction Channel (FCCH) and Basic Alerting Channel (BACH). The other signaling channel is known as the Random Access Channel (RACH). The RACH is a channel that provides ad hoc access to the network for the MESs. All MES units within a spot beam transmit bursts at L-Band on the RACH channel.

At L-Band downlink, the BCCH resides on a single carrier frequency, which is one of a group of 5 contiguous carrier frequencies assigned to the spot beam. The other 4 carrier frequencies in the group are available to carry dedicated Normal Traffic (NT) channels, which are shared by Traffic Channel (TCH) bursts and their matching Fast or Slow Associated Control Channels (FACCH or SACCH).

At L-band uplink, the RACH channel resides on one of a group of 5 carrier frequencies, with the other four carriers containing call traffic. The four L-band downlink traffic carriers are paired with the four L-Band uplink traffic carriers.

When a telephone call is established on the Thuraya network, regardless of whether it is a Mobile Originated (MO) call or a Fixed Originated (FO) call, a dedicated traffic channel (TCH3) and an associated control channel (FACCH3) are established for the call. This dedicated channel allocation is achieved by the MES transmitting a Channel Request message as a burst on the Random Access Channel (RACH) and the network responding with an Immediate Assignment message on the Access Grant Channel (AGCH). TTMS is able to receive both of these messages, the Channel Request from the L-band uplink, and the Immediate Assignment from the L-Band downlink.

The Immediate Assignment message includes frequency and timing information needed by the MES to tune to its dedicated traffic channel. The traffic channel assigned will be 3 consecutive time slots on one of the four traffic channels associated with the BCCH/RACH pair. TTMS uses this information to intercept both side of the call.

2.2. Configuration

The Company offers to supply, install, train and locally support the Tactical Thuraya Monitoring System.

Deliverable Package of the TTMS

- **Satellite antenna assembly for reception of Thuraya satellite signals**
- **Target antenna assembly for interception of the target terminal signals**
- **Ethernet switch, Downconverter and DSP server (mounted into Pelican-Hardigg Case)**
- **Monitor and keyboard tray for configuration, monitoring and analysis of received signals**
- **Interconnecting cables and accessories**
- **Software package**
- **Operating manual**

Figure 2-2 - TTMS

The fully integrated system has the capability to passively intercept activities and traffic in the Home Cluster of coverage area of the Thuraya satellite communication system.

2.3. Location

The TTMS may be used at any geographical position within the footprint of the Thuraya satellite. This means that the monitoring station will be located under a Thuraya spotbeam, which henceforth shall be referred to as the tactical system's Home Spotbeam. Six neighbor spot beams of home spotbeam compose the tactical system's Home Cluster. The two-side interception (uplink+downlink) is possible only when the target in on direct line-of-sight. In other cases, one-side (downlink) interception is provided. In 5-8% of cases an echo of uplink signal is present in downlink signal that makes possible to listen both sides of communication.
Note: the Company has experience in two-side target interception when it was located at 300 km distance from TTMS. In this case TTMS was placed on 200 m hill at sea shore.

2.4. Monitoring capabilities

The system provides the User with the following information about every call on every monitored spot beam:

- **Call Content including Voice, SMS, Fax and Data.**
- **Date and Time of Call.**
- **TMSI of the called MES.**
- **The IMEI of the MES.**
- **The telephone number dialed by the MES.**
- **Calling Line Identity Presentation (CLIP). The telephone number of call originator would be available on some calls.**
- **GPS position of the MES.**
- **Country / Region.**
- **Event Type (Mobile or Fixed Originated Call, which can be either Voice, Fax or Data, SMS, etc) which can be initiated by either the MES or the Network.**
- **A 4 or 6 digit sub-set of the MES IMSI.**
- **Terminal Type.**
- **Current Thuraya Spot Beam ID, GPS-position (co-ordinates) of geographic centre, and operating frequency.**
- **List of adjacent Spot Beams, their GPS-positions and operating frequencies.**
- **Random Reference Number (call ID).**

TTMS provides the User with information for 16 duplex calls made within the coverage of the target antenna or 32 simplex calls (forward direction) within the coverage of the home cluster.

Differences between captured information in the Duplex and Simplex operation mode.

Duplex Mode (forward + return direction)	Simplex Mode (forward direction)
▪ Data, Time, Direction ▪ GPS Position ▪ IMSI, TMSI, IMEI ▪ CLIP/ Dialled Number ▪ Region (Country) ▪ Content (two sides): Voice, SMS, FAX, DATA	▪ Data, Time, Direction ▪ GPS Position ▪ IMSI, TMSI, IMEI ▪ CLIP Number / Dialled Number ▪ Region (Country) ▪ Content (one side): Voice, SMS, FAX, DATA

3. TECHNICAL CAPABILITIES

3.1. TTMS

The following technical characteristics are provided:

3.1.1. Passive system operation.

3.1.2. Range min. 5 km in open area and min. 0.5 km in urban area at small dimensions of antennas. This distance may be increased up to 300 km if the uplink antenna is raised at sufficient altitude and target is located, for example, at the sea.

3.1.3. Simultaneous monitoring up to 4 Spot Beams of Home Cluster.

3.1.4. Simultaneous recording of 16 duplex or 32 simplex calls of Home Cluster.

3.1.5. Monitoring in real time of selected call.

3.1.7. System control and management via Graphic User's Interface.

3.1.8. Deciphering of monitored data (Voice, Fax, Data, SMS).

3.1.9. Collecting information on monitored User's terminals (IMSI, TMSI, IMEI) and sent data Voice, Fax, Data, SMS) in the Data Base.
3.1.10. Presentation of collected data in form if text, graphs and tables with possibility of exporting the data to other widely used formats of data recording.
3.1.11. Import and use of digital maps in Shp standard.
3.1.12. Graphic presentation on a map of the position of monitored User's terminals.
3.1.13. Operation in different climatic zones.
3.1.13.1. Lightning protection for all equipment.
3.1.13.2. Water Proofing: All connectors are filled with dielectric grease and sealed with a waterproofing kit.
3.1.13.3. Environmental Specification:

- **Operating temperature: -10 ~ 55°C**
- **Humidity: 10% ~ 90%**
- **Vibration: 1.25 Grms**
- **Shock: 10G**
- **Strike: 15G**

3.1.14. Operation, deployment and folding of the system by one person.
3.1.15. Compact structure enabling secretive transportation in travelling suitcases.
3.1.16. Fast and easy deployment and folding of the system.

3.2. Equipment Schedule

The equipment and software proposed for TTMS is shown in Table 3.1.

Table 3-1 – Schedule of the Company deliverables for TTMS

Item	Description	Qty
	Tactical Thuraya Monitoring System	**1**
1	**Antenna subsystem**	**1**
1.1	**L-band antenna system comprising:**	
1.1.1	**L-band antenna system with fixed pedestal**	**2**
1.1.2	**L-band low noise amplifier**	**2**
1.1.3	**Dual L-band downconverter**	**1**
2	**Demodulator subsystem**	**1**
	Comprising:	
2.1	**High Performance PCI-E DSP card fitted in to server**	**1**
2.2	**Demodulator, Deciphering & MAP Server**	**1**
3	**System Items**	**1**
	Including:	
3.1	**Monitor and keyboard tray**	**1**
3.2	**Software including:**	**1**
	Server Operating System	
	Server Software	
	Client Software including GIS	
	MySQL Community Server	
3.3	**Rack Case, fully wired, with remote power cycling (for the Monitoring system equipment)**	
3.4	**Optional - 12V Rack mount pure sine wave inverter 2000W**	**1**

3.5	**Optional - Rack Case, (for the 12V pure sine wave inverter)**	**1**
3.6	**Optional - 2 KVA UPS SYSTEM**	**1**
3.7	**Optional - Rack Case, (for the 2 KVA UPS SYSTEM)**	**1**
4	**Support Items**	**1**
4.1	**System Packing and Shipping (CIP)**	
4.2	**Turnkey Installation and Commissioning**	
4.3	**Factory Acceptance Testing**	
4.4	**Site Acceptance Testing**	
4.5	**Training & documentation**	

4. TTMS FUNCTIONALITY

4.1. System Management and Configuration

The following technical characteristics are provided:

4.1.1. The ability to set user and group policies and permissions to system resources.

4.1.2. The ability to perform corrective calibration on any subsystem.

4.1.3. The ability to monitor the Database server status.

4.1.4. The ability to monitor system and subsystems to insure proper operation and performance.

4.1.5. Built in Test for provided systems and devices.

4.2. Real-time Calls and Traffic Monitoring

Real-time Calls and Traffic may be presented in two possible displays. First view is based on table presentation and another is based on map.

A digital map is displayed on a dedicated screen. Both the table and digital map hold all required information to carry out all duties pertaining to real-time call and traffic monitoring.

4.2.1. All MES calls are displayed on and their location updated.

4.2.2. All active, standby and shutoff (last known position) of MESs are displayed.

4.2.3. All MESs may be displayed on the digital map.

4.2.4. The ability to zoom into or zoom out of the digital map.

4.2.5. Placing the mouse pointer on a MES, shown on the digital map, displays a balloon containing the following information:

- **MES ID (IMSI/TMSI)**
- **Phone number if known**
- **Name if given**
- **GPS coordinates**
- **If MES is active call duration, and number contacted**
- **Spot beam ID**

4.2.6. The ability to listen to active calls by selecting the MES on the table.

4.2.7. The ability to display all known information related to the MES by selecting it and then displaying the information on the other part of map display or screen.

4.2.8. Playback of call while it is still being recorded live.

4.3. Processing and Analysis

The following technical characteristics are provided:

4.3.1. The ability to query call and MES history.

4.3.2. The ability to playback intercepted audio.

4.3.3. The ability to view intercepted faxes.

4.3.4. The ability to view intercepted SMS messages.

4.3.5. The ability to view data in its raw format.

4.4. Voice Playback

If a target call contains voice telephony, the call maybe played back by the operator. Both forward and return links of a duplex conversation are available for monitoring, presented on separate loudspeakers or headset earpieces.
The operator may fast forward and move back through a recording by positioning a slider in the display. This also allows phrases in the recording to be repeatedly played for analysis.

The output level and balance between speakers (headphones) may be adjusted, and may be muted by a single action from mouse or keyboard.
The voice recording may be saved as a .WAV file, which can then be exported for further analysis outside TTMS.
4.5. Reporting
The following technical characteristics are provided:
4.5.1. All generated reports are of Microsoft Word format.
4.5.2. The results of queries on intercept histories are plotted with ability to generate a report that includes the map.
4.5.3. All reports are to be electronically archived.
Note: the Company provides a customized reporting form development in accordance with Customer specific requirements.
4.6. Database archive and retrieval
The database may be archived at any time by the system Administrator. The preferred medium is DVD DL R/W disks as supplied with the equipment, which provide a nominal storage capacity of 8.5GBytes per disk as standard.
Archiving is achieved through a dedicated selection window, into which the Start Archive date and End Archive date are entered. Dates are entered as date and hours, minutes and seconds in 24 hour format. TTMS responds by displaying the earliest and latest database entry in the Call Database within the selected time window. On Administrator acceptance of the time range, TTMS archives the material to the DVD drive and deletes the corresponding data from the System Server hard disk, freeing space for further data.
Analysis of archived material can be carried out by reloading the relevant archive database and running the Analysis application in the same manner as for Call Search with recent data.

5. SUPPORT

5.1. Spares

No spare parts are included with the basic system proposed. However Table 5-1 provides a list of recommended spare parts.

Table 5-1 – List of recommended Spare Parts for TTMS

Item	Description	Q-ty	Comment
1	L-band Antenna	1	
2	Low Noise Amplifier	1	
3	DSP board	1	
4	Cables set	1set	

5.2. Documentation

The Company provides standard operational and maintenance documentation, testing evaluation procedures in English language.

5.3. Warranty and Repairs

The equipment is delivered with a standard one year warranty, unless otherwise specified. Opening the equipment during the warranty period will void the warranty. It is recommended that defective or damaged equipment is returned to the Company unopened for repair or replacement.

The routing and documentation for returned equipment is country specific, and is detailed in the Technical Manual delivered with the system.

Computer equipment failure should, in general, be addressed to the in-country support facilities of the computer manufacturer. The arrangements for specific installations are detailed in the Technical Manual delivered with the system.

6. APPENDICES

6.1. Technical specification

6.1.1. L-band Antenna

No.	Parameter	Specification
1	Frequency Range	1.5 GHz – 1.7 GHz
2	Gain	3 dB or 15 dB selected for site.
3	Polarization	LHCP
4	Type	Flat plate.

6.1.2. Low Noise Amplifiers

No.	Parameter	Specification
1	Frequency Band Satellite LNA Target LNA	 1.525GHz – 1.559GHz 1.6265GHz – 1.6605GHz
2	Gain at mid band	30 dB
3	Gain flatness	± 1 dB over full band
4	Gain stability	± 0.5 dB from 0°C to +50°C
5	VSWR	Input and Output VSWR ≤ 1.30:1
6	Noise Temperature	170ºK at 25ºC
7	Input and Output Connectors	N Type Female/N type Female

6.1.3. L-band Down Converter

L-band Inputs

Frequency	**1.525 GHz – 1.559 GHz (Channel 1),** **1.6265 GHz – 1.6605 GHz (Channel 2)**
Connection	**50 Ohm N-type**
Signal Level	**-45 dBm …-60 dBm**

IF-Output

70 ± 18 MHz, Single down conversion, no frequency inversion

Connection	**50 Ohm BNC-type**

Transfer Characteristics	
Conversion gain	**+50 dB ± 2 dB**
Attenuation	**from 0 to 59 dB**
Att. 1	**0-31 dB, stepped 1 dB**
Att. 2	**0-28 dB, stepped 2 dB**
Gain stability	**±2 dB from 0°C to 50°C**
Gain flatness	**±1 dB full band**

RF Performance	
Phase noise (dBc/Hz)	
	-60 dBc @ 100 Hz
	-75 dBc @ 1 kHz
	-85 dBc @ 10 kHz
	-110 dBc @ 100 kHz
Noise figure	**6 dB nominal at maximum gain**

LNA Drives	
DC supply	**+5V, 0.1A**
Connection	**Fed on L-band cables**

Internal Reference	
Frequency	**10 MHz**
Stability	**±7.5 x 10-11 over 1 sec**
	±5 x 10-9 per 12 hrs
	±5 x 10-8 over 0°C to 50°C

Mechanical	
Width	**240 mm**
Height	**230 mm**
Depth	**40 mm**
Weight	**Approx. 6 kg**

Temperature Range	
Operating temp.	**from -10°C to +50°C**
Power supply	
DC Voltage	**12V, 2A**
Power	**10 W**
Control System	
Remote Control	**RS232 port**
Alarms	**Local oscillator 1**
	Local oscillator 2
	Frequency synthesizer
	Serial port

6.1.4. Demodulation subsystem

No.	Parameters	Specification
1	Type of demodulator	Software
2	Demodulation Type	Possible to demodulate digitally modulated signal for voice, data, fax, SMS etc. in common control channel, dedicated control channel and traffic channel.
4	Input Frequency	70 MHz±18 MHz
5	Input Impedance	50 Ω
6	Input Connector	SMA type Female
7	Remote control	Ethernet 100/1000 Base T

6.1.5. Decoding subsystem

Following types of calls is decoded:

- **Thuraya fixed/ MES to Thuraya fixed/ MES call**
- **Fixed land line, PLMN, other GMPCS originated call to Thuraya MES/ fixed telephone.**
- **Thuraya MES/ fixed telephone to fixed land line, PLMN, other GMPCS telephone.**

a. Voice Decoder

No.	Parameter	Specification
1	Function	To decompress 5.2 kbps voice traffic
2	Decoding algorithm	CVC AMBE + used over Thuraya network

b. Fax Decoding

No.	Parameter	Specification
1	Function	To decode fax calls intercepted by the system
2	Protocols	Group 3 and Group 4 fax – 2.4 kbps, 4.8 kbps and 9.6 kbps rate

c. Data Decoding

No.	Parameter	Specification
1	Function	To decode data calls intercepted by the system
2	Protocols	Data – 2.4 kbps, 4.8 kbps and 9.6 kbps rate

d. SMS Decoding

The system is able to decode SMS intercepted by the system.

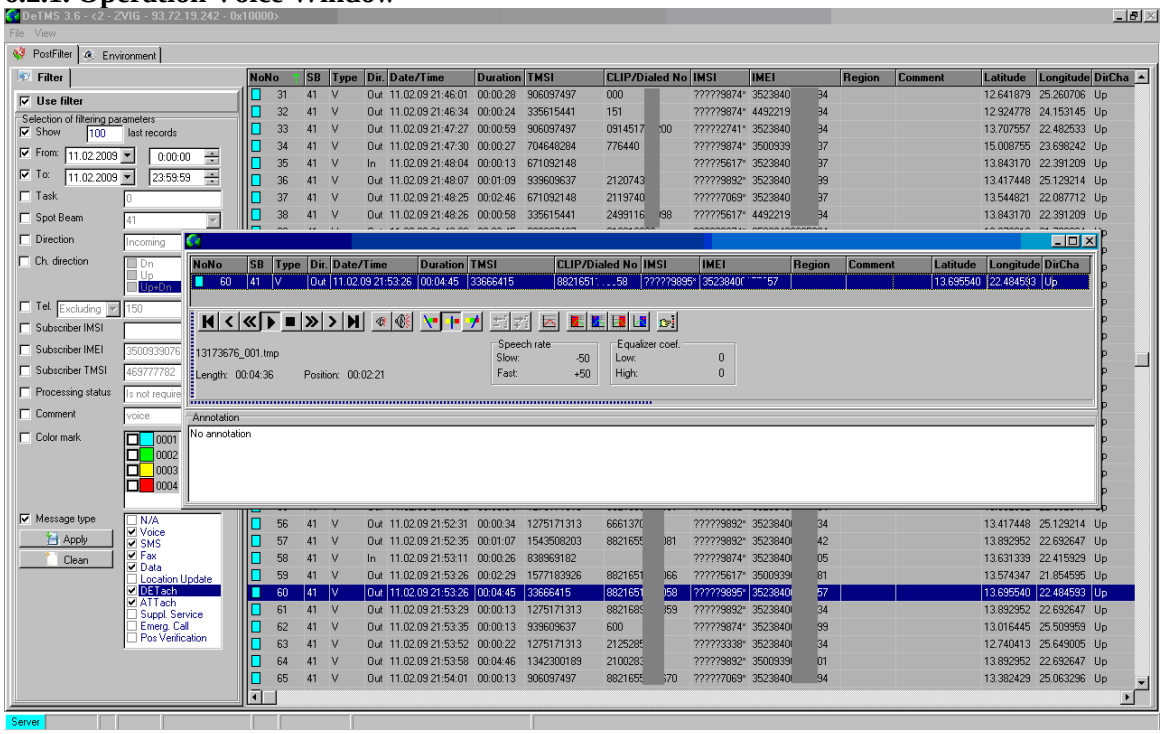
6.1.6. Analysis subsystem

No.	Parameter	Specification
1	Call Record Format	The system collects and stores in the data base all important and necessary information which are received from a common signaling channel or extracted from the call recording e.g. reference number, type of call, MES ISDN No., IMEI, IMSI, TMSI, country code, area code, Spot beam ID number, RAND, SRES, Ciphering Algorithm type, Call duration, Called or Calling Number, Target Name/group etc..

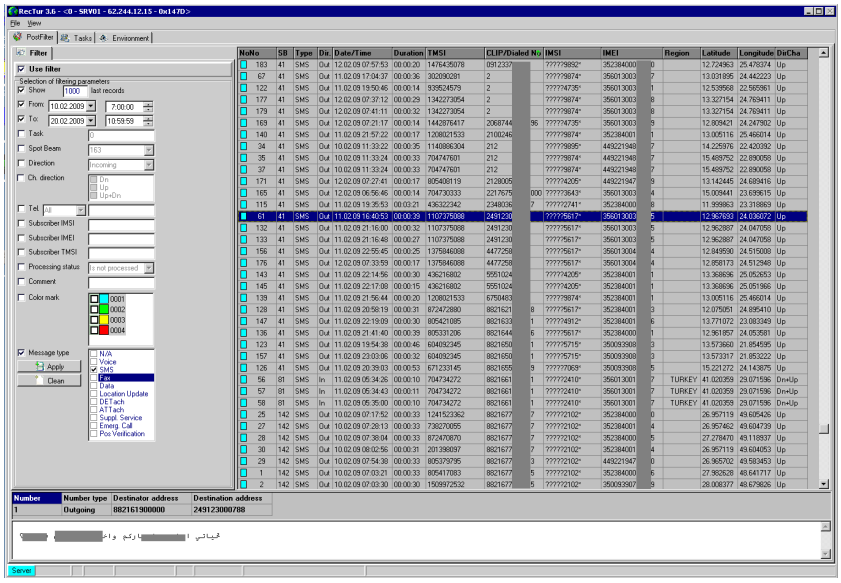
2	Filtering Criteria	The system gives possibility to define the all important and necessary filtering criteria for recording / interception e.g. CLIP/Dialed number, Conferee ID, Target ID, Data, Time.
3	Search Facility	The system provides various search options including wild card search for search the ID records data bases and communication data including SMS by defining all the important and necessary search criteria e.g. reference number, MES ISDN No., IMEI, IMSI, etc.
4	Database Management Software	MySQL based having original licensed service pack with server and client software.
5	Digital Map	Mapping engine: ArcView, Shp standard, Google Earth

6.2. THE TTMS SOFTWARE SCRENN SHOTS

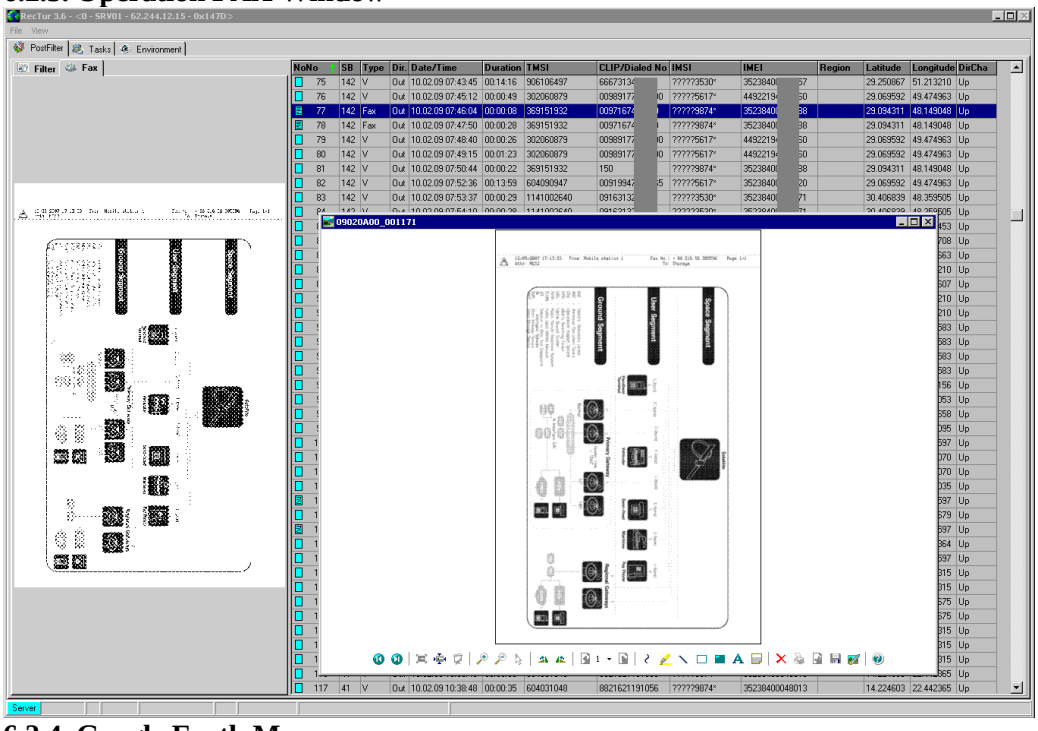
6.2.1. Operation Voice Window



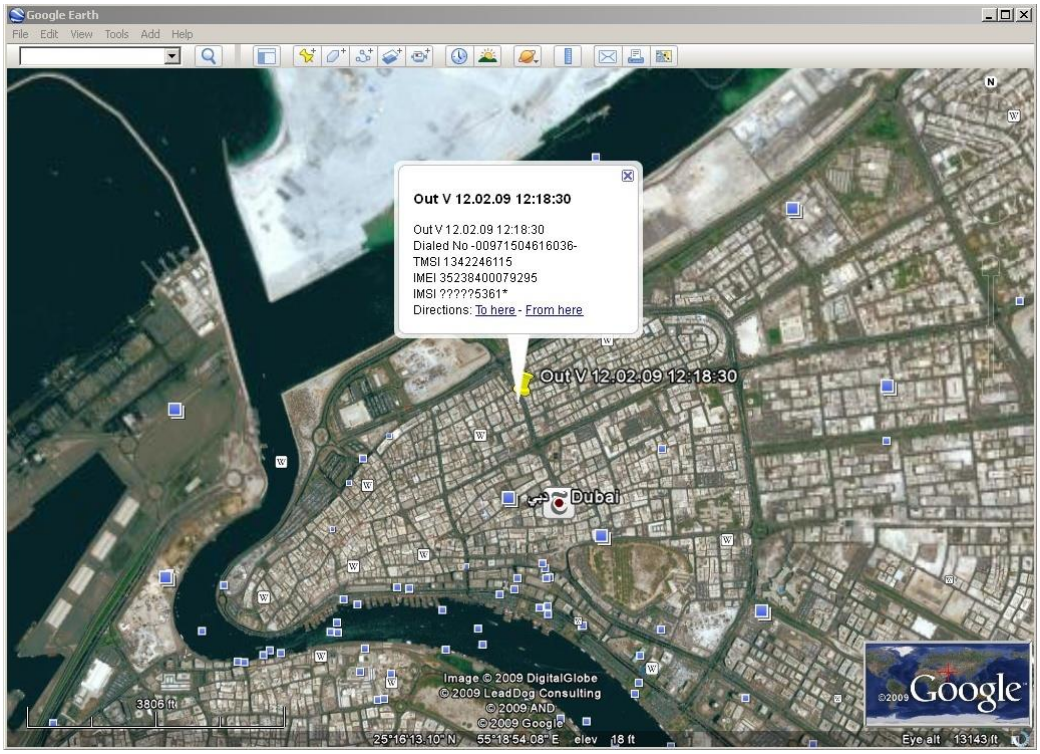
6.2.2. Operation SMS Window



6.2.3. Operation FAX Window

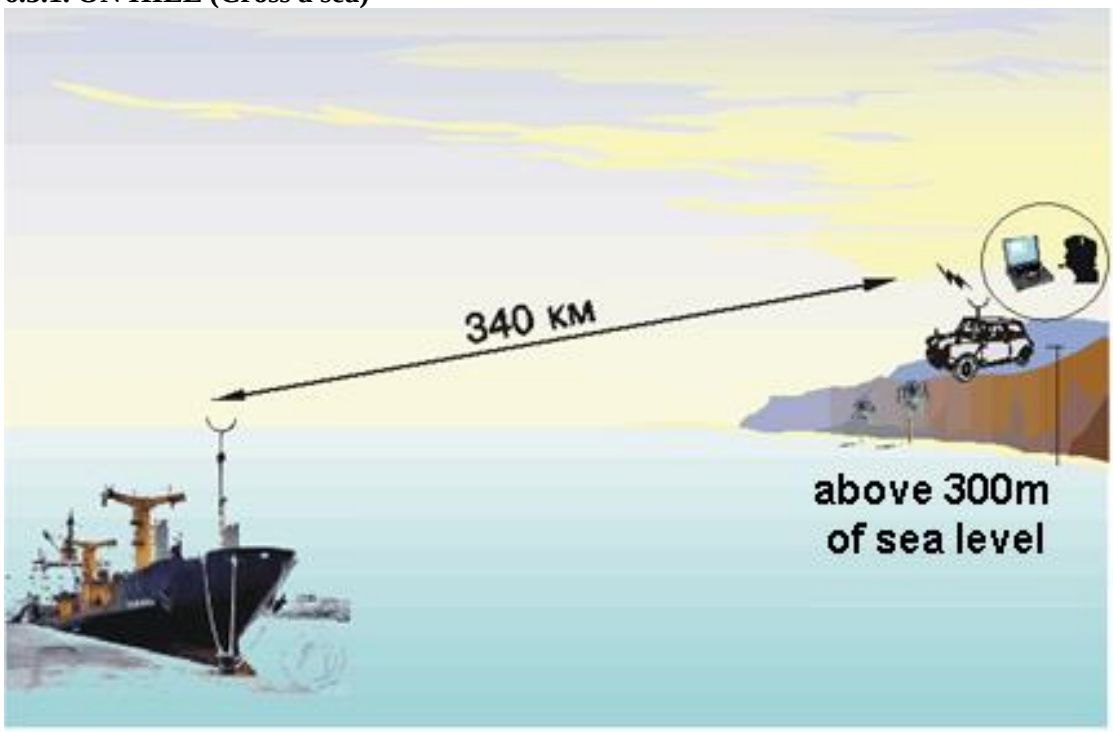


6.2.4. Google Earth Map

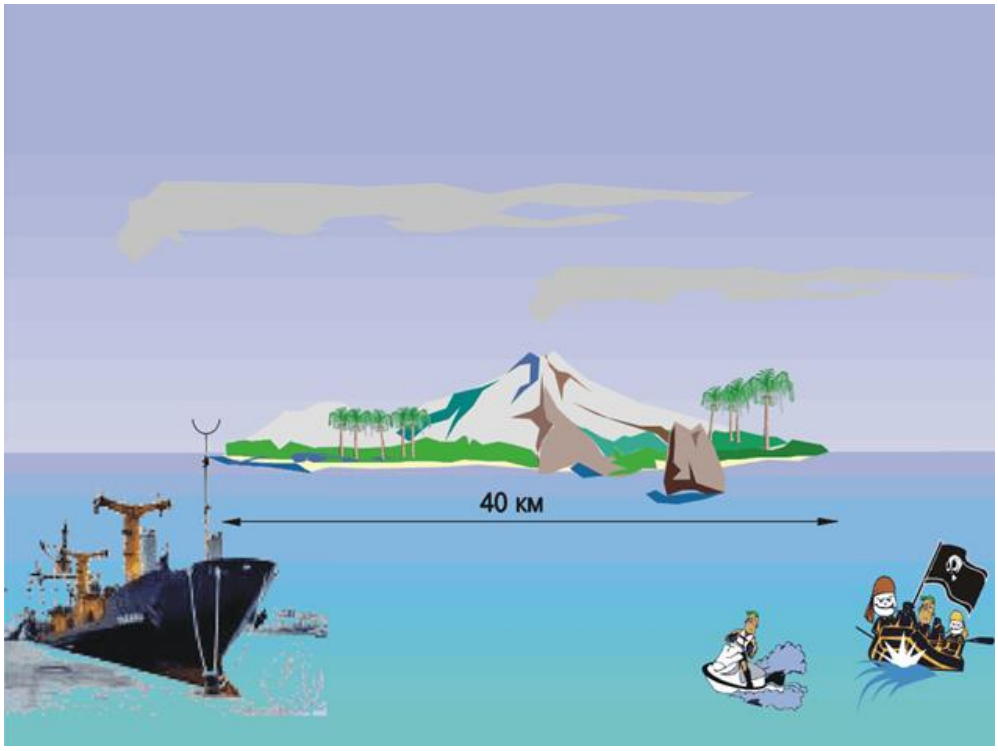

Google Earth
File Edit View Tools Add Help
Out V 12.02.09 12:18:30
Out V 12.02.09 12:18:30
Dialed No -00971504616036-
TMSI 1342246115
IMEI 35238400079295
IMSI ?????5361*
Directions: To here - From here
Out V 12.02.09 12:18:30
Dubai
Image © 2009 DigitalGlobe
© 2009 LeadDog Consulting
© 2009 AND
©2009 Google
3806 ft
25°16'13.10" N 55°18'54.08" E elev 18 ft
Eye alt 13143 ft
©2009 Google

6.3. Examples of a long distance intercept by the tactical solution

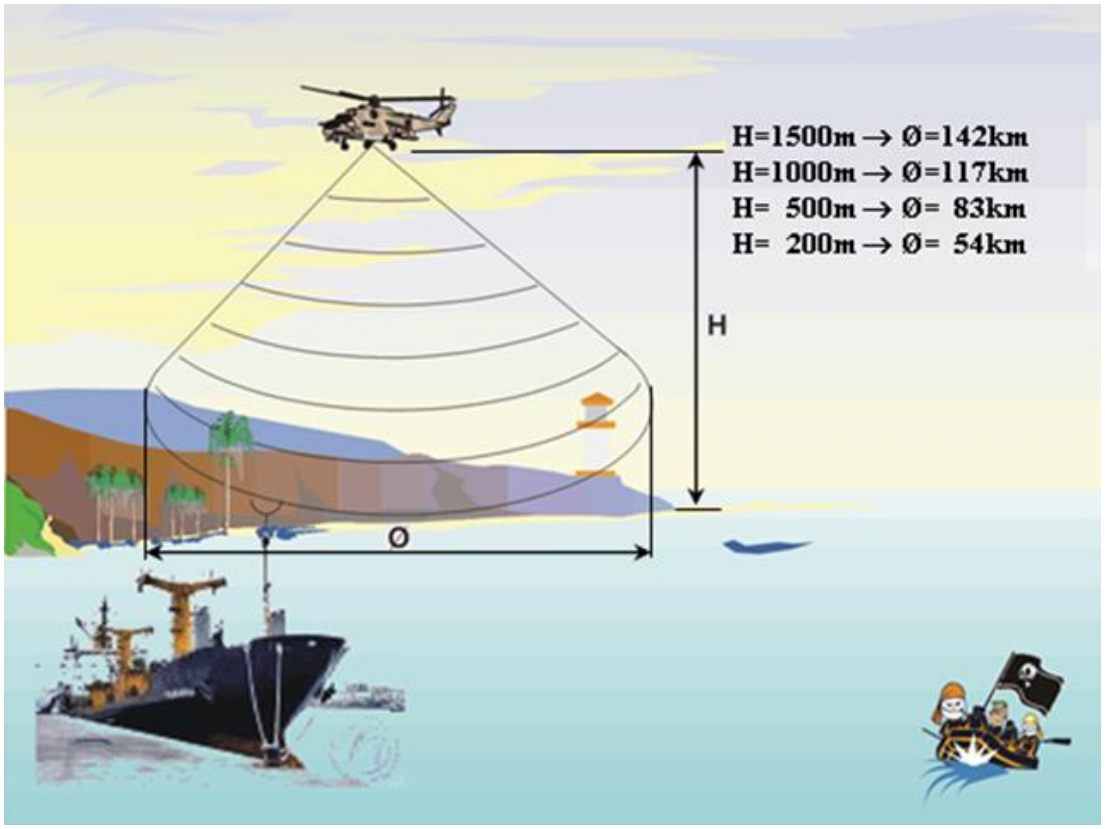
6.3.1. ON HILL (Cross a sea)



6.3.2. ON SHIP



6.3.3. IN HELICOPTER



Duplex interception:
Radio-line-of-sight distance formula for the Tactical Thuraya Monitoring System:
D(km) = 3.57 x (h1^0.5 + h2^0.5),
Where:

h1 (m) is height of the mobile terminal positioning

h2 (m) is height of the monitoring system antenna positioning

For example:

Mobile terminal located close ear of target has h1=1.7meter

Target antenna mounted on the support item has h2=2meters

Radio-line-of-sight distance for the target is 9.7 km.

Simplex interception:

Thuraya: up to 1500 km (3 spotbeams with diameter approx. 500km).

6.4. Dimensions of the system

Dimensions: H x W x D, mm = 284 x 589 x 721; Approx. weight: 30kg