

# IRNSS Signal Monitoring Facility

**Title:** IRNSS Signal Monitoring facility

**Category:** Satellite Navigation Systems

**The Challenge:** To develop complete Automated Test System which can acquire, record and analyze received signal from IRNSS (Indian Regional Navigation Satellite) satellites for the authenticated users. It should be capable to acquire data under 2 different conditions. One is when the system gets the start command from the Antenna system and stop recording the signal when it gets stop command from the Antenna system and second is manual acquisition in which data should be acquired for user defined time. System should be able to acquire either IQ data or RAW data as per user requirement. It should be able to demodulate interplexed modulated data which is a combination of BOC and BPSK signal.

**The Solution:** To fulfill these requirements we have provided complete set up which can acquire received signal in both the modes, store that signal and analyze the received signal as and when required by the authenticated user.

**Introduction:** Optimized Solutions Pvt. Ltd. is a leading ISO 9001:2008 certified Test & Measurement equipment supplier, Data Acquisition Solutions provider and Industrial Automation systems manufacturer.

We are located at Ahmedabad with our team of >40 Engineers from Electrical, Instrumentation and Electronics background. Our manufacturing facility is competent to manufacture CE marked Electrical Control Panels, MCC and PCC. We provide complete automation and data acquisitions solutions using NI products.

The Indian Regional Navigation Satellite System (IRNSS) is an autonomous regional satellite navigation system being developed by the Indian Space Research Organization, which would be under complete control of the Indian government. The requirement of such a navigation system is driven by the fact that access to foreign government-controlled global navigation satellite systems is not guaranteed in hostile situations, as happened to Indian military depending on American GPS during Kargil War. The IRNSS would provide two services, with the Standard Positioning Service open for civilian use and the Restricted Service, encrypted one, for authorized users.

## **Description:**

The system is capable to simultaneously acquire satellite data and store in RAID Drive at maximum speed of 500 MBPS. The system will acquire and store RAW data as well as IQ digitized data with resolutions of 16-bit for IQ data and 12-bit for Raw data. The system will have the flexibility to select between the Raw data and I/Q data. The recorded data will have a binary format which can be utilized for post processing in any customized software platform. There is provision for feeding external 10 MHz reference input to the system configuration.

The 'Data Acquisition and Recording System' is a TURN-KEY Solution fulfilling all the hardware and software requirements necessary for the operation of the system.

## Features

Software has been developed which can acquire the Satellite data, process the data and store that acquired data in given RAID storage so that it can be analyzed in future as and when required.

Developed software has the following main features:

- **User Administration:** To restrict the software access to common people, we made the software password protected. To strengthen the security of the software, password must have at least 8 characters and it must have at least one upper case character, one lower case character, one numeric and one special character  
We have also provided the different access to the software features according to the workgroup particular user belongs to. All the features are not available to all the users.
- **Main Host:** It has 3 modules as mentioned below:
  - Data Acquisition
  - Data Analysis
  - Data Transfer

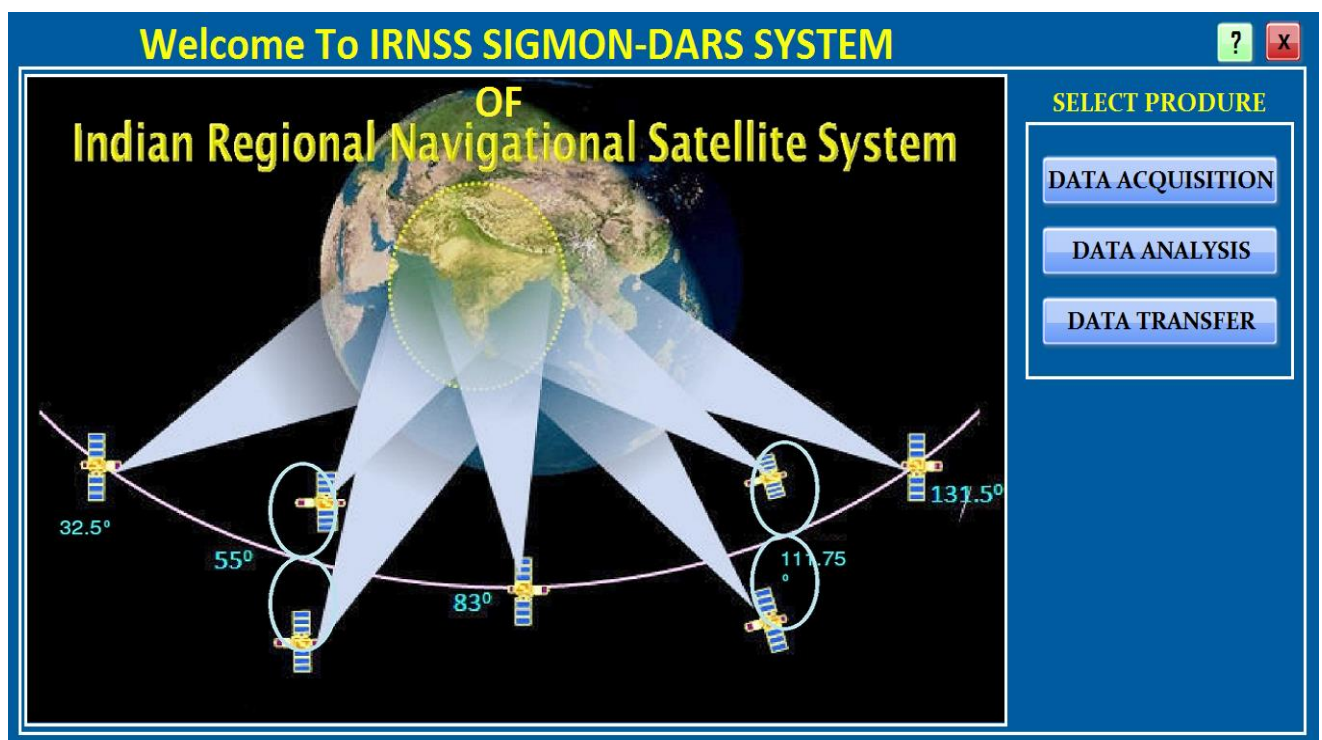


Figure 1Main Host Window

Each module has a specific purpose as described below:

**Data Acquisition:** This module will acquire the Satellite received signal as per the given user inputs. It is possible to acquire IQ data or RAW data in either scheduled mode or manual mode. In scheduled mode Data acquisition will be initiated only when recoding system receive the start command from the Antenna system. In manual mode user can acquired data for the defined time. It will continuously monitor the status of RAID drive and if the free disk space is less than the defined threshold level of total space then software will display the message to take the back up of stored data. Once configuration is set required space to store the data will be calculated according to the total duration and if free disk space is not sufficient then warning message will be displayed. Software can continuously acquire data for unlimited duration ideally but it is limited by the RAID Disk space which is a 24 TB. It is a hot swappable drive so if it is fully occupied then drives can be replaced with the empty drives in one partition while data is being written in another partition.

User Inputs	Session Details	
Acquisition Type	User Name: Administrator	Test Name: Test1
Configuration	User Comments: IRSNS Test	RAID Drive Status: [Yellow Bar]
START	Carrier Frequency: 1.17645GHz	Reference level: -30 dBm
ABORT	Satellite Name: IRSNS 1B	Total Duration: 1 Sec
	File Path: D:\IRNSS S Band Data\IQ Data	Sampling Rate: 40MS/sec
	Status Display: Welcome to IRSNS Signal Monitoring Facility	

Figure 2 Data Acquisition Window

**Data Analysis:** Once data has been stored, user can analyze the stored data at any time. The search option for selection of file by Date, User, and by test for both the data types IQ data and RAW Data as shown in the figure below:

Figure 3 Data Analysis Module

Once File is selected depending upon the data type, Analysis module will be displayed. Analysis module is capable of demodulating any PSK modulated data. It can also demodulate interleaved modulated data which was the special requirement for ISRO.

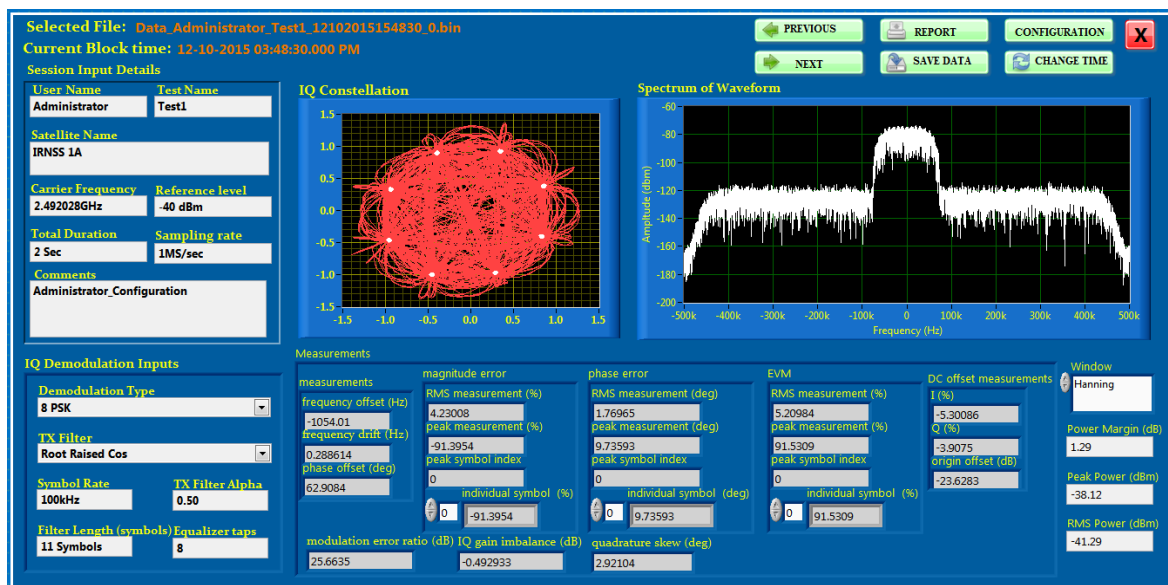


Figure 4 IQ Data Analysis Module

User can generate the report of demodulated data which contains constellation diagram along with all the required measurements. If it is RAW data, then channel power of the analyzed data will be displayed along with spectrum of acquired data. Also in this mode user can generate the report which contains all the information which is displayed on the analysis window.

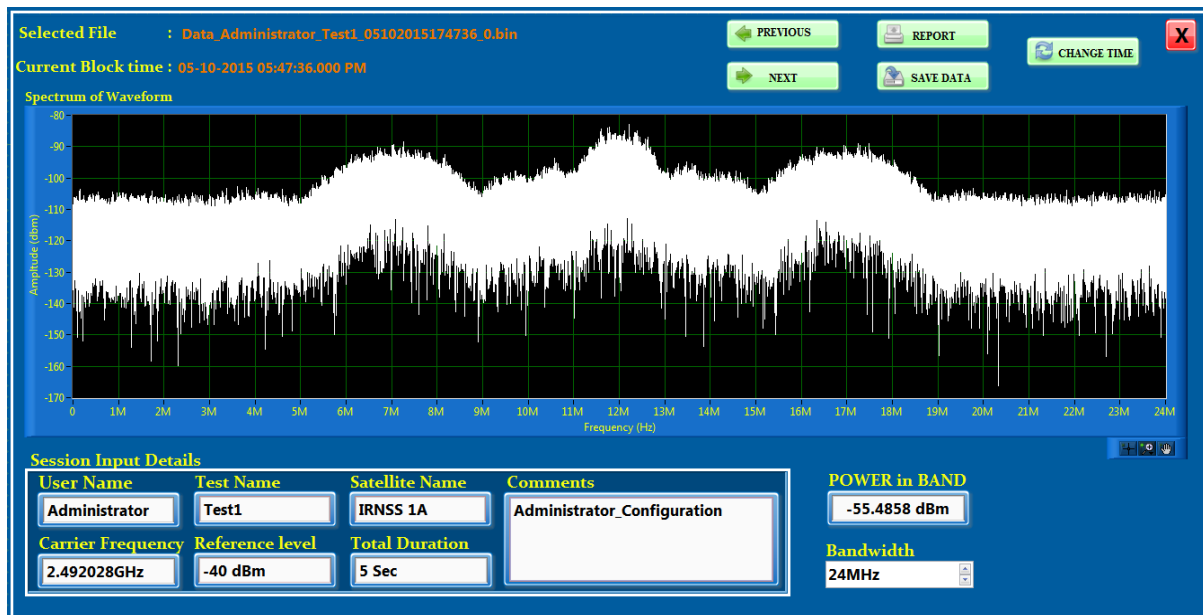


Figure 5 RAW Data Analysis Module

For both data type, user can save the acquired data as well as channel power data. As data is saved in binary format if user wants to analyze those data in some other software then we have the facility to convert those data to user's readable format as displayed below:

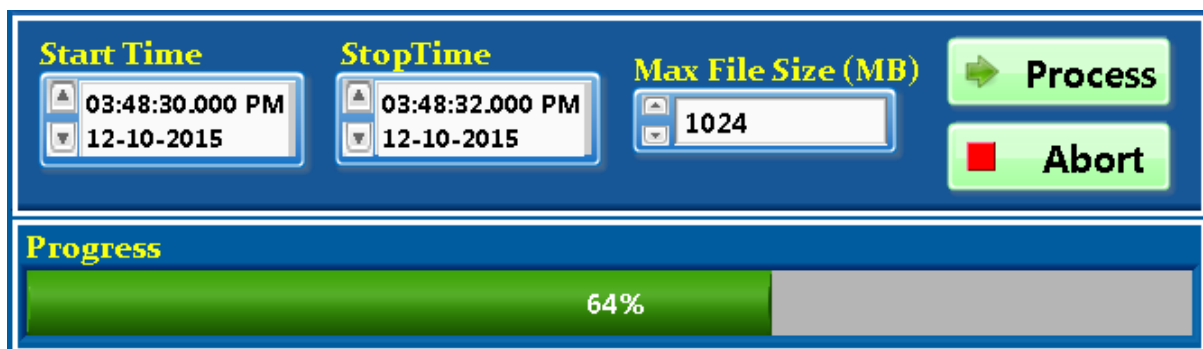


Figure 6 Saving Data in File with progress bar display

User can also analyze the channel power from the acquired data. To analyze channel power, user has the option to select the time interval at what user wants to check the channel power. Analyzed channel power will be plotted in graph and graph will be saved in Bitmap image.

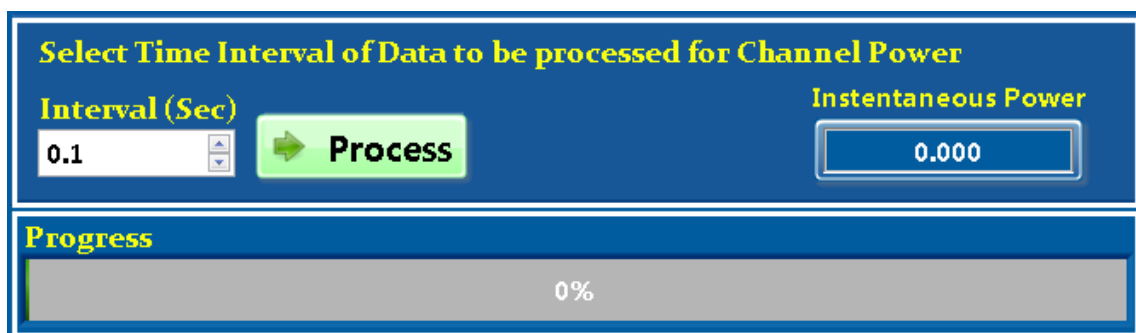


Figure 7 Analyze channel power from saved data

**Data Transfer:** As RAID Drive has the capacity of 24 TB, it is required to transfer saved data from RAID Drive to other storage facility. User can select the data by any of the following options like by User, Test name and by Date.

The screenshot shows a software interface for data transfer. It has a blue background and a white title bar. The interface is divided into several sections:

- User Name:** Administrator
- Work Group:** Administrator
- Select Data type:** IQ Data (selected), RAW Data
- Select Data By:** Date (selected), User Name, Test Name
- Destination Folder:** E:\Ishan\DATA\TRANSFER TEST
- Total List of recorded data:** A list of files including U1\_02\_Nov, U1\_04\_Nov\_20MS\_with\_AMP, U1\_04\_Nov\_20MS, U1\_04\_Nov\_40MS, U1\_04\_Nov\_75MS\_with\_AMP, U1\_04\_Nov\_75MS, U1\_05\_Oct, U1\_05\_oct, U1\_07\_Oct, U1\_8 PSK\_1MS\_12\_Oct, U1\_8PSK\_10MSym\_10MS, U1\_8PSK\_10MSym\_15MS, U1\_8PSK\_10MSym\_20MS, U1\_8PSK\_10MSym\_40MS, U1\_09\_Oct, U1\_09\_Oct\_LO, U1\_13\_Oct\_40MS, U1\_17\_Nov (selected), U1\_19\_Oct, U1\_21\_Oct\_40MS, U1\_21\_Oct\_75MS, and U1\_21\_Oct\_500KS.
- Records Added for transfer:** A list of files including U1 (selected), U1\_04\_Nov\_40MS\_with\_AMP, U1\_8PSK\_10MSym\_75MS, U1\_21\_Oct\_1MS, U1\_21\_Oct\_8 PSK\_40MS, and U1\_21\_Oct\_8 PSK\_75MS.
- Buttons:** ADD, REMOVE, Transfer Data (from RAID to Destination Folder), and Delete Data (from RAID on successful transfer).

Figure 8 Data Transfer Module

Once user select any of these options, all the details for selected options will be displayed. User can choose which data is required to transfer. Multiple files can be selected to transfer in a single click. Only Administrator has the option to delete the data from RAID Drive after successful transfer.