

QUICK LOOK BROWSING SYSTEM FOR INDIAN REMOTE SENSING SATELLITES (IRS) MISSIONS

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ABSTRACT

The Quick Look Browse (QLB) system caters to the pre-processing functions required for processing the data acquired through remote sensing satellites. It provides for displaying the sub-sampled imagery for the individual sensor as the satellite passes over the ground station, generation of ancillary information, data quality information, manual cloud cover estimation, browse chips generation, compression of browse chips for storage/transmission to a remote place. The QLB system works with a specially developed Front End Hardware (FEH) connected to the computer/work station through Small Computer System Interface (SCSI). The applications software has been realised on the SGI UNIX platform.

The system has been installed and operationalised at IRS ground stations, besides India, at Norman, USA, Neustrelitz, Germany and Bangkok, Thailand.

This paper describes the various design features, operations details, experience gained by ISRO in the whole process of design, development and operationalisation of QLB system for IRS future missions.

Keywords: Quick Look, Browse, Indian Remote sensing satellite (IRS), Payloads

1.0 INTRODUCTION

With the advent of fast processors, the functions of providing ancillary data for satellite data products generation, for evaluating the data quality and percentage of cloud cover etc., became feasible. Hence, a new approach was conceived for IRS missions.

The first Indian Remote Sensing satellite IRS-1A was launched in March 1988, this was followed by IRS-1B. These satellites have two multispectral sensors viz., the LISS-I and LISS-II. The second generation satellite, IRS-1C and IRS-1D are acclaimed to be the best civilian remote sensing satellites in the world, with three different types of sensors i.e., Panchromatic, Multispectral LISS-III and a Wide Field Imaging Sensors. Their On Board Tape Recorders are capable of recording data of any part of the globe. Data from these satellites are being received by International Ground Stations (in USA, Germany, Thailand and Taiwan) besides India.

The Quick Look Browse System (QLB), was developed to provide display of sub-sampled images of the individual sensor, as the satellite passes over the ground station, generation of ancillary information, data quality information, manual cloud cover estimation, browse chips generation, compression of browse chips for storage / transmission to a remote place. The QLB system is designed to meet the needs of many IRS missions at a single operations site. So, the system was designed to be functional for IRS-1B, IRS-P2, IRS-1C and IRS-1D missions. The system was realised on a UNIX platform and has been installed at many other locations.

2.0 FUNCTIONS OF QLB

The Quick Look Browse Facility is a pre-requisite for the generation of satellite data products. This system carries out the first level processing to generate digital browse data, ancillary information required to correct the data and also information

about the quality of the data. The context diagram of the QLB system is given in Figure-1.

Depending upon the time of operation, the functions performed by this system can be classified as:

Pre-pass Acquisition Planning:

The operations required to be performed before the advent of the pass is, Verification of state vector, Acquisition planning, Scene information prediction.

Realtime / Near Realtime Browse Processing:

The realtime functions performed during a satellite pass are; Real time browse data disk load for LISS-II, LISS-III and PAN. In case of, LISS-II browse scene generation is done as part of Realtime/Near Realtime process whereas for LISS-III and PAN video data is downloaded onto the disk for the whole path and browse scene generation is done during post pass processing. Display of browse image of selected sensor, Auxiliary data extraction, Barcode label generation are the additional functions. Provision is also made to carry out these operations after the pass as a contingency.

Post-pass Processing:

The ancillary data logged onto system during the pass is to be further processed to make it in a ready to use form for the data products generation on Image Correction system. These functions are:

- Auxiliary data validation
- Orbit and Attitude modelling
- Ancillary file generation
- Browse Image Generation and Manual assessment of cloud cover
- Enhancement and Compression of browse data
- Transfer of Browse data and related information to archival facility
- WiFS data processing

The display of Multi-spectral sensor data is in colour while the Panchromatic data display is in

black and white. The subsampling is selected to fit into a display with size 1K lines X 1K pixels.

3.0 HARDWARE SYSTEM CONFIGURATION

The QLB system works with a specially developed Front End Hardware (FEH). The FEH receives input either from a data recorder or from the bit synchronizer. It performs the front end processing on the serial bit stream. The frame synchronizer converts the serial data to parallel stream, tags the time code read from the Time Code Translator to each line and sends it to the computer / workstation through Small Computer System Interface (SCSI). Using the software, the data is subsequently derandomised, decommutated and the video and auxiliary data are formatted. The auxiliary data is written onto disk file as per a pre-defined format. The video data is subsampled and displayed in realtime. The computer system is a Silicon Graphics (SGI) workstation (CHAL-DM). The applications software has been realised on this platform, IRIX 5.3 Operating System. The Computer System and peripherals configuration is in Figure-2.

It can be seen from the diagram that there are three non-standard elements beside the Standard Computer hardware. They are Electronic Patch Panel (developed in-house), High Density Tape Recorder / Digital Cassette Recording System and Time Code Generator cum Translator (interfaced to the Computer through IEEE 488). These are essential and are integrated into the System.

4.0 SOFTWARE DESIGN FOR QLB

The QLB software is broadly classified into two categories:

Data ingest and Ancillary Data Processing subsystem:

This subsystem basically handles all the prepass, realtime and some postpass activities which are sequenced by a common scheduler. It includes the following software functional modules which work for LISS-III, PAN I/Q / I+Q of IRS-1C and 1D and LISS-II A/B of IRS-1B/P2.

- Scheduler
- Pass Planning - Prepass operation
- Quick Look and Browse processing for LISS-III
- Quick Look and Browse processing for PAN
- Quick Look and Browse processing for LISS-II
- Ancillary data processing - Postpass operation

Postpass Data Processing subsystem:

During this phase, all the postpass activities mentioned below are performed either immediately after the pass or at a later time. These operations can go on in a predefined sequence or can be user selectable through a window based user interface.

- Post pass Scheduler
- Ancillary data population
- Manual cloud cover estimation
- Browse compression
- Browse archival / local storage
- Browse transfer
- Accession catalogue generation
- WiFS data processing

4.1 Multimission Front End User Interface (MFUI)

The Quick look and browse generation process involves a sequence of operations which need to be performed for each mission separately. Four schedulers are designed (one for each mission). To reduce the command entry by the user/operator a graphical user interface for interfacing these three schedulers is designed. The key features of this multi mission front end user interface are:

- Status monitoring
- Error handling
- Intimation to Schedulers
- Message handling from mission specific schedulers
- Off line utilities like display, data validation, dump, etc.
- Help facility.

4.2 Scheduler

This activity involves running of a number of processes in a pre-defined sequence normally. A Scheduler software is designed to take care of this. However a provision is made to initiate manually some of the processes, if required.

The main functions of mission specific scheduler are :

- Creation of shared memory
- Sequencing of processes
- Error handling
- Restarting the sequence from a set of predefined restartable points
- Updation of operational database

Inputs required by any process is passed through a shared memory by Scheduler. Some of these inputs are accepted by Scheduler from the user and some are generated by the processes that are scheduled earlier. A set of routines is provided to QLB software elements for input, output, error and message. Each QLB software element calls these routines to get inputs from Scheduler, to transfer output to Scheduler and to transfer the error code to Scheduler.

4.3 Ephemeris Generation

Satellite ephemeris generation process provides satellite position and velocity which are required for carrying out various activities starting from satellite tracking to ADIF generation. The mathematical model to compute ephemeris includes a number of forces acting on the spacecraft.

4.4 Scene Framing and Orbital Reference Process

Provides scene framing and orbital information for data products generation.

4.5 Browse Processing

The functions of this module are to provide moving window color display during the pass, to generate pathwise browse file and Auxiliary data file used for ADIF file generation software. It reads the LISS-III video data from the FEH in browse mode i.e. line wise subsampled mode (sampling 1:6). The data read is processed in real time and sent to display. Processing involves derandomising, decommutation of video data and Auxiliary data.

Browse data file is generated on the disk after subsampling the above processed video data pixel wise.

4.6 Auxiliary data validation

This software validates the AUX data and generates the validated TM master frame file and GYRO rate information files which are required for other QLB software elements. This software is scheduled immediately after the creation of Auxiliary data file.

4.7 Attitude determination using Gyro and Earth Sensor

This software package determines the yaw, roll and pitch attitude of payload cameras as a function of time. It obtains the earth sensor / gyro data through telemetry and orbit information from satellite ephemeris file.

4.8 Ancillary Data Information File (ADIF) generation

This software generates Ancillary data information file for selected / all PAYLOAD passes of the day. The file contains the ancillary information like orbit and attitude, payload health and data quality related information required for further processing payload data.

4.9 Ancillary data population

The ancillary data population procedure reads the ADIF (Ancillary Data Information File), generated. The ADIF file is a formatted sequential file on disk.

4.10 Manual cloud cover estimation

This process displays the browse images on display monitor, accepts manually estimated cloud coverage percentage and updates the meta data file and ancillary data populated files.

4.11 Browse Compression

This consists of three modules for reading and validating the inputs, compressing the images using standard JPEG / JFIF technique and error handling.

4.12 Browse archival / retrieval

This consists of three modules for archiving the compressed browse data, retrieving and displaying the browse images whenever required and error handling.

4.13 Browse transfer

This consists of three modules for reading and validating the inputs, transfer the browse data to remote station and error handling.

4.14 Accession Catalogue generation

Accession catalogue generation procedure generates a catalogue, containing the accession information about the scenes acquired on a particular day.

4.15 WiFS Data Processing

Reads the LISS-III data from Frame sync in playback mode, extracts WiFS data, corrects it radiometrically and generates corrected data file. A Moving display is also provided during ingest.

5.0 CONCLUSION

The system underwent rigorous test and evaluation and has since been installed and operationalised at IRS ground stations like Norman, USA, Neustrelitz, Germany and Bangkok, Thailand.

With the advent of more powerful systems currently, plans are made to port Quicklook Browse software onto Silicon Graphics Octane systems.

Another area of concern in the recent past has been the recording and archiving on media like High Density tapes. The life of the data on these HDTs is varying from 5 to 10 years. This is not acceptable as the need for old archived data exists for various applications. Hence, currently work is in progress to avoid use of HDTs and instead go for direct archival on media like Digital Linear Tapes (DLT).

The QLB system is upgradable for taking care of future satellites also. This QLB software system has been imported on to DEC Alpha machines also.

6.0 REFERENCES

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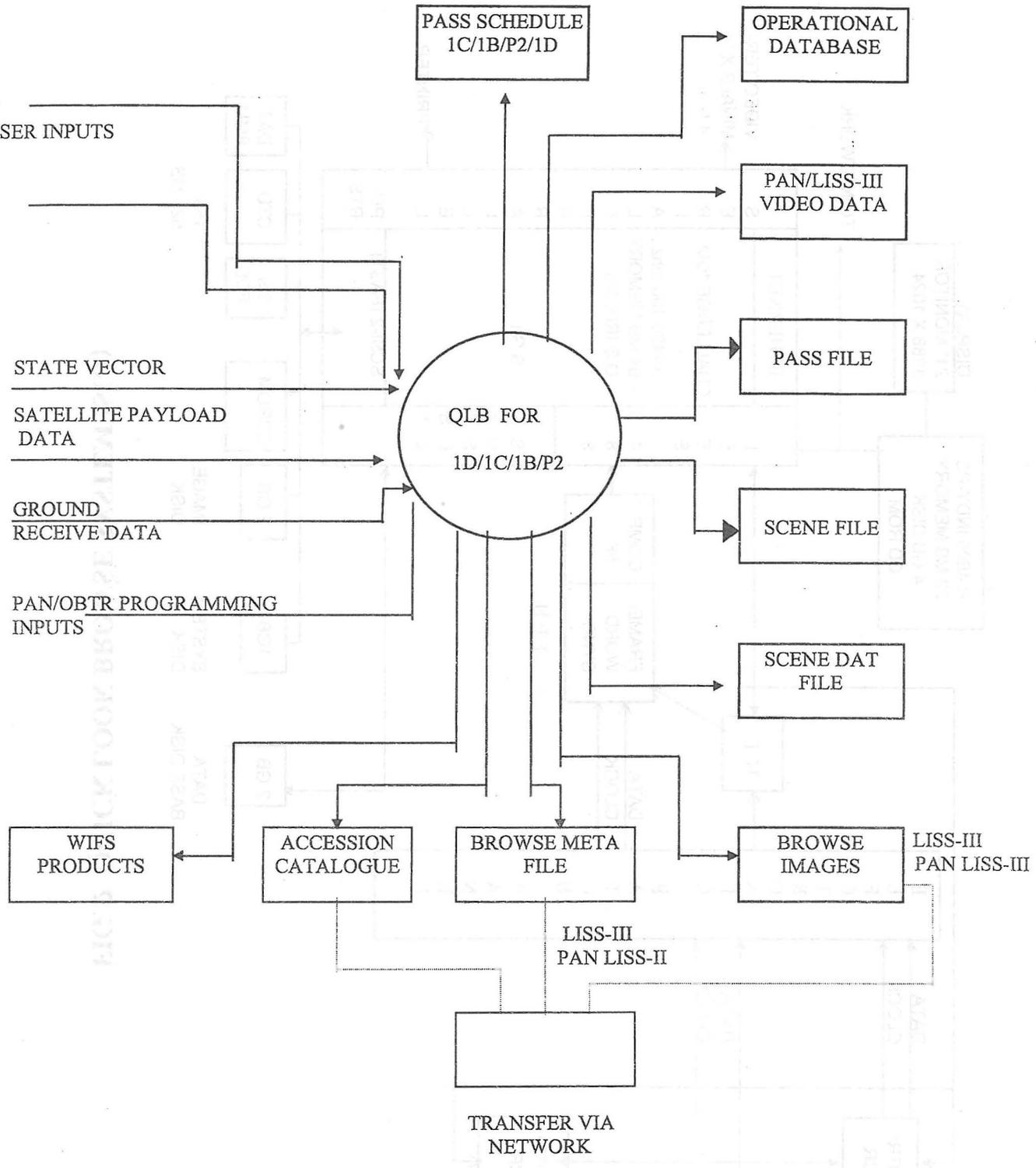


FIGURE-1. CONTEXT DIAGRAM

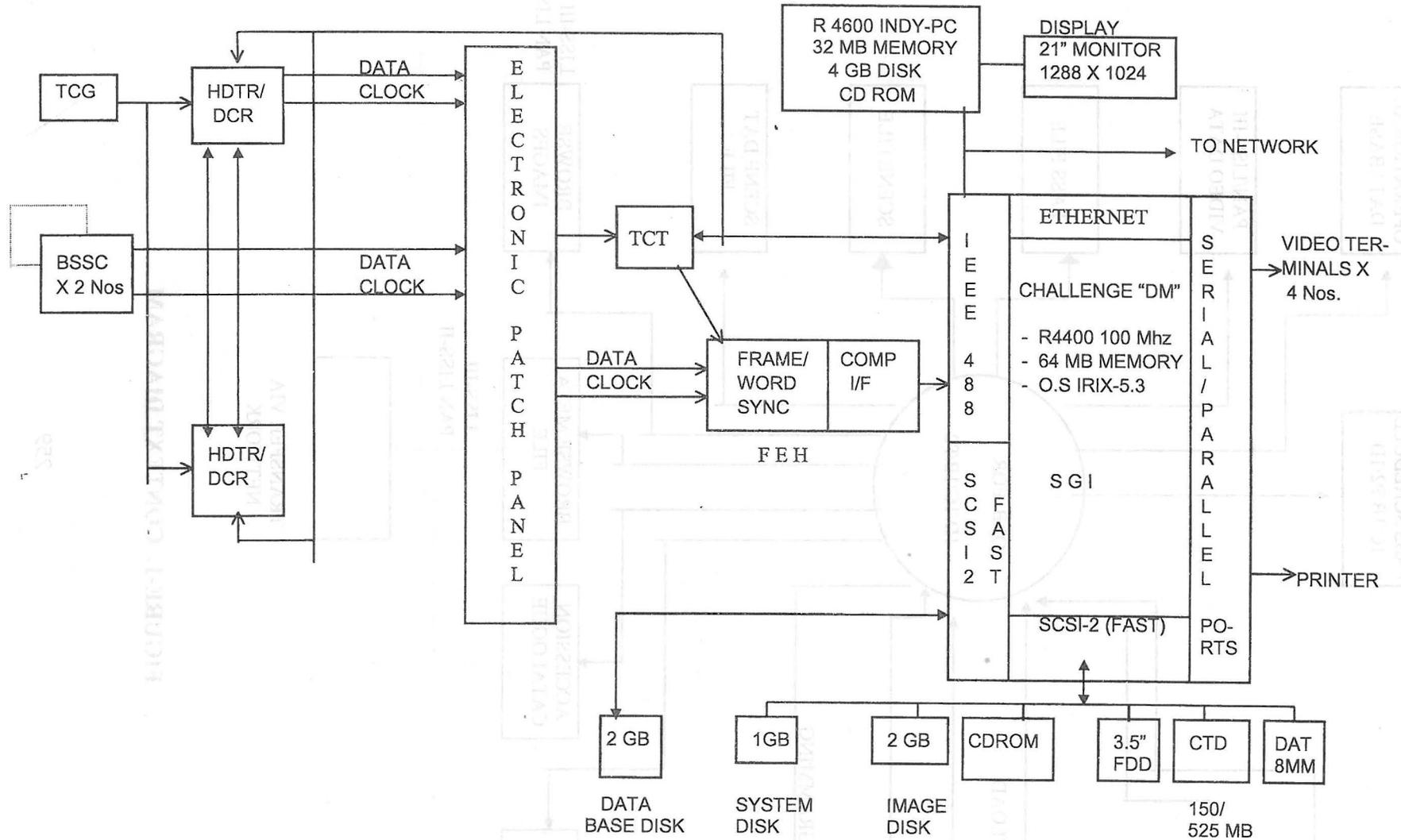


FIG. 2 QUICK LOOK BROWSE SYSTEM (SGI)