NATIONAL PROGRAM FOR HANDLING LARGE VOLUMES OF SATELLITE DATA

B.L.DEEKSHATULU
DIRECTOR
NATIONAL REMOTE SENSING AGENCY
HYDERABAD-500 037.
INDIA

1. SATELLITE PROGRAMS:

In India, the National Remote Sensing Agency (NRSA) of the Department of Space, Government of India had been given the responsibility to receive, process and dissemiante the satellite data products to various users in the country. Accordingly, NRSA set up the satellite data reception and processing facilities initially for the MSS data from Landsat-2 and 3 in 1979. Subsequently, the station was upgraded to handle data from Landsat-4 and 5. When the more powerful sensor, viz., Thematic Mapper (TM) was introduced and the TM data was available to foreign ground stations (on Landsat-5), NRSA set up the facility to receive and process this data. The system integration, hardware and software development for TM data processing were done inhouse. The supply of TM data products to the user community commenced during end 1985.

During 1979-85 the growth in the use of remote sensing techniques had been substantial and this led to increased expectations regarding the potential uses of remote sensing. The SPOT data reception and processing facilities were established and declared operational from May 1987.

Since March 1988 the Earth Station is receiving the LISS-I & LISS-II A&B data from the Indian Remote Sensing Satelite.

Since 1979, NRSA has also been receiving the data from meteorological satellite series (NOAA 6 to 11). The comparison of satellite/sensors volume of data handled is given in Table 1.

Being an active sensor which can 'see through' clouds, Synthetic Aperture Radar (SAR) has been an all weather sensor with invaluable applications in tropical countries such as India where perennial cloud cover in many parts of the country precludes the utility of optical/IR sensors. Owing to these advantages India also is planning at present for its own space borne microwave remote sensing mission (with the Synthetic Aperture Radar (SAR) forming an important component by 1993-94)

2. DATA PRODUCTS GENERATION AND DEMAND:

When the distribution of data products began in early 1980, the remote sensing technology in India was in its initial promotional phase. Satellite data products generation and supply were a few hundreds in 1980.

In the last few years, the number of users requiring the data products increased at a fast pace. Initially, the major users were from within the Department of Space, which is the nodal agency in India for developing and promoting

TABLE 1 COMPARISON OF SATELLITE/SENSORS VOLUMES

Satellite/ Sensor	Type	No.of Pixels X No.of scan-lines(Apprx.)	Pixel size (in mts)	Area cover-age (Apprx. in Kms)	No.of Bands	No.of scenes acquired/day (Average) (Land Area)	No.of MB/Scene /Band (Approx)
Landsat/ MSS	Electro-Mechani-cal Scanner	3240 X 2400	56X79	185 X 185	4	25 - 30	7.5
Landsat/	Electro-Mechani-cal Scanner	6320 x 6000	30x30	185 x 170	7	25 - 30	36
SPOT (Panchro-matic)	CCD	6000 x 6000 to 8500	10x10	60 x 60 to 85	1	15	36
SPOT (Multi-spectral)	CCD	3000 x 3000 to 4250	20x20	60 x 60 to 85	3	15	9
IRS LISS-I	CCD	2048 x 2400	72.5x72.5	148.5 x174	4	35	4
IRS LISS-II	CCD	2048 x 2400	36.25 x 36.25	74.25 x 87	4	140	4
NOAA series Met. Satellite		2048 x 4000	1 Kmx 1 Km	-	5	4	8

remote sensing technology. Gradually, the other Central Government agencies also started using data products. During this period, to bring out the user awareness, seminars were organised, presentation made, workshops held, courses conducted, pilot projects completed, results presented to decision makers, etc. These promotional efforts has had a telling effect on the growth of demand. Now Central and State Government agencies are the major users. Many of the universities have started teaching remote sensing and have post-graduate diploma courses on the subject. The growth in the number of users also has been substantial.

With this large growth in users, the demand for data products also increased substantially. While in 1980, about 30-40 product requests per month were processed, the number increased to more than 900 products per month in 1987. The demand in the last few years and the corresponding supply is shown in Fig.1

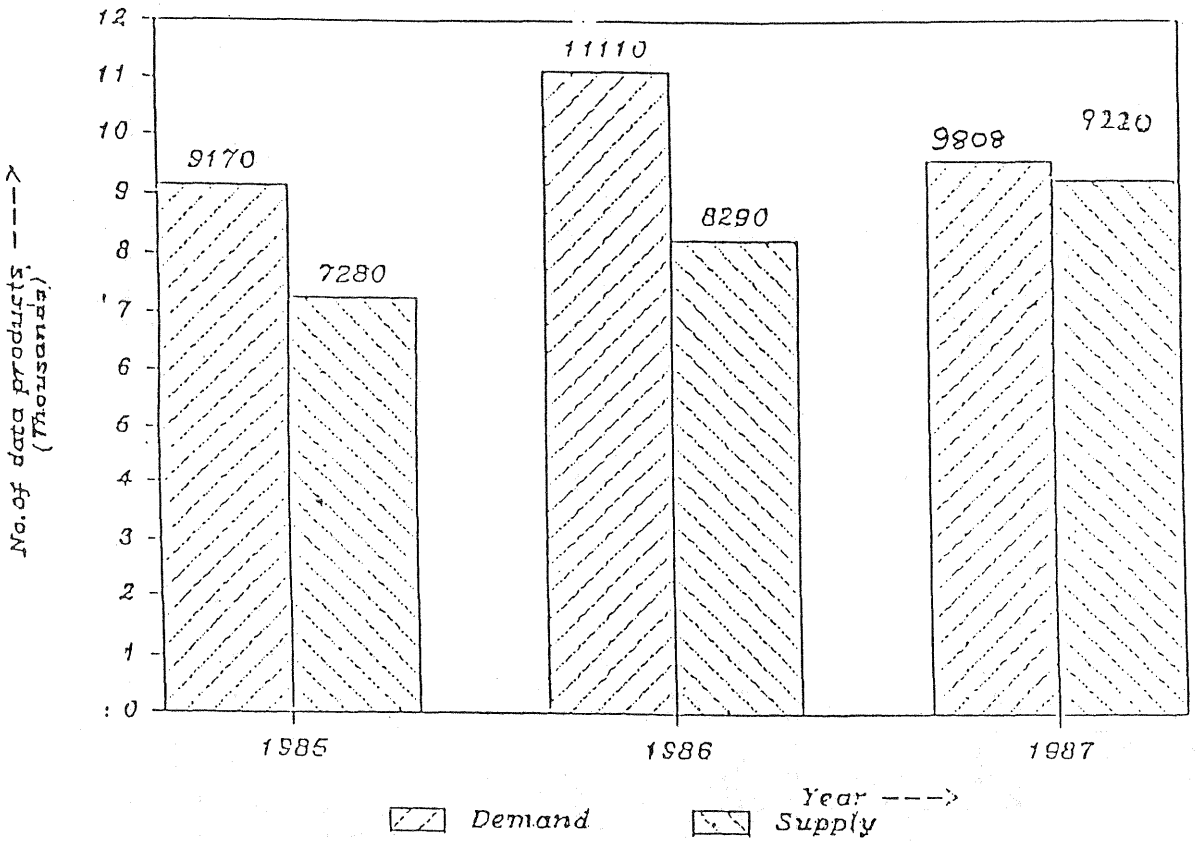


Fig.1 demand and supply of data products

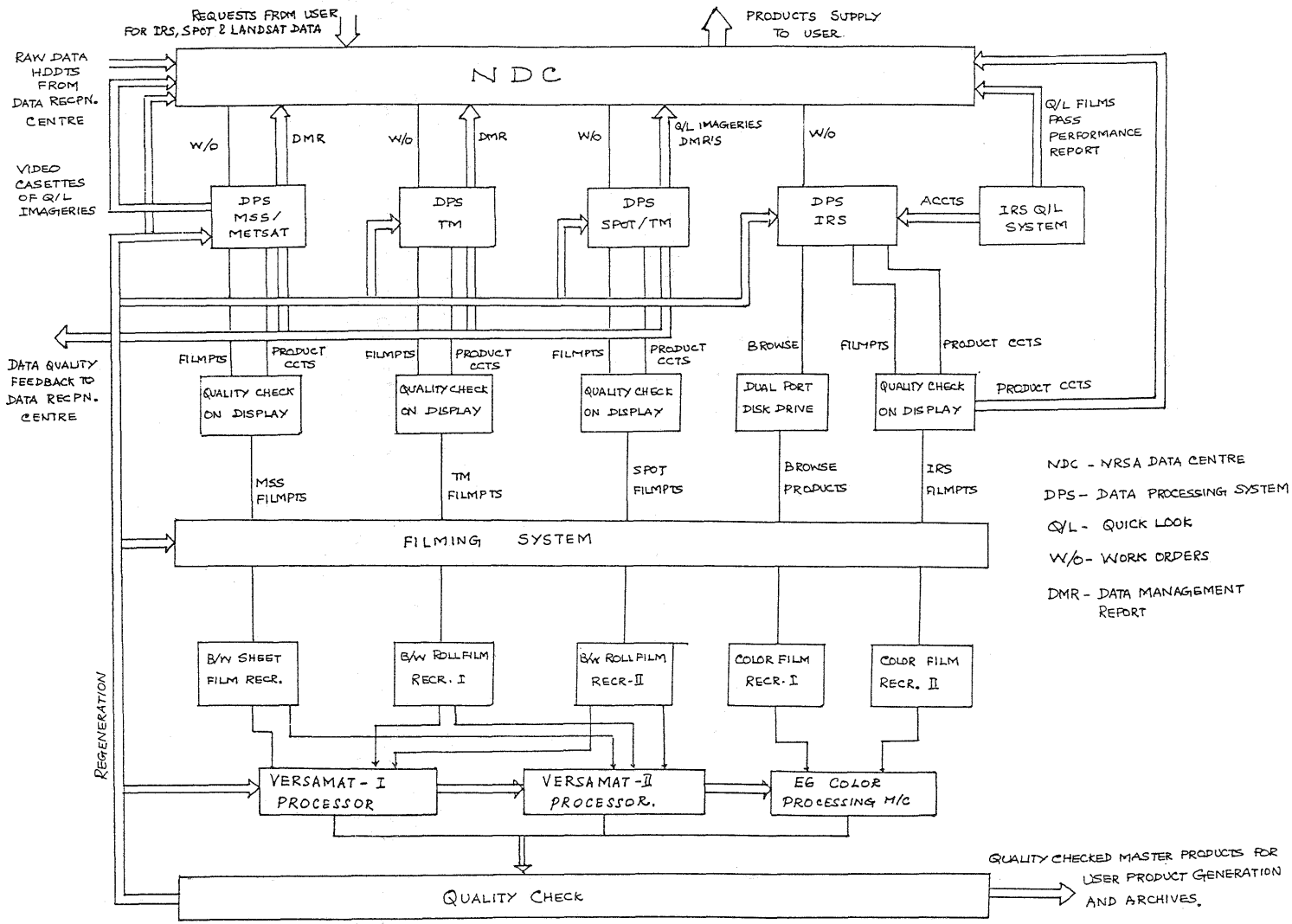
3. SATELLITE DATA PROCESSING:

With such a multiple satellite data processing program, hundreds of gigabytes of data are to be handled everday. The processing steps involved in handling satellite data are reception, archival, storage of 'information on data', and its retrieval, processing of the data to convert it to a usable form using computers, photo processing equipments; distribution, application/ analysis of such data, maintenance of such facilities etc. Allied steps are training of personnel, conception and execution of national level projects to use the data. (Fig. 2 and 3)

To handle the large increase in products supply, a multi billion dollar program is under execution at NRSA, which envisages going in for newer, technologically advanced, faster systems. Firstly, large volume data calls for a well thought out archival policy where only useful data are archived.

Next, an integrated information management system in the form of an electronic data base is planned to be implemented which serves as an external user interface while at the same time controlling the internal data flow and production. This system is designed such that it serves as the master assigning jobs to all the slave work centres.

Fig.2 MASTER DATA PRODUCTS GENERATION: DATA PROCESSING, FILMING & PHOTOPROCESSING.



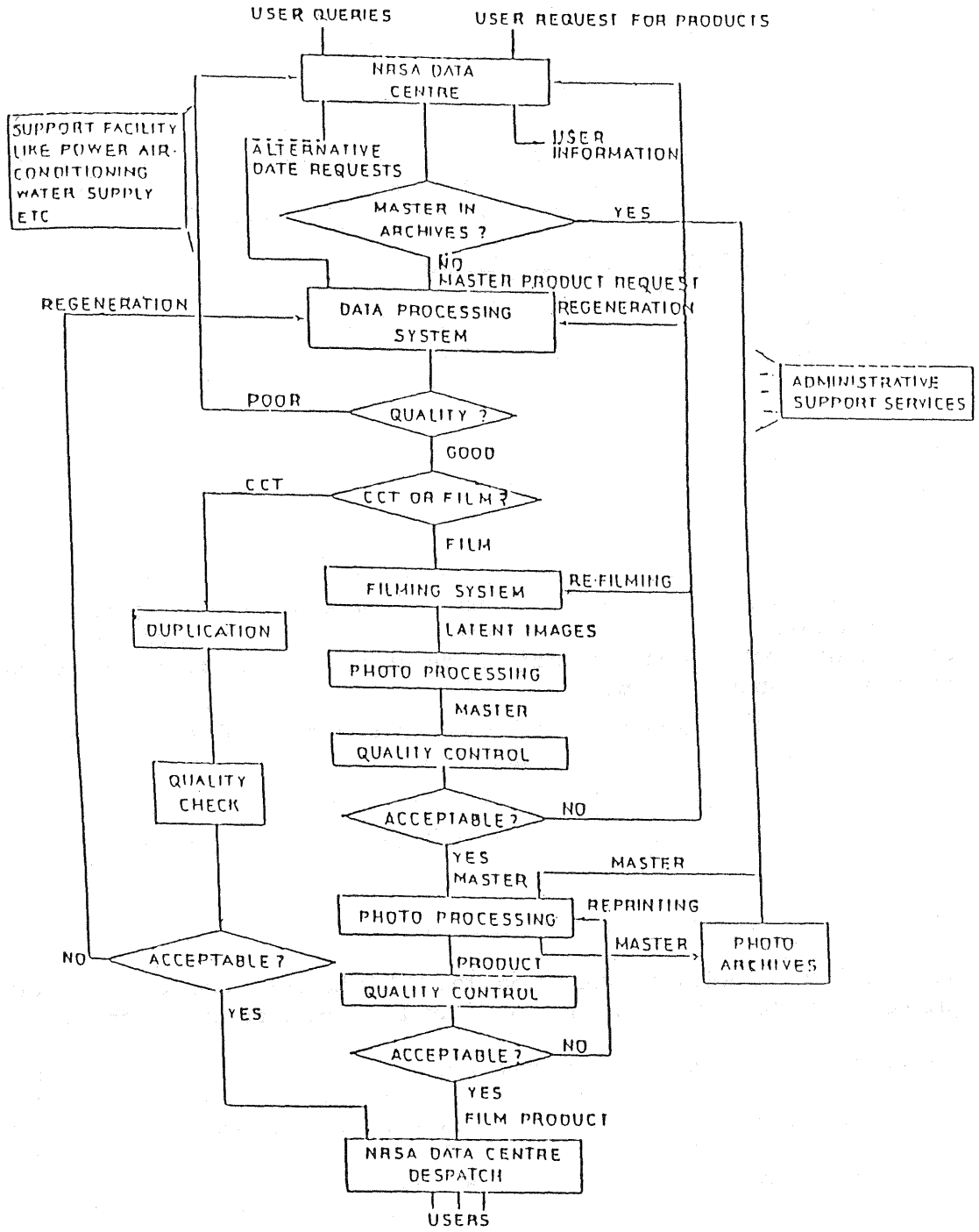


Fig.3 DATA PRODUCTS' GENERATION FLOW

The data processing systems so far have been using the 'Conventional' approach where in the data is first transferred from high density tapes to disk and then the data is corrected in Array Processors. This poses limitations in thruput and utilizes system resources less efficiently. To overcome this, using an I/O computer connected to the conventional processor, the input/output speed is enhanced and more efficient utilization of resources achieved. In yet another innovation, a Master Flexible System (MFS) is being designed and implemented, which shall have the capability to process all types of sensor data. This is

essential in our environment, where the demand for different types of products from different sensors may vary over time and such a MFS can act as a 'load' balancer.

Large percentage of the data products required are photo products; hence the program envisages going for large volume production using roll film recorders, automatic photo-processing machines and the building of a modern, controlled; dust free photo processing laboratory.

3.1 POLICY FOR THE ARCHIVAL OF DATA:

The archival of satellite data has been in the form of raw data on High Density Tapes, quick look Video Cassettes, Quick Look Films, User Computer Compatible Tapes (CCTs), 240mm Negative/Positive B/W or Color master films.

The High Density Tapes (HDTs) contain data from Landsat MSS, RBV, TM, SPOT, Metsat as well as IRS data.

Enormous amount of data had been archived in the last 5 years.(Table 2 and 3) The policy so far, had been to acquire and archive as much data as possible. With the increasing volume of data, it became apparent that a suitable archival policy had to be worked out and implemented. Accordingly, after wide consultations, a draft archival policy has been worked out, which when implemented will

- ensure that an archive of representative and useful satellite imagery of India exists, is maintained and is accessible.
- ensure that selected scenes from the existing data set are not lost;
- reduce the tape storage and tape consumption to manageable proportions

The three tier criteria for archival is as follows:

Tier 1 : Within a week of acquisition, the HDTs having technical reproduction problems will be identified. These will not be considered at all for archival.

Tier 2 : After a year of acquisition, data to be retained will be subject to the criteria that only when 5 or more scenes in a pass have less than 40% cloud cover, the data of that pass shall be retained in the archives. Before destroying the weeded out HDTs adequate notice will be given to the user community to indicate whether they have any need for the data identified to be removed. During such weeding process it will also be ensured that sufficient data for Target Sites are available.

Tier 3 : After 5 years of acquisition the following data only will be retained:

i. One pre-monsoon coverage of India
ii. One post-monsoon coverage of India
iii. Disaster affected areas
iv. Data at the required frequency for Target Sites

TABLE 2

ARCHIVED LANDSAT QL AND CCT DATA

Satellite & Sensor	Archive Medium & Data Format	Date Range of Archive Data	Approx.No. of Frames
Lansat 4&5 MSS	70 mm Film rolls	Sept.1982 to Mar.1985	33,500 frames
Landsat 4&5 MSS	Quick Look Video cassettes	April 1985 to August 1985	5,900 scenes
Landsat 4&5 MSS	Quick Look Video cassettes	Feb.1986 to Oct.1986	20,800 scenes
Landsat 2,3 MSS	1600 bpi Digital Tape	Nov.1979 to Dec.1982	650 scenes

TABLE 3

ARCHIVED LANDSAT HDDTs

Satellite & Sensor	Archived Medium & Data Format	Date Range of Archive Data	Approx.No. of Frames
Landsat 4&5 MSS	HDDT	Aug.'82-Oct.'86	1,50,400 scenes
Landsat 5 TM	HDDT	June'84-Nov.'84	6,250 scenes
Landsat 5 TM	HDDT	Mar.'85-Nov.85	15,600 scenes
Landsat 5 TM	HDDT	Jan.'86-Oct.'86	17,000 scenes

3.2 INTEGRATED INFORMATION MANAGEMENT SYSTEM:

NRSA Data Centre is the focal point of data products generation activity. It is the interface between the user agencies and NRSA. It handles the data products requirements of all the users both internal and external. The primary function of NDC are User assistance, data archival, User order processing and data dissemination in response to user requests. The user interface with NDC typically includes both general enquiries about the data availability and ordering procedures as well as requests for data covering specific areas. NDC also provides to any user, on request, the information on the status of his order or account. It enables the visitors to view Quick Look data and make use of reference facilities such as catalogues, orbital calendars etc.

The volume of information being handled is enormous. Currently, NDC is operating in a semi-automatic, semi-manual mode. Because of large growth in demand, it is planned that the entire activities of NDC is computerised and handled through the data base. This can be achieved through a multi satellite, Integrated Information Management System (IIMS).

IIMS is a system to store, manage and retrieve information of several Users of the system as a resource for their mutual benefit and for several purposes. IIMS will also be used as a production controlling, monitoring system work centre wise and also create job orders for various work centres. The system will be based around two VAX processors. NDC data base operations are very critical. The information to be dealt with is voluminous and prompt information retrieval is desirable to answer the Users queries within reasonable time. To meet this criticality, it is necessary that system should have no down time virtually. To ensure this, the system has a redundant processor, redundant intelligent I/O server and sufficient number of disk drives. Data processing computer system will be connected to this system through Eathernet Local Area Network. The Gateway will connect Decnet nodes on the Eathernet network to Remote Users for information retrieval. This system will store and retrieve data kept in by several Users such as DATA RECEPTION, DATA PROCESSING UNITS, PHOTOLAB and DATA CENTRE. Using the Eathernet link; information such as type and details of the products to be generated, HDT No., priority of products, products generated, quality of products, acquisition and data processing information, system status etc., can be exchanged between this system and the various Data Processing Computers, Photoprocessig, Filming System, Quality Control, Data Acquisition, Data Archival etc.

4. CONCLUSION:

With the completion of the activities relating to the augmentation programme the Data Products supply is expected to be streamlined and will have a Turn Around Time (TAT) of within 7 days for 50% of the products and within 21 days for the balance. It will also be possible to cater to increase in user demand for any one type of sensor products with the corresponding decrease in any other sensor products. It will also ensure guaranteed supply of products in case of emergency and the data products quality is also to be better. While, going through this programme it will also be ensured that future expansion can be easily done.

Till about a couple of years back, the facility available for digital analysis of the Remote Sensing data was practically not existent in the country. To overcome this situation, 5 Regional Remote Sensing Service Centres along with two Associate Centres which can perform high thruput digital analysis has been established. It is likely that in the next few years the digital analysis of satellite data will increase manifold and Remote Sensing will be used in an operational mode regularly.