Some Progresses of National Spatial Information Infrastructure in China[1]

Shouyong Yan

Institute of remote Sensing Applications
Chinese Academy of Sciences
Beijing 100101, China
Syyan@public.east.cn.net

ABSTRACT The key links, such as data acquisition, data processing, data applications and data sharing, in information flow of National Spatial Information Infrastructure (NSII) in China are dealt with by several key projects separately. They are “RS-based Quick Reporting System on Agricultural Condition in China”, “RS-based Dynamic Inventory of Land Use/ Land Cover in China”, “Spatial Decision Support System for Regional Sustainable Development”, “Technical Support System for Remote Sensing Applications” and “Network-based Integrated Technical Support System for Spatial Information Applications”, etc. The technical frameworks of the national key projects are introduced briefly in this paper. A general picture on the progresses of NSII in China may be sketched via the brief introduction.

So-called "National Spatial Information Infrastructure" ("NSII") here means the technology, policies, standards and human resources necessary to acquire, process, store, distribute and improve utilization of geospatial data and information, and resources of geospatial data and information themselves. The definition of NSII in China is a lit bit different from the one of NSDI in U. S[1]. The first difference is that NSII includes the resources of data and information themselves, NSDI does not; the second one is that NSII pays more attention to geospatial information extracted from geospatial data, not just data themselves. As a basic part of National Information Infrastructure (NII), NSII plays more and more important roles in sustainable development of China.

The key links of the information flow in NSII are geospatial data acquisition, data processing, data applications and data sharing. There are several national key projects to deal with the ones in China recently. They are RS-based Quick Reporting System on Agricultural Condition (RQRS/AC), RS-based Dynamic Inventory System for Land Use/Land Cover (RDIS/LULC), Spatial Decision Support System for Regional Sustainable Development (SDSS/RSD), Technical Support System for Remote Sensing Development and Applications (TSS/RSDA) and Network-based Integrated System for Geospatial Information Applications (NIS/GIA), etc. All of the projects are related to or charged by the Institute of Remote Sensing Applications, Chinese Academy of Sciences (IRSA/CAS). As a member of IRSA/CAS, author would be very happy if the paper can sketch a general picture of NSII in China.

I. RS-Based Quick Reporting System on Agricultural Condition

An operational and integrated RQRS/AC for whole country has been developed since 1996. It consists of three key subsystems: Multi-technical Integrated System for Monitoring of Floods (MIS/MF), AVHRR-based Monitoring and Early Warning System of Agricultural Condition (AMEWS/AC) and RS-based Multi-stage Sampling System for Crop Yield Estimation (RMSS/CYE). The brief introduction of the systems is as follow:

1) Multi-technical Integrated Flood Monitoring System

MIS/MF in China has been developed and operated since 1996. The system consists of three segments and eight subsystems (Fig. 1). The segment of flood information generation includes 5 subsystems: image data preprocessing, image interactive interpretation, assessment of flood losses, information distribution and background databases; the segment of flood information services includes 3 subsystems: on-line flood information services, flood clearinghouse and WAN and LAN network environment; the segment of users. Input data of the system are AVHRR / NOAA, SAR / RADARSAT, ERS, airborne SAR and TM / LANDSAT. The outputs are flood information reports with corresponding flood image, land use map in flood-submerged area and statistic table. In past four years, such reports of **112** issues are provided to the state council, ministries and provincial governments. The system plays very important role in flood control and disaster mitigation, especially in serious floods occurred in the meddle reaches of

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Yangtze River, Songhua River and Nen River in 1998[2].

2) AVHRR-based Monitoring and Early Warning System of Agricultural Condition

In order to monitor and give early warning of the agricultural condition, such as ecological status, crop health and natural disasters (flood, drought, forest fires, etc.) in the whole country, an operational AMEWS/AC (Fig. 2) is been developing by IRSA/CAS. Based on time series analysis of historic AVHRR, natural disasters, climate, phonological and social economic data, in general, normal criteria and warning criteria of agricultural condition for each pixel or county have been set up at the first. After that, daily new coming AVHRR data compare with those criteria in the databases, and output the comparison results, e.g. the map of monitoring and early warning of agricultural condition timely and automatically.

3) RS-based Multi-stage Sampling System for Crop Yield Estimation

An operational RMSS/CYE is been developing by IRSA/CAS and his partners. Supported by RS-based multi-stage sampling techniques, the system output the results of crop yield estimation timely. The target crops of RMSS/CYE are wheat, rice, corn and others for the whole country.

II. RS-Based Dynamic Inventory System for Land Use/Land Cover

Status of land use/land cover in a region is an important indicator of interaction between human and earth in the long term. Since early 90', social-economic development is very fast in China, especially in eastern part of China. Dynamic inventories of land use/land cover status and their changes in the whole country are urgent and significant issues not only for decision making and adjustment of policies, but also for monitoring of global environment changes. During past decade, using RS GIS and GPS, etc., the inventories at statewide have been carried out two times by IRSA and his partners mainly. A series of significant results, from both of management and scientific research point of view, are gained from the inventories. In the meantime, the inventories have already made a solid fundamental for further inventories and comparison studies.

1) Based on manual interpretation of Landsat TM, the land use/land cover inventory with the scale of 1: 250,000 in the eastern part of China and 1: 500,000 in the western part of China was completed by IRSA and his 19 partners during 1992-1995. The inventory spent three more years. After the inventory and digitizing of its maps, a series of natural resources and environment databases with a variety of map scales. The scales include 1: 400 M, 1: 100 M, 1; 0.5 M and 1: 0.25 M. The results have led to a very important conception: "land use changes are not only in land quantity aspect, but also in land quality". They have already played a very important role in decision making and policy modification for sustainable development of the country at the state level.[3]

2) Supported by techniques of image interactive interpretation and multi-stage remote sensing sampling, the inventory of land use/land cover with the scale of 1: 100,000 in China was completed by IRSA and his partners during June, 1997-August,1998. The inventory spent just one more years and much quicker than before because the whole procedures of the inventory are carrying out in digital world (Fig. 3). 300 scenes of TM during 1995-1996 for eastern China and active places in western China, 200 scenes of TM in early 90's for most places of western China, and 7,000 air-photos for sampling were utilized in the inventory. The first data set of land use/land cover at county level for the whole country was generated through the inventory using remote sensing images in such short period of time. They are invaluable for macro-decision making and policy modification of the development at the state level.[4]

III. Spatial Decision Support System for Regional Sustainable Development[5, 6]

Spatial Decision Support System (SDSS) is a new field developed on the basis of Geographic Information System (GIS) and Decision Support System (DSS). Since the late 1980's, more and more attention has been paid to the techniques of SDSS in China as well as abroad. SDSS is an information system, which is capable of providing spatial decision making schemes to the decision-makers. Based on this understanding, some pilot studies, such as development of SDSS software tool and its applications for agricultural development and city system planning in China, are been carrying out by IRSA and his partners.

1) Development of SDSS software tool

According to the requirements and characteristics of regional planning, management and decision making, it is important to emphasize the combination of quantitative analysis and qualitative analysis and the visualization of the processing results. The architecture of such a SDSS is demonstrated in Fig. 4 It contains the following key components: spatial data, general model, user interface three sub-systems and GIS, expert system, multimedia displaying three independent software tools. A prototype of SDSS software tool and a

model base have been developed through its

Table 1 Application fields of TSS/RSDA

Fields	Objects
Resources and environment	Land, water, range, forest, agriculture, ocean, ecological environment, geological and mineral resources
Natural disasters	Floods, drought, fires, earthquakes, etc.
Urban and regional planning	City, city system, county, province, state, regions, global
Research and test	Space missions, new field exploration, fundamental research

applications since 2 more years ago.

2) SDSS applications to agricultural development

China is a developing and agricultural country with huge population and big differences in time and space. Agricultural, especially food problems are not only the ones with the first priority in the country, but also the ones most countries in the world have paid great attention to. So, the sustainable agriculture development in China is selected as a pilot study area for SDSS applications. From management point of view,

The problems have been studied. They are agricultural zoning, potentials of agricultural production agricultural technical policies, investment planning and food dispatching, etc. Some useful results have been output gradually since last year.

3) SDSS applications to cities system planning in China

Cities system in China is a basic frame or backbone of the country. It plays a decisive role in economic and social development of China. As everybody knows, more than 80% of GNP is generated by cities in the country. So, cities system planning in China is selected as another pilot study area for SDSS applications. Some interesting research topics are been carrying out in IRSA/CAS right now. The topics include evolution of city groups in time and space, layout of cities and city groups, adjustment of industrial structure in the groups, layout of infrastructure between cities, population migration and management, etc.

IV. Technical Support System for Remote Sensing Development and Applications[7]

Through technical development and equipment importation, CAS and his partners have developed a Technical Support System for Remote Sensing Development and Applications (TSS/RSDA) for more than 15 years. TSS/RSDA is an integrated system with modular structure. It is easy to reorganize modules of TSS/RSDA and formulate some new corresponding applied systems for different application tasks and purposes. Through wide applications, TSS/RSDA has been got better and stronger gradually.

1) System structure

The structure of TSS/RSDA is shown in Fig. 5. According to the functions and characteristics of all modules in Fig. 5, the system can be divided into 5 parts. They are data acquisition system, data processing system, data application system, ground truth support system and data communication system. Institutes in CAS develop the most of sensors and software systems in the figure as mentioned before. For example, Institute of Electronics has developed SAR and its data processing systems; Institute of Technical Physics has developed Imaging Spectrometers and its processing system; IRSA has developed the software systems for data processing of general image, IS and SAR etc., and for GIS, SDSS and their applications. Different government agencies have operated and maintained the most of ground truth support systems. Of course, data communication system of TSS/RSDA has to include computer-based network systems, such as INTERNET, CEINet, etc.

2) System applications

As mentioned before, the modules of TSS/RSDA can be easily reorganized and formulated to some new corresponding applied systems according to different application tasks and purposes. The system has been widely utilized to a variety of the application fields, such as resources and environment, natural disasters, urban and regional planning and research and test of RS techniques themselves, etc. More details are shown in Table 1.

V. Network-Based Integrated System For Geopatial Information Applications[8]

Recently, digital data communication networks have been developed very quickly in China. The main backbone networks have already covered the most cities in the country. A new project for establishing of statewide high-speed optical fiber network has

already lunched by CAS, Ministry of Railway, Ministry of Broadcast and TV and Shanghai together. All of these have made strong support to development of NSII in China. A technical framework of NSII prototype, Network-based Integrated System for Geospatial Information Applications (NIS/GIA), in China has been developed by IRSA/CAS, State Information Center (SIC), Institute of Macro-Economics (IME), information centers of related ministries and Hainan province since 1997.

1) Key points in development of NIS/GIA

The main efforts to development of NIS/GIA include four aspects as follow:

(1) Making of a national development planning in long-term, some policies and technical standards for data sharing.

(2) Developing of distributed sharing database systems to connect databases of natural resources, environment and regional economics in different organizations.

(3) Developing of SDSS software tool and its applied systems for regional development and other fields of geospatial data applications.

(4) Formulating of a network-based integrated application technical environment to support planning, management and decision making at the state and province levels.

2) Technical frame of NIS/GIA

A NSII prototype in China has been developed since 1997,as shown in Fig. 6. Based on Chinese Economic Information Network (CEINet) and Internet, the prototype consists of the systems at three levels: main integrated system at SIC/SDPCC; subsystems at ministries, provinces and IRSA/CAS; and domestic and international users.

(1) Main integrated system at SIC/SDPCC

The system consists of National Center for Spatial Information Exchange (NCSIE, that is National Clearinghouse), Data Base Sever, Model Base Server, Hypermedia Server, Web Server, Centralized (C-) Sharing Databases, etc. The main tasks are: to support the businesses of development planning, management and decision making at the state level; to promote NSII development and data sharing in China.

(2) Subsystems at ministries, provinces and IRSA/CAS

Ministries, provinces and IRSA/CAS are data producers in the one hand; they are data users in the other hand. So, the main tasks of the subsystems are not only to support the businesses of planning, management and decision making at province or ministry level, but also to provide the data sets to main system at SIC/SDPCC and to share the data sets with other agencies operationally. The databases of these subsystems are distributed ones or D-sharing DB in Fig. 6.

(3) Domestic and international users

According to data sharing policies in China, domestic and international users can access NCSIE as mentioned before and get the data sets from corresponding agencies through INTERNET or CEINet.

Acknowledgements

Author has taken a certain responsibility to formulate and implement several national key projects on RS, GIS and NSII in China since 1983. After that, both social activities and personal research of author have got many strong and friendly supports from his colleagues, friends inside and outside of IRSA/CAS, and related agencies. Here, author wishes wholeheartedly to acknowledge them all for their kind and warm encouragement and assistants.

References

[1] Bill Clinton, Coordinating Geographic Data Acquisition and Access: the National Spatial Data Infrastructure, *Executive Order 12906,* the White House, April 11, 1994

[2] S. Y. Yan, S. X.. Wang, C. J. Wei and F. Xu, Network-based Flood Quick Reporting System Using Remote Sensing, IRSA/CAS and SIC, November 1998

[3] J. Y. Liu (Chief-editor), Macro-scale Survey and Dynamic Study of Natural Resources and Environment of China by Remote Sensing, Publishing House of Sciences and Technologies in China, December 1996

[4] The expert team of the project, Working Report: RS-based Inventory of Agricultural Land Resources at County Level in the whole country, SBS and CAS, December 1998

[5] S. Y. Yan, Q. Tian, C. S. Xiao, et all, Spatial Decision Support System and Its Applications, IRSA/CAS, March 1999

[6] S. Y. Yan, Q. Tian, S. X. Wang, et al, "Preliminary Study on Development of General Software tool for Spatial Decision Support System", *Remote Sensing on Environment, China,* Vol. 11, No.1, February 1996. PP. 68-78

[7] S. Y. Yan, Modern Remote Sensing Technical System and its Development Trends", *Remote Sensing on Environment, China,* Vol.10, No.1, February 1995. PP. 52-62

[8] The Project Expert Team, General Technical Report: National Resources, Environment and Regional Economy Information System and Key Techniques of National Spatial Information Infrastructure in China, February 1997

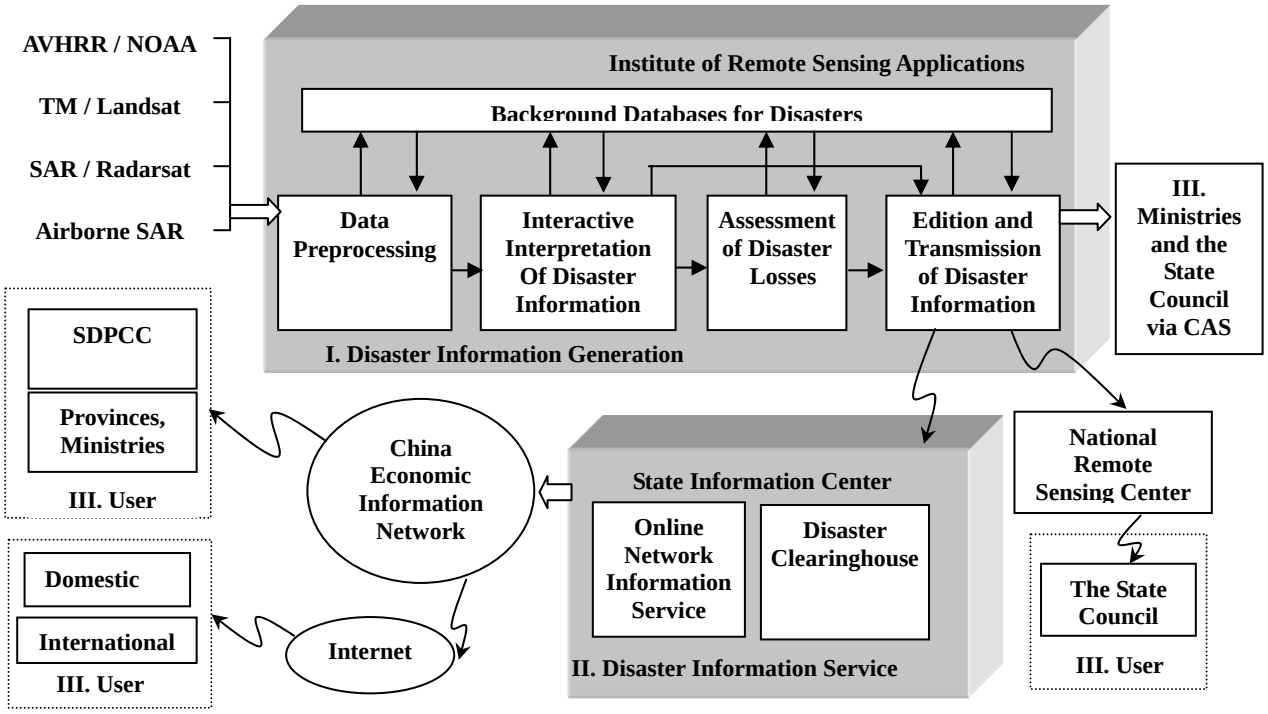

Fig. 1 Multi-technical Integrated System for Monitoring

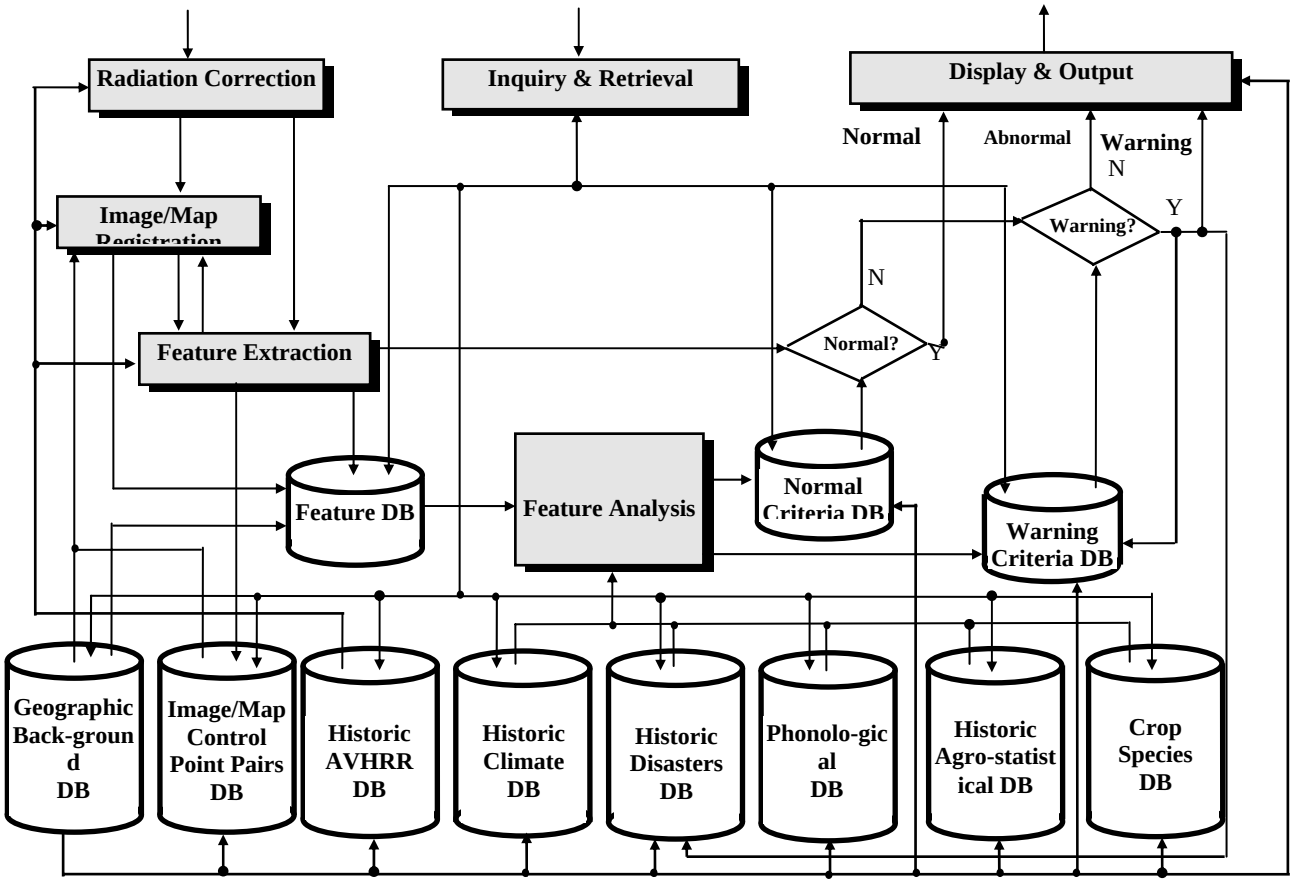

Fig. 2 AVHRR-based Monitoring and Early Warning System of Agricultural Condition

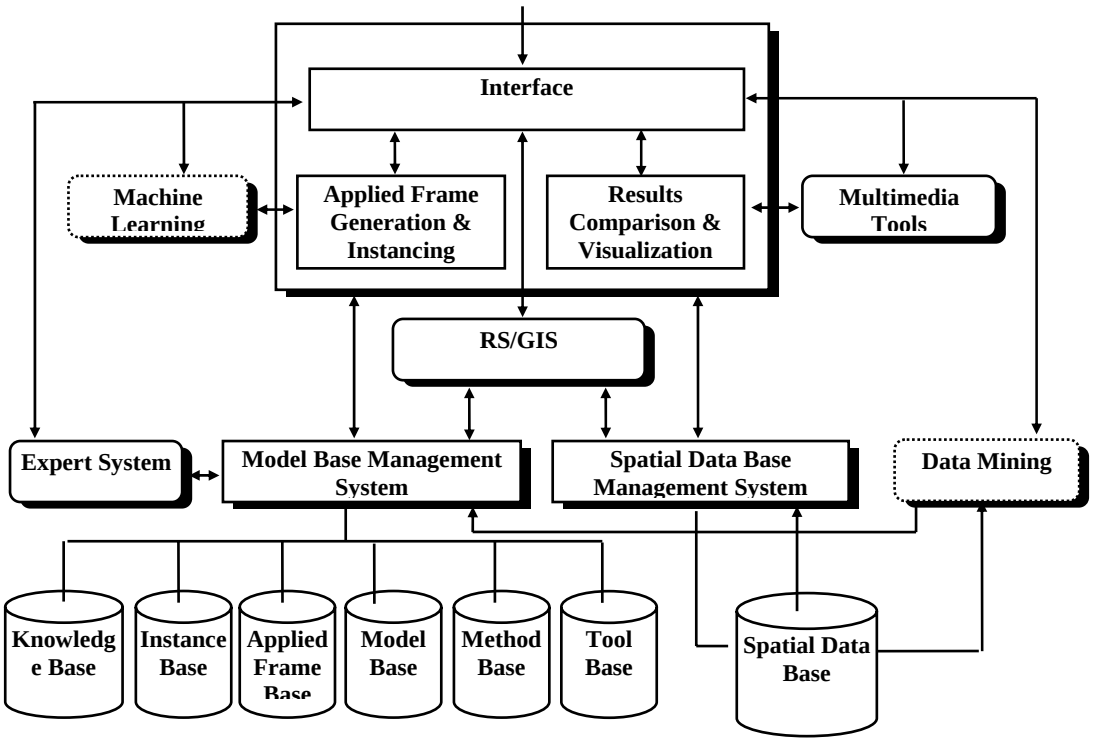

Fig. 4 Structure of SDSS general software tool

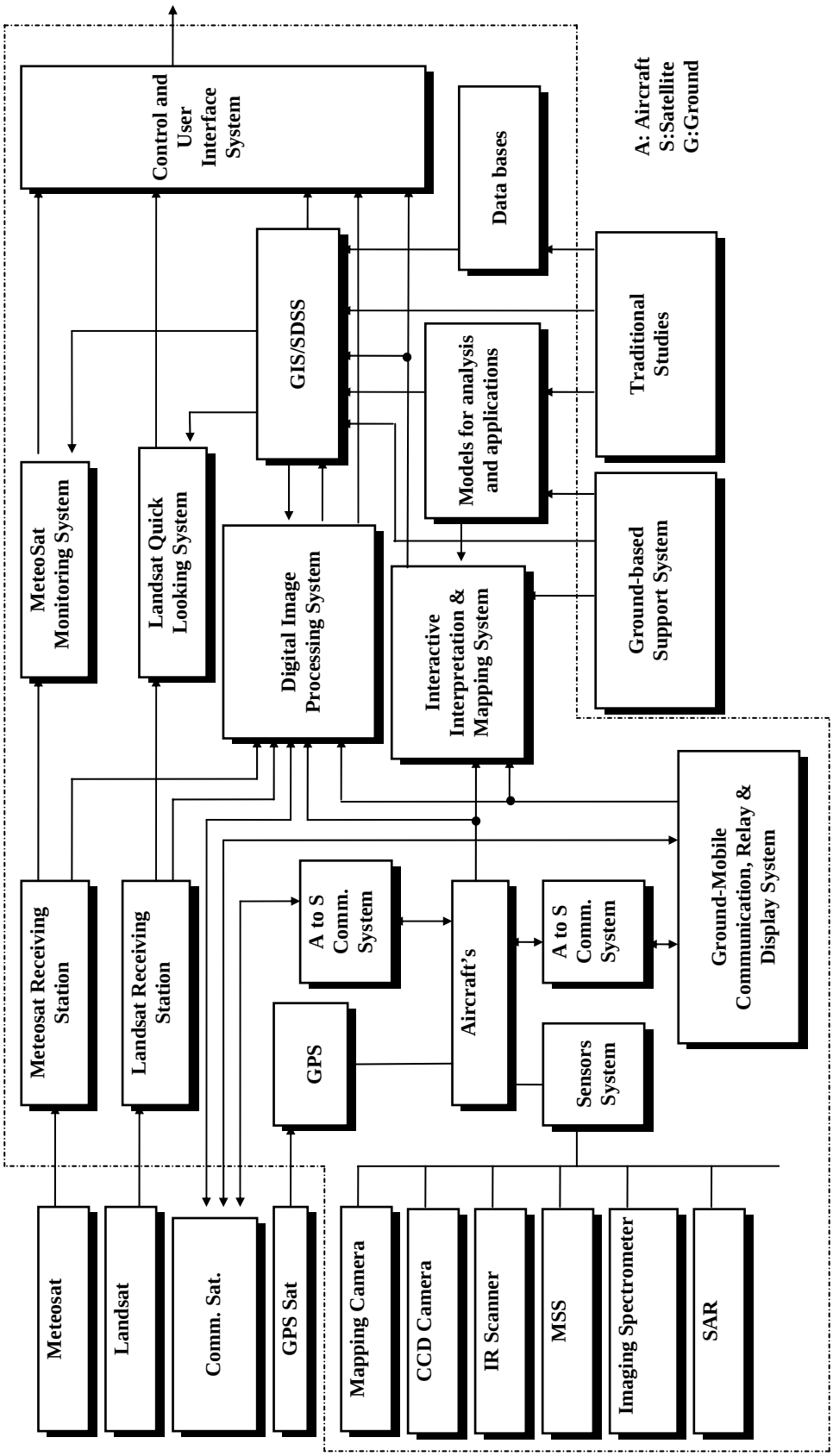

Fig. 5 Structure of TSS/RSDA

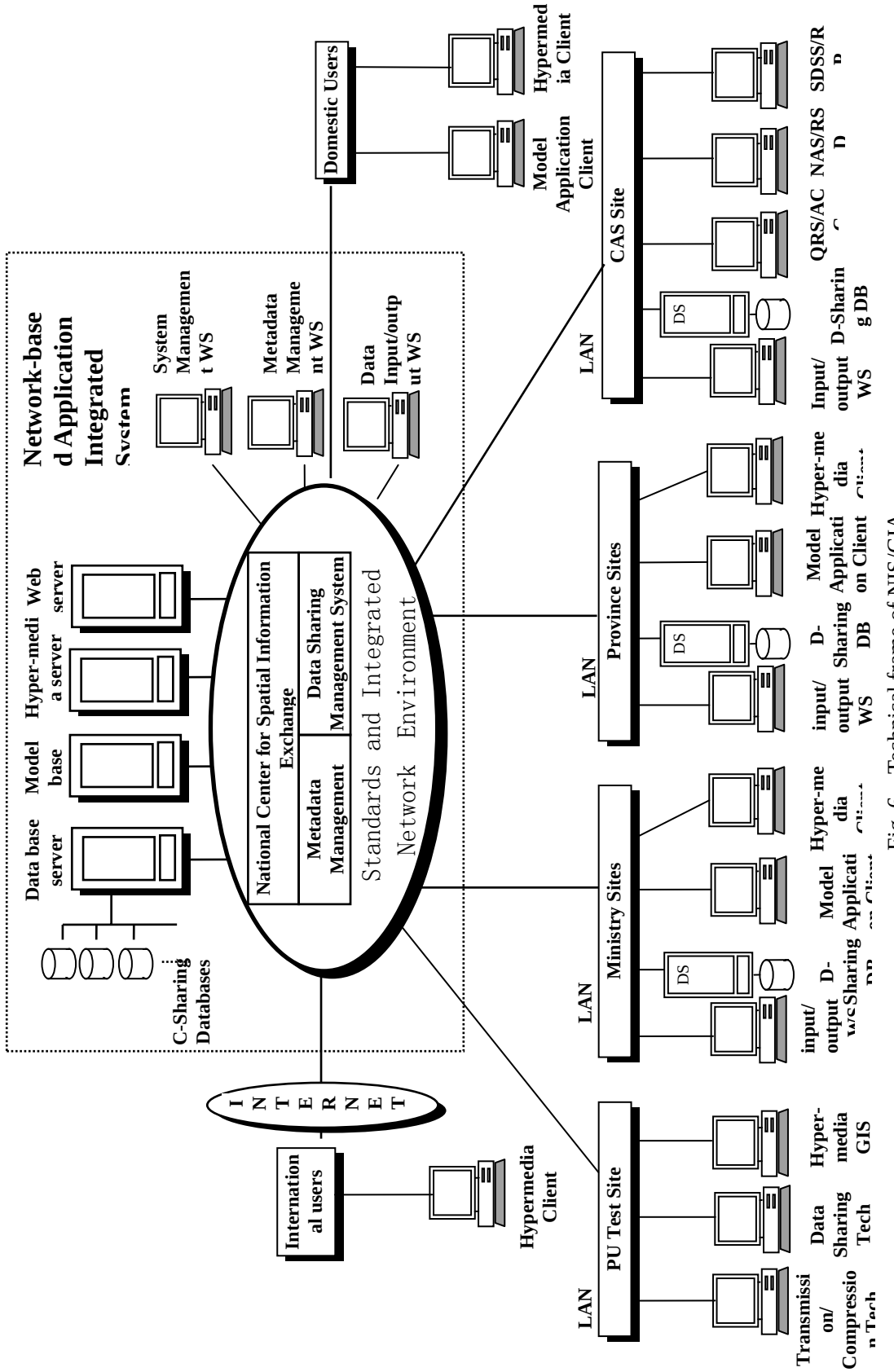

Fig. 6 Technical frame of NIS/GIA