

EARTH OBSERVATION IN THE INFORMATION AGE - TRENDS IN UTILISATION OF NETWORKS FOR EARTH OBSERVATION APPLICATIONS

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ABSTRACT: The information age with its new multi-media technologies has already now a great influence on the way the Earth Observation community exchanges information. Even more will come up in the next future. In many countries network based satellite information systems have been set up. As an example, one of the most advanced user interfaces, the ISIS of the German remote sensing data center DFD/DLR is presented. It is well accepted by the users and gives access to online meta-data and search tools.

Due to the exponential growth of the number of web servers for EO relevant subjects new approaches are necessary to deal with the „information pollution“. In the European context the CEO activity of the European Commission tries to offer a standardised internet environment and tools to enable a „one stop shopping“ for the user. Higher network bandwidths will give further possibilities for direct data delivery and decentralised utilisation of databases.

Also the commercial scene is starting to use the new media which opens the door for completely new marketing approaches and services which could help to accelerate the extension of the market.

Even in developing countries new communication strategies will help to overcome the information gap caused by the lack of infrastructure. A pilot project for a developing country information locator system is presented.

KURZFASSUNG: Das Informationszeitalter mit seinen Multimedia Technologien hat schon jetzt einen großen Einfluß auf die Art, wie die Erdbeobachtungs-Community Informationen austauscht. Schon die nächste Zukunft wird weitere wesentliche Änderungen bringen. In vielen Ländern wurden in den vergangenen Jahren netzwerkbasierende Satelliten-Informationssysteme aufgebaut. Als Beispiel wird eines der fortschrittlichsten Systeme dieser Art, das ISIS des Deutschen Fernerkundungs-Datenzentrums DFD/DLR vorgestellt. Es wurde von den Nutzern sehr gut angenommen und ermöglicht den Zugang zu online Metadaten und Suchwerkzeugen.

Durch das exponentielle Wachstum der Anzahl der Netzwerk Server für erdbeobachtungs-relevante Themen ergibt sich die Notwendigkeit neuer Ansätze um mit der unüberschaubaren Informationsmenge umgehen zu können. Im europäischen Rahmen versucht die EU Kommission mit ihrer CEO Initiative eine Standardumgebung und Werkzeuge anzubieten um für die Nutzer ein „one stop shopping“ zu ermöglichen. Höhere Netzwerk Bandbreiten werden schon in naher Zukunft erweiterte Möglichkeiten für die direkte Datenlieferung und die Nutzung dezentraler Datenbanken geben. Auch die kommerziellen Anbieter beginnen die neuen Medien zu nutzen, da diese völlig neue Marketing-Strategien und Dienstleistungen ermöglichen die helfen können den Markt auszuweiten.

Auch in Entwicklungsländern beginnen neue Kommunikationsstrategien die Informationslücke zu schließen, die durch das Fehlen von Infrastruktur verursacht ist. Ein Pilotprojekt für ein Information Locator System für Entwicklungsländer wird vorgestellt.

1. INTRODUCTION

The explosive growth of networks in the last years has changed the way people communicate and exchange data and information. Especially the internet has become a de facto standard by the overwhelming user acceptance. An estimated 30 million users and over a million servers are actually on the „net“. The idea of a global information highway has so become reality within a very short time.

Whereas in the beginning of wide area network applications most activities concentrated on letter-based mail and file exchange the technological development has now reached a standard where graphic-based communication takes place. Even more sophisticated multi-media applications are in preparation as net video and audio.

The free availability of World Wide Web clients, e.g. mosaic or netscape, and easy to use Hyper Text Markup

Language (HTML) editors have opened the internet for Earth observation services of any kind.

Hundreds of servers have been developed in a short time but the growth is uncoordinated and the user is more or less left alone with the flood of information. On the other hand the new technologies give the chance to bring online access to Earth observation data and metadata on every desk. New developments like the Java programming language will open further opportunities also for Earth observation users. An investigation of the European infrastructure of Earth observation related datasets (DHV/ESYS, 1995) within research organisations summarises: „The research organisations did not have the resources...to establish and maintain external interfaces. Dissemination and sharing of research information of results had a high priority. Internet connections and WWW homepages are becoming a customary adjunct to normal publication“ In this article three examples shall demonstrate the state of the art and future developments of Internet based Earth observation systems.

2. USER INTERFACES, META-DATA AND CATALOGUE SYSTEMS

The development of externally accessible catalogue and information systems was the technological answer and deciding step from the „data graves“ of the past to the data libraries of today. One of the most advanced systems of this kind is the Intelligent Satellite Information System, ISIS, of the German Remote Sensing Data Center (DFD-DLR) which was sponsored by the German Ministry of Research, Technology, Education and Science (BMBF). The graphical user interface is also GISIS.

accessible via ISDN, telephone modem, X-25 network. Comparable systems were developed in ESA (UIT), as part of the US EOSDIS and by private companies (eiNet/Eurimage or DALI/spotimage).

All have a similar structure and offer, under a graphical user surface, access to a data catalogue with search tools. Differences exist on the underlying databases and catalogue systems.

ISIS has, via the CEOS International Directory Network (IDN), access to worldwide meta-databases. An even higher level of catalogue interoperability is realised in the framework of the CEOS Catalogue Interoperability Experiment (CINTEX). CINTEX has defined a Catalogue

Interoperability Protocol (CIP). By this technique the searching machine translates a query into CIP and accesses different catalogue systems worldwide. For the user it looks like one large catalogue. So it is possible to search for available images of a certain area not only in the DLR archives but also in US or Japanese catalogues. DLR is taking part at CINTEX with ISIS. The service is only available for pilot users yett. Many future systems as ESA's MUIS will follow this CEOS standard.

ISIS allows to select interesting target areas by the geographic location, via a geographic name database with ca. 170000 entries or graphical by drawing a window on a map (map browser tool). Other categories of selection are the type of sensor (e.g. AVHRR, Landsat, XSAR, etc.) and the acquisition period (see fig. 1).

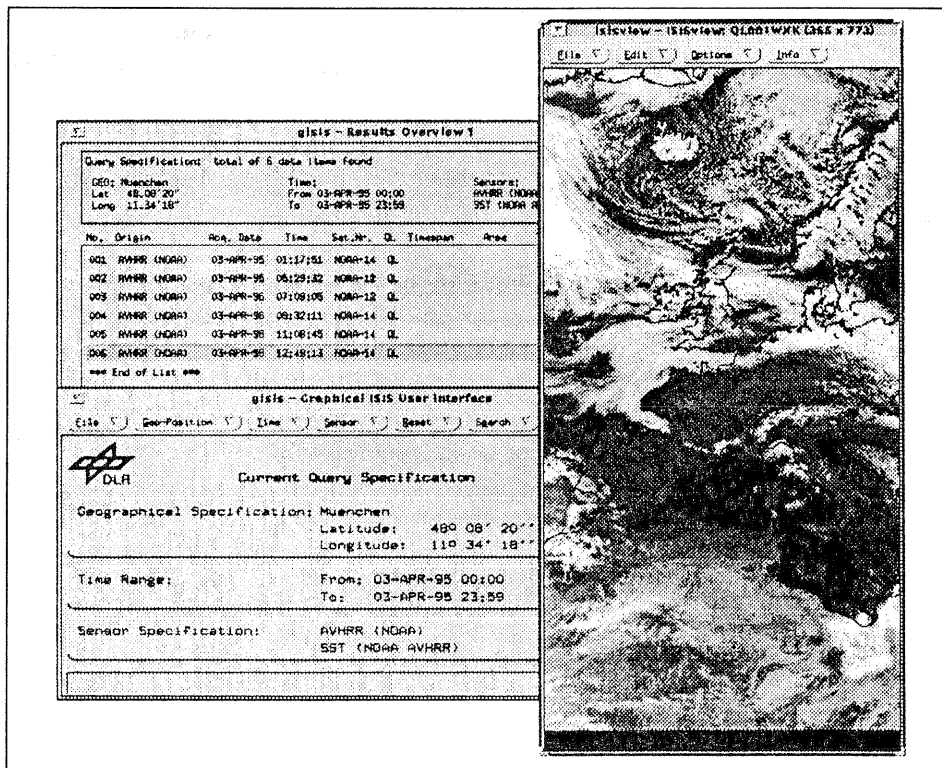
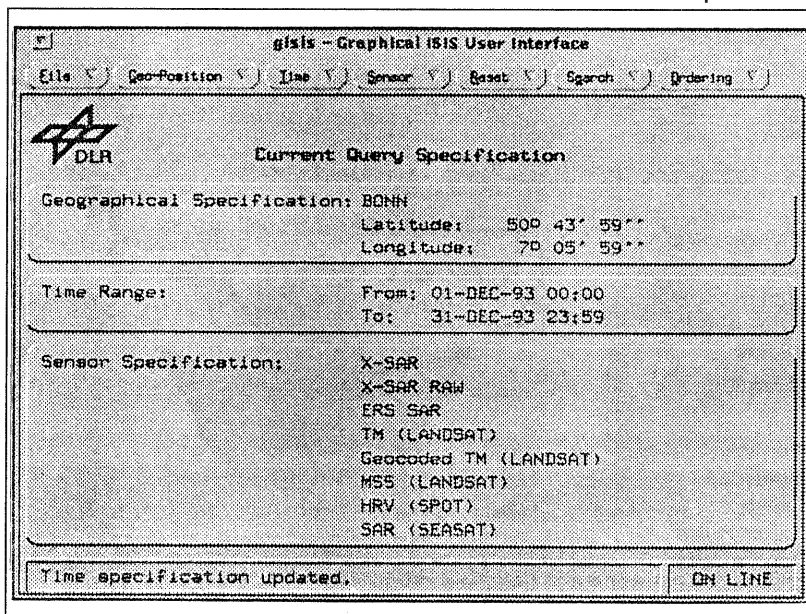
Footprints of available products are displayed on digital maps after the search process and digital quicklooks can be visualised on-line by a browser tool (see fig.2).

Fig. 1: ISIS complete catalogue query

According to a study of the EC (ESYS 1995), DFD is the major non-revenue based data supplier, by numbers of products, in Europe (42%), followed by Dundee University and ESA. Non-revenue based data supply is four times the number of revenue-based products supplied.

Part of this success is due to the external access to all meta-data by of a sophisticated user interface. It is now available in an Internet based version and is also

Fig. 2 ISIS displaying a typical NOAA-AVHRR quicklook (Lotz-Iwen et al, 1995)



So the user can decide whether he wants to order a product or not. Ordering can also be performed online. Data transfer via network is only possible for selected datasets, as the actual available (and payable) bandwidth does not allow the transmission of high resolution data products with 100 Mbyte and more each. ISIS offers additional user support by an Infoboard with text information, software tools, and a Thesaurus Navigator.

ISIS will also be the technological backbone of a commercial spin off. The newly founded German company Euromap, a GAF daughter, holding the distribution rights for Indian high resolution satellite images over Europe, will use an ISIS derivate as commercial distribution system.

3. EUROPEAN APPROACHES - CEO

The situation in the Earth observation ground segment in Europe is very diverse and inhomogenous. It is based mainly on investments made by national space agencies, ESA and Eumetsat. However, by the end of the century there will be a significant increase in the number of Earth observation satellites. This will result in Terabytes of data a week. These data have to be made available and transformed into information of use to policy makers, industrialists and scientists.

If one extrapolates the „information pollution“ on the Internet on the one hand and the very inhomogenous activities in terms of the Earth observation ground segment and user services in Europe on the other to the coming years then one discovers that some action was necessary. To improve the situation the European Commission has decided together with its member states to establish the CEO programme (EC-JRC, 1995a).

CEO is thought to be a „one stop shopping mall“ for Earth observation related information and services. To further elaborate this example the CEO programme would deliver the shops and the infrastructure of the mall whereas service providers would move in and determine the offers and services.

The goals of CEO as stated in the concept papers (EC-JRC, 1995a) are to stimulate user oriented services building on existing facilities and projects by

- encouraging better communication between individual users and between user communities
- stimulating the creation of high level products
- contributing to improved data standardisation and quality assurance
- promoting the design and operation of decentralised data archives, databases and data delivery services for Earth observation data and products and relevant non space data
- improving the visibility of Earth observation services and expertise

The CEO programme (see fig. 4) comprises four inter-related components (EC-JRC, 1995b):

- Application Support: stimulates the production of information services from Earth observation data, in response to customers' needs, thereby drawing more customers into the system.
- User Support: comprises actions and measures designed to help CEO participants to use Earth observation data to meet their requirements.
- Enabling services: initiates actions and measures to provide software tools and systems to increase the exchange and accessibility of meta-data and information about Earth observation
- Monitoring and Coordination Services manages, monitors and develops the CEO programme and services

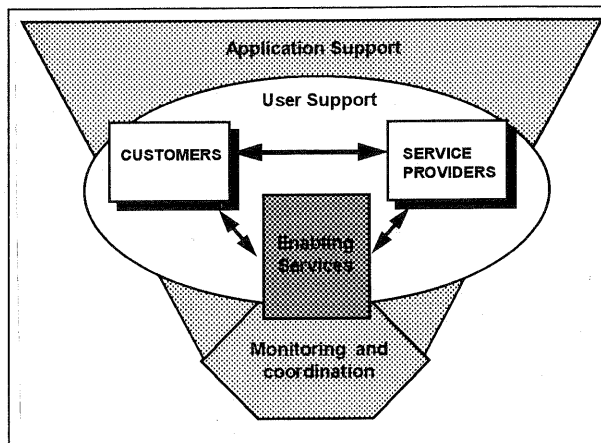


Fig. 3: The CEO Programme

The third component of CEO, the Enabling Services, will concentrate on developing toolkits (EC-JRC, 1995c) for standard services as „Yellow Pages“, higher level subscription services, advertising and dictionaries (see fig. 4). As ISIS, the Enabling Services will also build on the experience of CINTEX and include the Catalogue interoperability protocol. A catalogue interoperability gateway toolkit will also be developed.

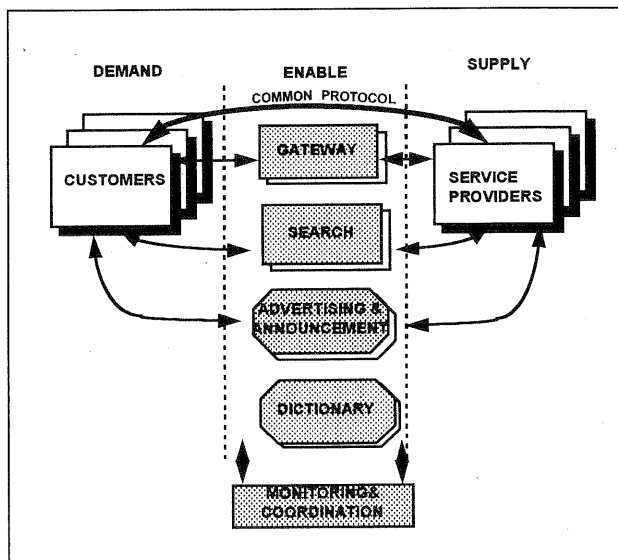
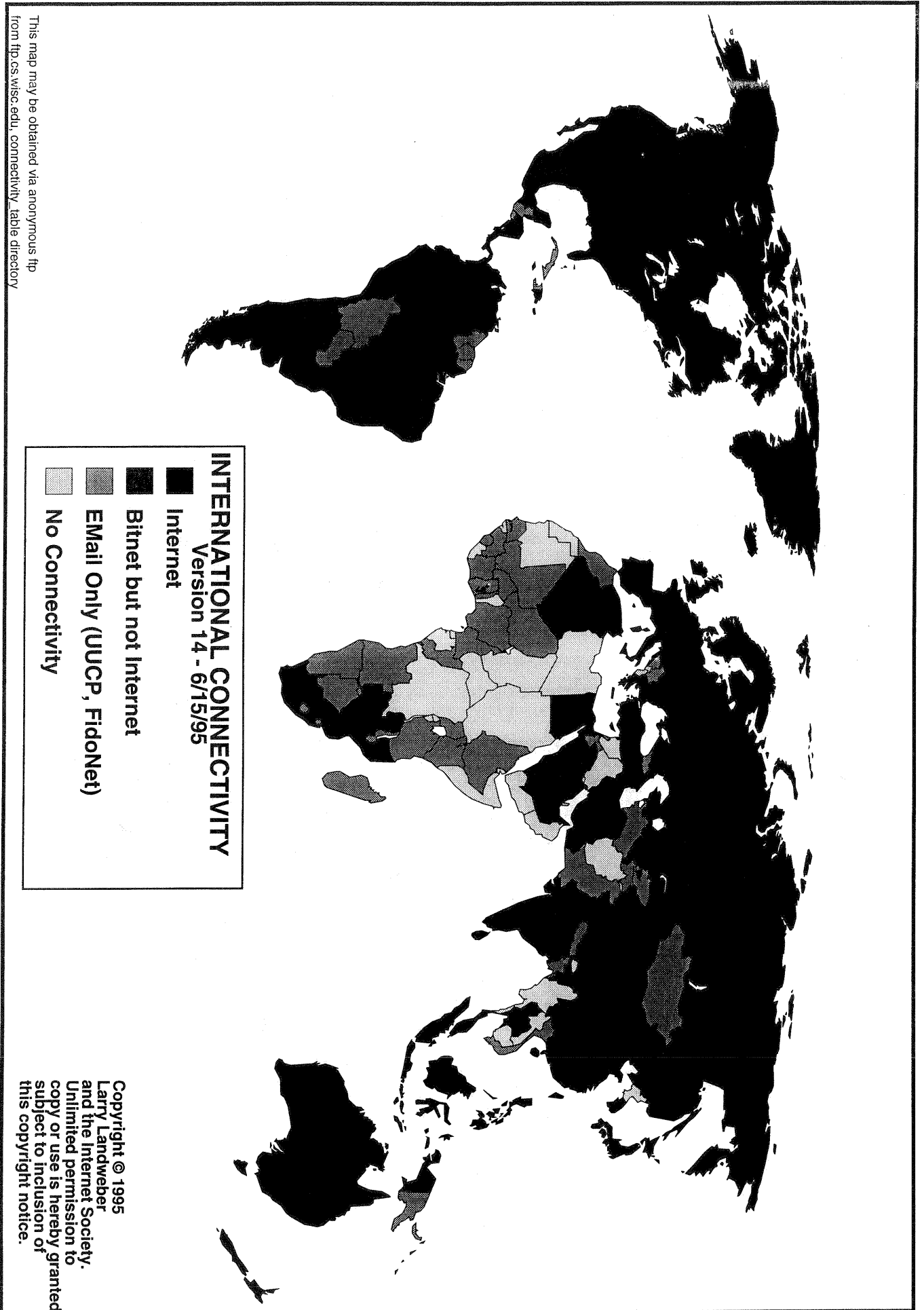


Fig. 4: CEO Enabling Services



This map may be obtained via anonymous ftp
from <ftp.cs.wisc.edu>, connectivity_table directory

Fig. 7: International Internet connectivity

As a proof of concept activity the JRC team has set up in the pathfinder phase the European Wide Service Exchange (EWSE) a testbed for potential users and services. The aim is to increase the number of data, products, information and services advertised through the EWSE to be transferred to the Enabling Services when released. EWSE shall also test new technologies and give user feedback for the improvement of developments.

Already now the EWS gives an impression on how a future information highway based system could look like. At the moment it offers Queries, a Tradeshow, a Geotool and a Calendar. The Tradeshow is organised as a number of *pavilions* in which the customer can visit different *shops* on different *floors* (see fig. 5). Some *shops* offer already now interesting pilot services as wind and temperature maps produced by ECWMF.

A service provider can interactively (EC-JRC, 1995d) create its own *shop* in a pavilion. By online access even to the level of the Hyper Text Markup Language (HTML) source code almost complete control over the appearance of the *shop* is possible.

An attractive highlight of EWSE is a virtual 3-D flight around the Earth based on satellite images (fig. 6)

The EWSE is the prototype of a future European service platform which shows the potential but also the limitations of the actually available technology if the user tries to access EWSE by modem or other low bandwidth connection.

4. DEVELOPING COUNTRIES

The lack of a reliable communication infrastructure is a major problem in developing countries (DCs). On the other hand there is a high demand on Earth observation data and derived products like maps or agricultural and hydrologic data. A study on this subject found out that "...a whole variety of activities is going on and many data and directory services are available, but the coordination is insufficient. It is widely accepted, even by people who are running data systems in this field, that DCs and donor countries are often unaware of what already exists, and they often act without the best information" (Geoscan, 1995).

The international Internet connectivity has been investigated and is shown in fig. 7. As a principle online access is not possible in most DCs but off-line services as e-mail are often more reliable than fax (Geoscan, 1995). Many organisations as Worldbank, UNEP and FAO put strong emphasis on the improvement of the information infrastructure in DCs and support local Internet projects. So the situation is going to improve. Gaps could also be filled by satellite based systems as UNEP's MERCURE

The Committee on Earth Observation Satellites (CEOS), an international forum for the coordination of space-related Earth observation issues has during its Plenary session in Berlin expressed its specific interest in supporting DCs. The German Space Agency, DARA, initiated a feasibility study on a space information for DCs. The study investigated the existing systems, networks and requirements of DCs concerning Earth

observation data. The result was that "DCs are primarily interested in value-added information for project purposes... Many diversified data systems are already in existence in developed regions of the world, but in a rather uncoordinated fashion. By themselves, they are of little use to developing countries (Geoscan, 1995)". An Information Locator System (ILS) was proposed as solution to facilitate the search for value added information, project results and data sources. An ILS does not contain data itself but pointers on other data bases.

At the last CEOS Plenary DARA was asked to perform a pilot project for an ILS. The pilot project is led under DARA contract by DFD/DLR with subcontractors Kayser-Threde, Munich and DSS/DASA, Friedrichshafen. The pilot project will run for two years. In the first year an ILS pilot system will be set up, using as much as possible tools already existent, as the EWSE. For the second year some pilot users in DCs will be involved to gain experience with the system and to deliver feedback.

As CEOS is a non profit organisation the necessary system maintenance has to be minimal and users must have the possibility to enter own information (DC and donor organisations).

Internet WWW addresses:

ISIS can be accessed via <http://www.dfd.dlr.de>.
The internet address of EWSE is <http://ewse.ceo.org/>.
CEOS documents can be found in the CEOS Infosys under <http://ceos.esrin.esa.it/Cceosinfo>.

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