INTERNATIONAL TELECOMMUNICATION UNION

Telecommunication support for the protection of the environment

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Report on Question 7/2

PUBLICATIONS OF ITU-D STUDY GROUPS

Study Period 1995-1998

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REPORT ON QUESTION 7/2

Telecommunication support for the protection of the environment

1 Executive summary

The question of environmental protection today has attracted worldwide attention. This is reflected in the issues raised both in the Rio Declaration on Environment and Development and in the Agenda 21, Chapters 35 and 40 (See Note). Telecommunication and information technologies respect the environment and the important role telecommunication technologies can play in protecting the environment is recognized with significance.

NOTE – Agenda 21 adopted on 14 June 1992 during the Earth Summit in Rio de Janeiro (Brazil), 3-14 June 1992.

Consequently, the World Telecommunication Development Conference (Buenos Aires, March 1994) and the Plenipotentiary Conference (Kyoto, September 1994) convened by the International Telecommunication Union adopted Resolutions 8 and 35 respectively which called, *inter alia,* for establishing a framework of studying and disseminating information at a global level on ways of using telecommunications support for the protection of the environment with a view to creating awareness among all concerned parties.

Towards implementing the above Resolutions this study question (Question 7/2 – Telecommunications Support for the Protection of the Environment) was incorporated into the mandate of the Study Group 2 established by the WTDC. During the study period 1995-97 all members of the ITU Development Sector were invited to provide inputs to the study and this report contains results of the invaluable contributions received from numerous telecommunications and environmental entities, of developing and developed countries.

Firstly, this report looks at many environmental problems and concerns arising at a global, regional and national levels, and later, at ways of providing telecommunications support in minimizing if not eliminating such problems.

Earth is now faced with a number of serious problems including overpopulation, depletion of resources, destruction of ecosystems, and environmental pollution. Stopping the ongoing destruction of the environment is finally becoming a worldwide issue. It is now obvious that technology plays a major role in measures aimed at solving environmental problems, and although it is true that technological advances have also been a cause of environmental deterioration, there is little doubt that development of appropriate technology is the key to achieving compatibility between economic growth and a healthy environment.

All modern telecommunication means, wired and wireless, terrestrial and satellite, have a part to play in the efforts to keep the Earth green, clean and healthy. Telecommunications services benefit the environment in many ways. For example, substituting on-line communications for actual physical movement or delivery conserves a considerable energy and natural resources while sharply reducing the CO_2 emissions into the atmosphere.

The real time transmission capability of networks also keeps us well informed about global and regional environmental conditions and enables us to take appropriate decisions in order to prevent or to combat multifarious environmental degradation. Telecommunication services have enormous potential to awaken people and to make them aware of the urgency of environmental degradation. Networks can also provide instantaneous feedback showing people the implications of their actions and behaviour. Telecommunication is therefore a powerful incentive for people to change environmentally irresponsible habits and behaviour.

2 Introduction

2.1 Background

The World Telecommunication Development Conference (WTDC) convened by the International Telecommunication Union (ITU) in Buenos Aires in March 1994 established two Study Groups, one of which was tasked with a question regarding the role of telecommunications in protecting the environment. Study Group 2 met for the first time in

May 1995 in Geneva at which time a Rapporteur was elected and a work plan was established in order to complete the study of this question by the end of 1997. All the members of the ITU Development Sectors were invited to contribute to the study during the course of the study period. This report compiles the activities, results, guidelines and recommendations associated with the study of this question.

2.2 Statement of Problem

Telecommunication and information technologies have an important role to play in protecting the environment and in promoting activities at low risk to the environment. The application of the latest telecommunication and information technologies, especially those associated with space systems, can be extremely useful in implementing and conducting environment protection activities such as monitoring of air, river, harbour and sea pollution, as well as forestry, wildlife studies and others.

The application of telecommunication technology contributes to reducing paperwork which ultimately saves forests. Telecommunication and information technologies respect the environment, and the related industries can be located in rural areas in order to reduce urban congestion. There is a need to disseminate information on these aspects as stated in the Declaration on Environment and Development and Agenda 21.

NOTE – Final Report, World Telecommunication Development Conference, Buenos Aires, March 1994, p. 50.

2.3 Study Question

The WTDC approved the following terms of reference for this question to be studied.

In order to promote the application of telecommunication and information technologies for protecting the environment, the ITU/BDT, in collaboration with international and regional organizations shall:

a) prepare a policy document for promoting the use of telecommunication, information and space technologies for applications devoted to the protection of the environment;

b) disseminate information on applications of telecommunication and information technologies for the protection of the environment;

c) organize seminars, training programmes, exhibitions and other similar activities to meet these objectives;

d) create appropriate course material for conducting training programmes on this subject;

e) conduct studies in selected areas (e.g., transport, forestry, river, harbour and sea pollution, wildlife migration etc.) for evaluating and highlighting the advantages of telecommunication applications.

3 Environmental concerns

3.1 Natural Causes

3.1.1 Review of Major Environmental Disasters

In 1995, the Caribbean was struck by several powerful hurricanes. This has caused extensive damage to office buildings, hotels, hospitals and houses. Antigua was especially hard hit, with much damage to its telecommunications system.

In early 1995, Kobe and Sakhalin was struck by powerful earthquakes which caused sudden and huge devastation, leaving thousands of people dead and many others adversely affected. Infrastructure, including telecommunications were destroyed to a large extent in both cases.

Several thousands of people in China were affected by the flood caused due to waters of Yang-tze River in August 1995.

The above-mentioned are only few of the many more natural disasters which occur from time to time and unfortunately nothing can be done to stop them. Early warning and disaster mitigation are therefore vital to minimize the casualties and other harmful effects caused to humanity. As will be described in the later chapters, telecommunications have a very important role to play in facilitating relief programmes in times of disaster.

3.1.2 Hurricanes, Typhoons and Cyclones

These are high speed winds and storms which strike certain parts of the world depending on the geographical location. These storms are capable of causing extensive damage to buildings and houses leading to loss of life in some situations.

3.1.3 Flooding

Owing to the geographical location, some countries are exposed to the seasonal and multi-annual irregularity in the rainfall rate which often cause disastrous flooding. For instance, in the last fifty years, there have been three major climatic events (in 1969, 1973 and 1990) in the central and southern regions of Tunisia, each having caused flooding. In the case of the January flooding, the rainfall recorded over two days was ten times higher than the monthly average for the whole of January, and the damage was more extensive than in 1969 and 1973 (See Note). In Bangladesh, flooding is frequent and sometimes cause several deaths and serious casualties as well as rendering others homeless.

NOTE – "Use of Satellite Imaging for Monitoring and Preservation of Floods in Tunisia", Sinan Bacha (CNT – Tunisia), April 1996.

3.1.4 Earthquakes

Earthquakes are one of the major natural disasters that occur from time to time in certain parts of the world and the effects can be quite devastating at times, killing lives and making several thousands homeless. For instance, the great Hanshin Earthquake which hit western Japan in 1995, registered 7.2 on the Richter scale. A total of more than 5 500 people were killed in this horrible incident.

NOTE – "Telecommunications at the time of Great Hanshin Earthquake and Approaches to restore Telecommunications Networks in Stricken Areas", ITU Document 2/63, Japan.

3.1.5 Locust devastation

Several countries, especially in Africa, are regularly exposed to invasion by migratory locusts and to the devastation they wreak on all forms of vegetation, particularly crops. With their Earth observation and monitoring capacities, satellite telecommunication technologies could, in association with early warning systems, help to forestall such catastrophes.

3.2 Man-made Causes

The deterioration of the global environment has recently become a problem of great urgency. This includes global warming and ozone layer depletion caused by use of chloroflourocarbons, the loss of tropical rain forests, desertification in arid regions, deforestation caused by acid rain, ocean contamination and the frequently anomalous climate. Much of these problems are caused by the adverse effects of the human activities on the globe.

3.2.1 Urban Congestion – Migration to Cities

Many countries today are faced with the problems caused due to high population densities in their major cities. This primarily is due to the lack of sufficient social infrastructure in the rural and remote areas. As a result, migrations occur from these rural areas to urban areas where socio-economic infrastructure has been established. Overcrowding of the urban cities causes many problems including:

- extensive and unbalanced use of natural resources;
- problems of waste management;
- air and noise pollution;
- congestion of traffic on roads;
- proliferation of unauthorized human settlements.

3.2.2 Industrialization and Air Pollution

Industrialization has become a long lasting issue in causing adverse effects to the environment. The main focus here is on the problems caused by polluting the atmosphere due to the continuous emission of potentially hazardous gases to our natural environment. In the developed countries this situation is prominent. Alternative ways of dealing with this problem has now become most urgent.

One other aspect of pollution especially in the major cities is the pollution of air; one of the sources causing this pollution is the heavy road traffic and most of the times congestion of this traffic on the roads causing emission of carbon dioxide.

3.2.3 Nuclear, Toxic and other Waste

One of the major concerns arising at global level is that of nuclear and toxic water due to industrial activities. Nuclear sources are a potential threat to the very existence of man and harmful radiation which can be detected over large distances is becoming an increasing concern. Many developing countries neither have the means or knowledge to monitor radiation in the food chain, nor the appropriate response measures to contain it.

3.2.4 Pollution of Drinking Water

One of the most serious challenges that the 21st century will face is undoubtedly on acute shortage of water. This is mainly due to two factors; mismanagement and contamination of water resources. It is calculated for example, that India has 70% of its total surface water polluted. Pollution prevention of ground water and river systems require stringent monitoring that require scientific knowledge of the hydrosphere and adequate environmental protection policies that enforce the implementation of codes of good practice. In many developing countries, waterborne diseases (diarrhoea, bilharzia, etc.) many times cause death and disabilities especially among young children.

3.2.5 Ozone Layer Depletion and Global Warming

The emission of greenhouse gases into the atmosphere mainly from the continuous use of CFCs has caused depletion of the ozone layer in the upper atmosphere. From the time scientists have discovered this effect, continuous monitoring of this phenomenon is in progress and the results cannot be said to be satisfactory. The ozone composition is not being maintained at a constant level, but the degradation is becoming more and more prominent. At this rate of depletion, it is believed that the Earth will continue to experience global warming and the melting of the polar ice caps would cause the Earth’s sea level to rise. More detrimentally affected would be the extremely vulnerable low lying small island nations of the world which, in some cases, is believed will be completely submerged in the next generation.

This is a very serious problem which has to be looked into, not only by the small islands who would be the ultimate victims, but also by the industrialized world whose activities, on a major part cause these problems. The multilateral Fund of the Montreal Protocol should be strengthened in order to play its role more efficiently.

3.2.6 Killing Wild Life and Ecosystems

The extensive use of natural resources is not the only problem faced today, but also the near extinction of certain species from the Earth remains a major concern for the environmentalists. Killing of wild life or the endangered species for a temporary wealth over the years have caused major upsets to the ecosystems. Today, some of the wild animals are so rare that the threat of their elimination from the food chains is quite imminent.

3.2.7 Pollution in Rivers, Harbours and Sea

Pollution in rivers, harbours and sea may be caused by various factors. One that is common is the dumping of waste and toxic substances causing contamination.

3.2.8 Over-fishing

In many areas of the sea, fishing activities are so extensive that continuous fishing from the same areas over and over again tends to cause an imbalance in the distribution of fish living in those areas. This is a likely cause for the exhaustion of fish in some areas, wiping out the entire population. Preventive measures have to be taken to ensure a more environment friendly way of dealing with this problem.

3.2.9 Destruction of Forests

The Food and Agricultural Organisation (FAO) of the UN has estimated that over a quarter of all land on Earth is covered by forests of which 46% are found in the developed countries while the remaining 54% are located in developing countries. Forests have multi-functional tasks; wood and paper production, climate stability, carbon sink, reservoir for biodiversity, wildlife habitat, soil erosion detriment, clean water cover and recreation. Despite the high environmental interest in forests on a global level the annual deforestation is rapidly continuing with annual deforestation estimated to be 10 million ha per year. Less than 20% of this annual loss of forests is afforested while the rest is turned into other land cover forms.

3.2.10 Oil and Gas Pipeline Spillage

Power line and pipelines carrying oil and gas often extend for hundreds or even thousands of kilometres and pass through vast stretches of remote areas. Pipeline breaks can cause enormous environmental damage, as accidents of this nature in various regions of the World have shown before. For the operator, the safety of the pipeline is of prime importance. The remoteness of large portions of the pipeline and its pumping stations make it difficult to provide a highly reliable method of altering the operator in the event of a disaster.

NOTE – "Protecting the Environment with the Help of Mobile-Satellite Services", David Wright (Inmarsat – UK).

A major tanker disaster which took place in the Mediterranean waters was the Haven explosion on 11 April 1991 when a Cypriot tanker caught fire and exploded while at anchor seven miles off Genoa in Italy. The tanker which carried 144 000 tonnes of crude oil, broke into three parts and more than 10 000 tonnes of fresh and partly burnt oil were spilled into the sea before the ship sank. Within the week following the incident, floating oil affected beaches to the west of Genoa and strong winds buried oil in the sand. Some oil spread as far as the Hyeres near Toulon in France. The coast of Monaco was also affected. It took ten days before divers were able to stop the main leakage from the wreck.

NOTE – "Highways for Peace – Telecommunication Networks for the Mediterranean", Telemalta Corporation. ITU Document 2/139.

3.2.11 Forest Fires

Our national parks are constantly being threatened by a large number of forest fires throughout the year. There are approximately 125 000 forest fires annually of which 92% are the result of man-made causes. These "man-made" causes include fires that are the result of campfires that are not properly extinguished, the burning of debris to clear land, improper extinguishing of smokers' matches or other tobacco products, fires caused by some form of arson, and fires resulting from railroad workers and lumberjacks. The other 8% are made up of natural causes such as lightning or unknown causes.

Not all forest fires cause the same amount of damage. In fact, there are three different types of forest fires that each have their own level of damage. The first type is a surface fire. Surface fires burn surface litter, small vegetation, and other loose debris of the forest floor. These forest fires may and often do burn into the taller vegetation. The second type of fire is a crown fire. These fires advance from top to top of trees or shrubs. These are the fastest spreading of all forest fires. The final type of forest fire is ground fire. These consume organic material beneath surface litter of the forest floor. These are the most destructive and most difficult to control of all forest fires.

When a forest fire starts it may do a variety of things. First of all, it consumes woody material. This effect is most often used in slash burning and land clearing. Forest fires also create heat effects which kill living vegetation and animal life and damage the soil. They also produce residual mineral products which often create chemical effects. All of these effects are very damaging to forest life and harm our nation's parks.

One of the worst forest fires in a national park occurred in 1988 in Yellowstone Park. During this fire, 793 880 acres of land were burned. 41% of this land was burned forest, 35% was a combination of unburned, scorched, and blackened trees, 13% was surface burn, 6% was non-forest burn, and 5% was undifferentiated burn. Although this damage seems extensive, the recovery of the park has been proceeding rapidly. For example, areas that had mixed levels of burn and nutrient-rich soil have seen a significant increase in their crown biomass.

3.3 The Difficulties Facing Developing Countries in Protecting their Environment

The economies of most developing countries are based on the use of their natural resources.

Management of those resources require reliable up-to-date data which are often unavailable. The use of remote sensing and geographical information systems (GIS) constitutes one of the best low-cost means of filling this void. In many countries, remote sensing units have been established to produce information on the environment.

The introduction of the advanced technology required by remote sensing and GIS techniques involves a number of constraints including for example:

- inadequately trained staff;
- software failure;
- unreliable maintenance system;
- relatively slow data integration;
- inadequate budget ;
- reliance on outside assistance;
- relations with users;
- uninformed decision makers.

The problems encountered are often very diverse and depend on several factors (managerial staff, financial backers, etc.).

NOTE – Contribution to the Tunis Symposium, April 1996, "Implementation of information systems for environmental management: costs and constraints – The situation of Benin" by Vincent J. Mama and Marcellin Tchibozo.

3.3.1 Financing

As far as huge capital investments are concerned, sources of funding are not readily available. The budget allocations for the implementation of advanced technological options such as remote sensing and GIS nodes, which are essential for the operation of a basic environmental protection system, are inadequate in most countries. A relatively low-cost solution is sought in most cases which will incur possible delays.

3.3.2 Training

Human resource development has always been a major issue in most of the developing countries and it is no exception when it comes to protecting the environment. The financial constraints associated with the appropriate training of staff does hinder progress of activities. It must be noted that for a major part, developing countries depend on the developed countries for much of their technical training needs. Exploiting methods of delivering training for sustainable development is therefore the key issue.

3.3.3 Awareness of Appropriate Policies

In most developing countries, although significant importance is given to environmental protection at policy level, this information is not passed properly for the public to be made aware of. There is generally a lack of lateral information flow which is necessary for better implementation of appropriate policies at the National level.

3.4 Exploiting the Environment in a Positive Way aiming at a Sustainable Development

3.4.1 Eco-Tourism

Paradise on earth is under threat. The most inaccessible tropical rainforests, the most fragile coral reef systems, the remotest tribal peoples, are now within easy reach of the global ecotourist.

Ecotourism means all things to all parties from the tourist and the environmentalist, to the tour operator and government official. In its purest sense, it is an industry which claims to make a low impact on the environment and local culture, while helping to generate money, jobs, and the conservation of wildlife and vegetation.

Whether or not it lives up to its billing, it generates billions of dollars globally and is reported to be growing at a pace of 10-15% every year. Estimates fluctuate considerably, but according to the Canadian Wildlife Service over US$ 200 billion was spent on ecotourism activities in 1990 and much of this will have been spent in the South.

Many developing countries and international aid donors envisage a paradise gained. In a bid to tap the world's growing tourism markets, Southern governments have taken to marketing their natural beauty spots in a big way. For them, it provides much-needed hard currency for strapped economies, and being small scale requires less infrastructure to set up. It can also be less damaging to the environment than mining, logging and other commercial activities.

But it also threatens a paradise lost. Any tourism comes at a price. However aware the visitors, the sheer weight of numbers entering fragile environmental areas leads to severe environmental degradation, while local cultures are also disrupted. Just who owns this paradise is also critical, many foreign developers are buying up land and raking in a big share of the profits.

If ecotourism is to realise its potential, observers say the industry needs to be regulated and the impact of ecotourists strictly monitored. Crucially, developing countries need to make ecotourism part of national and local development strategies, involving local communities and distributing the wealth. But many critics say that ecotourism can only help developing countries in a small way and until crippling national debts and dependence on commodities is resolved, bankruptcy and mass poverty will continue to threaten the earth's last remaining beauty spots.

3.4.2 Aqua-culture and Fish Farms

The Aquaculture broadly refers to the research and development for the cultivation of aquatic organisms. Such programs include the culture of crustaceans, fish, molluscs, marine plants, ornamental fish, fisheries enhancement, training and education, and technology transfer. For example, the HBOI Aquaculture Division, in collaboration with academic, governmental and private research institutions, has designed and implemented culture systems for a variety of marine animals and plants in a 15 acre complex adjacent to the Indian River Estuary. The facilities include several laboratories, hatcheries, nurseries, covered raceways, a 20 000 gallon environmentally controlled recirculation system and a total capacity of over 1 000 000 litres of saltwater culture systems. A 40 acre Aquaculture Park has recently opened to further development of unique, new aquaculture technologies; collaborate with a broad variety of private sector commercial partners; and provide training of individuals interested in participating in the aquaculture's explosive growth worldwide.

4 Role of telecommunications in environmental protection

4.1 Need for Continuous Monitoring of Environmental Conditions

4.1.1 Use of Telecommunications

Telecommunications – A Potential Protecting Instrument

Telecommunication is sometimes referred to as the catalyst to the overall socio-economic development. It is used as a co-ordination tool in virtually any application; voice, data, video and multimedia communications are the most effective means of transferring information from one point to another. Keeping one informed of events that have occurred in the past, that are happening real time and that are likely to happen in the future is the context in which telecommunication is referred to in the case of environmental protection.

Telecommunication satellites observe current Earth conditions and movements, and transfer this data onto an information network capable of processing and analysing the measured data, and disseminate this information to the end user in a comprehensive manner. The result is the possibility of acquiring the necessary information and knowledge enabling urgent action to be performed, be it preparation for relief operation in times of potential disasters or simply the alert for travelling during bad weather. The difficulty for developing countries to access to the appropriate information should be underlined, as well as the necessity to provide them with the appropriate assistance in order to achieve this goal.

How Telecommunications can be used in the Transfer of Information in the Decision Making Process

Readiness with which information is available on various environmental scenarios is the key to efficient decision making. Telecommunication networks can carry a vast amount of information on a wide range of issues.

A more efficient approach is that of an Integrated Resource Management which is based on the premise of shared information, that is, easy flow of data from one sector to another. The revolutionary aspect of this approach will be that information passes not only vertically; i.e., it follows not only the usual hierarchical organization structure, but information flows also occur laterally, that is from one sector to another. The latter flow is then not necessarily restricted towards the top of the sector, as it may indeed occur predominantly at the level where the actual data is required.

The short-term and long-term benefits of IRM will be in having all the necessary data available whenever a need arises, thus enabling both prompt and sound decision making. The combined use of remote sensing, GIS and modern data communication infrastructure presents a necessary condition to carry out sound environmental management on a national and regional scale.

NOTE – "Highways for Peace – Telecommunication Networks for the Mediterranean", Anna Spiteri, Consultant to TeleMalta.

4.1.2 Disaster mitigation

Disaster remains a persistent problem that will never be eradicated but during times of disaster, even though there is very little one can do to stop them, it can be managed so that these effects can be mitigated. Effective disaster management depends on reliable communications. Unfortunately the communication most relied upon, wireline and cellular services, are the most vulnerable to disruption. It follows that the ideal communication tool in an emergency situation is the use of mobile-satellite services because they have several advantages over other means of communications such as, independence on existing infrastructure, high portability and relative cheapness.

Inmarsat

Inmarsat SCADA terminals support remote monitoring of natural hazards (volcanoes and high water levels) and early warning of seismic activity, storms, flash floods, earth slides and other natural phenomena in order to minimize their impact. Other applications for SCADA terminals include monitoring to help minimize environmental damage caused by accidents in nuclear and other power plants and chemical factories; by ruptures or failures of electricity supplies; by harmful agricultural forestry activities; and by pollution in harbours, rivers and lakes.

NOTE – "Using mobile-satellite services to protect the environment", David Wright, Inmarsat.

Iridium

Recently the Global Mobile Personal Communications System (GMPCS) has been the subject of much discussion within the world telecommunication community. The proposed IRIDIUM system which begins construction late 1996 is uniquely suited to the requirements of emergency communications. Based upon a constellation of 66 Low-Earth Orbit (LEO) satellite and twelve to fifteen gateways (which serve as interfaces between the constellation and the public switched telephone networks), Iridium will provide an unprecedented global telephone service. The service will enable a person to take one telephone anywhere in the world with the security of knowing that he or she will always be able to contact any other part of the world.

When an Iridium call is made, the phone first searches for a local cellular network. If one is found, the phone functions as a normal cellular telephone and the call is routed along the standard cellular paths. If no cellular network is found, the phone then becomes a satellite transceiver. The phone makes contact with one of the satellites which then routes the call through the constellation. The signal passes from satellite to satellite until the call is sent to the appropriate gateway, nearest to the call's destination, where it is then transferred into the public switched network. In cases of emergency, handset to handset communication via satellite is possible.

The application of Iridium technology to disaster mitigation is operationally defined as Global Response Emergency Telecommunications in that it enables the user to respond to an emergency situation anywhere in the world.

NOTE – "Role of Telecommunications and Information Technologies in Preventing and Combating Natural Disasters", Mademba Cisse (Iridium – USA).

Globalstar

The Globalstar system consists of a constellation of 48 Low-Earth Orbit Satellites and more than 100 Gateways will be strategically located throughout the World. The Globalstar system will provide Mobile Satellite Services supporting telephony, data and fax transmissions. The Globalstar system integrates with existing telephone networks, both fixed and mobile, to expand the reach of telecommunication services to areas currently deprived of them, and which need them the most – the remote and the rural areas of the planet.

With Globalstar portable, mobile or fixed telephone, a user can make calls to and receive calls from any telephone in the world from practically any place. The high reliability of the Globalstar system ensures the provision of cost effective, high quality communication services which are available 24 hours a day, all year around. The level of redundancy and dependability inherent in the system, makes Globalstar ideally suited to serve the needs of public safety, emergency services and disaster mitigation agencies. During critical situations, personnel of these agencies using Globalstar telephones are assured not only of obtaining telecommunication services from a reliable network but they also enjoy the benefit of receiving preferential access for its use. Additionally, all Globalstar users have the ability to place "priority" calls to local emergency service centres.

The Globalstar system's data transmission capabilities together with its reliable global reach meet the stringent requirements of remote monitoring, telemetry, scientific and environmental applications in support of disaster mitigation as well as disaster management.

NOTE – "Globalstar", France Telecom.

Other GMPCS

There are other Global Mobile Personal Communication Systems which have been designed to provide telecommunication services globally and which will function more or less like Iridium and Globalstar described above. Of these Teledesic will provide wide band capacity between any location on earth. Odyssey and ICO will also have a global coverage but with thin route connectivity. Intelsat will continue using the Geostationary Satellite Orbit.

4.2 Indirect Support

4.2.1 Decentralization and Environmental Preservation

Decentralization of economic and social activities is the main challenge for developing countries and this is vital to the minimizing of urban congestion. The relatively high cost of building the infrastructure in rural areas imposes a barrier to start with. It is desirable to put the telecommunication infrastructure in place before decentralization could effectively take place. The idea of decentralization is to create social structures which have smaller burden on the environment such as efficient management of waste and pollution and careful exploitation of natural resources. Telecommunications facilitate this process while ensuring the environment is preserved and managed efficiently.

4.2.2 Reduction of Energy Consumption

How telecommunications can be used as a substitute for travel

Research shows that teleworking in various forms is gaining momentum. It can help to establish jobs in less favoured regions, and it can contribute to the reduction of traffic and pollution. A large number of computer terminals or workstation based services can be provided today to support deployment of teleworking. However to establish telework as a real alternative to working on-site, new telecommunications services especially services allowing high quality, real time visual contacts will be needed.

NOTE – "Telecommunications and innovation in the Marketplace" by Anna Spiteri.

Info-communications will change people's lives and business activities by acting as a substitute for the movement of people and objects from one place to another. Some of the positive factors which affect the environment due to this substitution are:

- gas emissions such as carbon dioxide are drastically reduced;
- through the promotion of paperless society, the consumption of natural resources can be controlled;
- ability to assess energy consumption through detailed monitoring;
- reduction of energy consumption by making production activities and transportation more efficient.

  NOTE – H. Ikeda, "Info-Telecommunications Technologies as an Environmental Measure".

The environmental impacts of telecommunication equipment manufacturing

Telecommunications is rightfully regarded as one possible solution for the growing environmental concerns associated with the efforts to raise the standard of living and fulfil the basic needs of humanity for the whole mankind. Examples are easy to find; telework instead of daily commuting, better coverage for education, better understanding and follow-up of the state of the environment and telemedicine. While all of these telecommunication point us the way towards a sustainable economy and way of living the coin does have an alternative side. The massive growth of the telecommunications and information industry set unparalleled requirements to raise the efficiency of the resource usage in the primary product design as well as in efforts to close the material loops by recycling.

NOTE – "The Environmental Impacts of Telecommunications Equipment Manufacturing", Mikko Jalas (Nokia Research Centre – Finland).

First and very demanding requirement is to expand the traditional site-specific view to cover the whole life cycle of the products. Equipment manufacturers should be able to optimize the overall impacts of the products, not just the ones associated directly with their own operations. In fact, when selling an equipment you are selling also all the impacts that have been caused during the manufacturing chain, impacts which will be caused during the use phase and possibilities to recover value at the end of the life of the equipment. Next conclusion is that product development is the stage in which the impacts can be best managed.

The main environmental concerns during the course of a typical life cycle of telecommunication equipment can be stated as follows:

- usage of virgin, non-renewable resources;
- organic solvents during manufacturing;
- heavy metal releases of the plating processes;
- use energy consumption and the airborne emissions associated;
- used batteries of all portable equipment;
- waste of the obsolete equipment;
- heavy metal leaching from old equipment (copper, lead, tin);
- halogenated flame retardants setting strict requirements to incineration processes of plastics.

The electronics industry has been active in solving the above-mentioned problems. Products have been miniaturized due to technology development. This has yielded a far better resource efficiency. Weight per traffic channel in cellular base stations has declined. Some products have in addition a specified recycled material content. The manufacturing process impacts have been lessened with a rapid pace. Along with total phase out of CFCs in all Montreal Protocol signatory countries, also other volatile emissions have been reduced drastically. Waste water control has been tightened as well. Semiconductor and printed circuit board manufacturing continue to be most critical manufacturing steps.

The use phase energy consumption typically clearly dominates the overall environmental impacts. Reductions can be sought by software and hardware development. As an example of the previous the operating voltage decline and of the latter various sleep modes of products. The energy consumption of equipment such as telephone exchanges has declined. The share of portables is increasing with the various new applications. Battery technologies have enabled us to leave the old Ni-Cd technology where both metals were challenging for the recycling efforts. New power sources are continuously being developed with the aim to increase efficiency and ultimately shift to renewable sources.

The end of life management of obsolete electronic equipment is an art of its own. Manufacturers have been using Design-for-Recycling (DFR) guidelines which aim at high rate material recycling. Important targets are material harmonization and identification, ease of disassembly and elimination of any hazardous content. Simultaneously, the authorities are experiencing the flow of the first generation equipment, for which the present DFR activities do little good. At the moment such waste amounts to 6 000 000 annual ton in Europe and the figure is expected to reach 9 000 000 by the year 2000 (Hedemalm *et al.*, 1995). Clearly the solution is that the sources of materials for new products will be the old ones. With present mining rates the reserves of some key metals for the telecommunications industry will be quickly exhausted (Holmberg, 1995) as follows:

- Zn 20 years
- Cr 100 years
- Ni 55 years
- Cu 36 years
- Pb 20 years

More importantly, Holmberg argues that accumulation of metals from lithosphere to biosphere will force us to raise the recycling rates close to 100% before the actual resources will run out. Same applies to energy sources. The accelerated greenhouse effect will be the main driver of renewable energy sources instead of the exhaustion of resources (IPCC, 1996).

The direction is clear, but the industry needs catalyst. Such catalyst will be further developed eco-labelling. Public awareness and thereby willingness to pay premium for environmentally compatible product will turn the issue to competitiveness. This can already be seen in the increasing efforts companies are paying to build internal deep understanding of the overall impacts of their products. True competitiveness is not about the green glossy that we have seen in the past, but understanding the concept of life cycle thinking and sustainability and being able to communicate this understanding to your customers' mitigation.

Office and Factory Automation Systems

A number of advanced office automation and factory automation systems are already in use including floppy disk data transfer systems, paperless facsimile capabilities and a host of computer aided design and manufacturing (CAD and CAM) systems. As ATM-based ISDN deployment continues to drive transmission costs down, this will permit more volume intensive applications such as electronic newspapers to be offered. This will not only conserve paper but will also save energy needed to deliver the hard-copy equivalent.

NOTE – "Services and technical development in telecommunications for preserving the environment", ITU/Telecom 95 Technology Summit Vol. 1, Tomoyuki Toshima (NTT Interdisciplinary Research Laboratories, Japan).

Telemetry and Telecontrol

Quite a range of telemetry systems are already in the field to detect gas and water leaks, to monitor vending machine sales and for other remote monitoring tasks. Not only does remote monitoring obviate the need to send maintenance personnel into the field, it has even a greater environmental impact because there are fewer maintenance vehicles on the road.

4.3 Direct Support

4.3.1 Climatic Changes and Weather Forecast

Weather forecast, monitoring of climatic changes and dissemination of such meteorological information is one of the widely used environmental services today. The use of the Global Telecommunication System is next described as managed by the World Meteorological Organization.

World Weather Watch – WMO

The main purpose of the Global Telecommunication System (GTS) is to provide telecommunication services for the rapid and reliable collection and exchange of the required observational data, meteorological products and related information within the World Weather Watch programme with a view to meeting requirements of WMO members for operational and research needs in real time or quasi-real time. The GTS also gives telecommunications support to other WMO and related international programmes, including the Tropical Cyclone Programme, the International Decade on Natural Disaster Reduction, the Global Climate Observing System, the Global Ocean Observing System, Environmental Emergency Response Activities and also aspects related to follow-up action to the United Nations Conference on Environment and Development, and this support is expected to play an important role.

NOTE – "World Weather Watch – The Global Telecommunication System", Pierre Kerherve (WMO), April 1996.

GTS facilities are implemented and operated by States or Territories maintaining their own Meteorological Services which are WMO members (178). The organization and planning of the GTS and the overall coordination of its operation are the responsibility of the Commission for Basic Systems (CBS) of WMO and of WMO Regional Associations.

The GTS consists of a worldwide integrated network of point-to-point circuits, and multipoint circuits which interconnect meteorological telecommunication centres. It is organized on three levels, namely:

a) the Main Telecommunication Network (MTN);

b) the six Regional Meteorological Telecommunication Networks (RMTNs);

c) the National Meteorological Telecommunication Networks (NMTNs).

The MTN is the core network of the GTS. It links together the World Meteorological Centres and 15 regional Telecommunication Hubs. These are:

a) WMCs: Melbourne, Moscow and Washington;

b) RTHs: Algiers, Beijing, Bracknell, Brasilia, Buenos Aires, Cairo, Dakar, Jeddah, Nairobi, New Delhi, Offenbach, Paris, Prague, Sofia and Tokyo.

The MTN has the function of providing an efficient and reliable communication service between its centres, in order to ensure the rapid and reliable global and interregional exchange of observational data, processed information and other data required by its Members.

The RMTNs consists of an integrated network of interconnecting RTHs, National Meteorological Centres (NMCs), and Regional Specialized Meteorological Centres (RSMCs) and/or WMCs which are complemented by radio broadcasts where necessary. The RMTNs are to ensure the collection of observational data and the regional selective distribution of meteorological and other related information to Members. The RTHs on the MTN perform an interface function between the RMTNs and the MTN. The NMTNs enable the NMCs to collect observational data and to receive and distribute meteorological information on a national level.

The circuits of the GTS are composed of a combination of terrestrial and satellite telecommunication links. They comprise of point-to-point circuits, point-multipoint circuits for data distribution, multipoint-to-point circuits for data collection, as well as two way multipoint circuits. MTCs are responsible for receiving data and relaying it selectively on the circuits, to ensure its exchange and distribution as internationally agreed, in the appropriate form and with the appropriate operational procedures.

Satellite based data collection and/or data distribution systems are integrated in the GTS as an essential element of the global, regional and national levels of the GTS. Data collection systems operated via geostationary or near polar orbiting meteorological/environmental satellites, including ARGOS, are widely used for the collection of observational data. Marine data are also collected through the International Maritime Mobile Service and through Inmarsat. Data distribution systems operated either via meteorological satellites are efficiently complementing the point-to-point GTS circuits.

The adequate implementation of the GTS and in particular of the links between NMCs and their associated Regional Telecommunication Hubs, is of particular importance for enabling WMO Members to contribute their observational data to the World Weather Watch system, and to benefit from the system through the reception of meteorological data and products required for the provision of meteorological services to meet their national and international responsibilities.

4.3.2 Environmental Monitoring Mechanisms in Place

Geomatics

In order to tackle the growing complexity of problems relating to land use, it is necessary to have a whole set of methods and tools which are capable of gathering, handling and analysing data of various origins and types in order to supply relevant information which can assist decision makers. Geomatic tools in the form of Earth observation technologies (photogrammetry, remote sensing, global positioning systems (GPS), and geographical information systems (GIS)) are now preferred problem solving tools for land managers. These systems for gathering and management of data, combined with the tools of the engineer, offer the prospect of new studies: spatial analyses, impact evaluation, simulations of foreseeable phenomena, comparison of land-use planning scenarios, etc. These new information technologies thus represent an important element in rational land use management and environmental protection.

NOTE – "Role of Satellite Technology for Environmental Protection and Management", Dr. Giovanni Canizzaro and M. Ricottilli (Nuova Telespazio – Italy).

Remote Sensing

As far as environment monitoring and characterization is concerned, Earth Observation satellites have been in use for years, as an instrument for continuous environmental observation. At any one time, a number of diverse satellites are in orbit, providing continual observation of land, of the sea or of atmospheric conditions.

There are two different types of satellites which are distinguishable by their function:

- high spatial resolution satellites (a few metres), capable of distinguishing relatively small objects on the ground; they have a relatively small repetition time (some days);
- high repetition satellites, capable of frequent observation of the same object (every 1/2 to 6 hours); they are characterized by a smaller spatial resolution (hundreds or thousand metres).

The first category includes the French satellite SPOT (resolution 10/20 m), the United States LANDSAT 5 (resolution 30 m), the Japanese MOS (resolution 50 m) and the European radar satellites ERS-1 and 2.

The second category includes meteorological satellites, such as the METEOSAT, that enable continuous observation, or repeated daily observation, of a certain area of the Earth. This category includes AVHRR (Advanced Very High Resolution Radiometer) sensors, which are mounted on the NOAA satellites. Such data provides information relative to a single zone up to four times a day, with a nominal resolution of 1 100 m at ground level. The spatial resolution is therefore low, but NOAA data can provide information on the land for small scale applications (e.g. vegetation monitoring), information on meteorological conditions, both qualitative and quantitative information on the dynamics of ocean currents.

A basic application for the data provided by multi-spectral sensors (e.g., Landset, which works with 7 bands in the visible and infrared regions) or panchromatic ones (e.g., SPOT) is the identification and characterization of land features (basic cartography) and of land use and cover (thematic cartography). As far as the former is concerned, the goal is the identification and the characterization of objects on the Earth's surface (urban areas, roads, water bodies, crop fields, etc.) with the goal also of precisely locating them.

NOTE – "Role of Satellite Technology for Environmental Protection and Management", Dr. Giovanni Canizzaro.

Telecommunications

Mobile satcoms are used for reporting environmental data from small unattended terminals attached to remote environmental sensors.

In the maritime environment, Inmarsat satcoms coupled with sensors measure tide levels, current speed, sea temperature and salinity and atmospheric parameters such as temperature and pressure. While many of these systems are buoy-mounted, there are also applications on land. Applications include the remote monitoring and control of lighthouses, which calls for the reporting of atmospheric parameters and control of lights, foghorns, radio beacons and power generating equipment.

NOTE – "Using Mobile-satellite services to protect the environment", David Wright, Inmarsat.

4.3.3 Dissemination of Environmental Information

Many developing countries lack information on the state of their natural resources. In order to know where to begin a management programme, a country must have answers to a number of fundamental questions concerning its resources: available areas and types, their current use, conservation measures, critical spots requiring urgent intervention, etc. Telecommunication resources can be used to disseminate environmental information to the community.

4.4 New Technologies

Environmental Monitoring of the Amazon Region using a New Data Acquisition Method (by Santana, C.E. and Ceballos, D.C., INPE, Brazil)

The effective environmental monitoring of the Amazon region requires observation of phenomena – deforestation, forest fires etc. – that present rapid variation with time. This type of monitoring is not possible with the use of conventional synchronous satellites not only due to their long revisit time but also due to their data distribution being performed through a centralized agency, thus precluding the users from getting real time access of the data.

The above limitations can be circumvented with the use of Brazilian Remote Sensing Satellite, SSR, which is an unconventional low cost equatorial satellite of limited technological complexity that covers the region between 5 degrees N and 15 degrees S several times per day and transmits 100 m images directly to the end users.

The SSR satellite includes optical sensors especially designed for the Brazilian Amazon Region. It also utilizes a novel onboard data compression and distribution scheme that allows direct image reception by the end-users by means of inexpensive stations coupled to their processing computers.

The SSR system represents a great advance in remote sensing methods for the intertropical zone and will be an invaluable tool for the preservation of the rain forest.

4.5 Case Studies

The following case studies undertaken in various countries by different organizations show examples of how telecommunications have been used to support the protection of the environment. It is thought that developing countries may take advantage of these reviews in developing and promoting new applications for environmental protection in their countries.

4.5.1 Brazil

The Brazilian and Equatorial Belt Telecommunications Needs in Sustainable Development Support and Environmental Monitoring, Control and Enforcement (by Luis Antonio Waack Bambace, National Institute for Space Research INPE and Joao Mello da Silva, TELEBRAS)

Introduction

The lack of effective environmental control and monitoring implies in severe economic losses to developing countries. Predatory fishery which causes the reduction of abundance of many fish species and uncontrolled wood extraction and forest fires that can result in extinction of important species, are just two examples.

The problem is not to stop the use of natural resources, but discipline this use, in order to assure steady conditions. It is necessary to understand ecosystems in order to use them properly, without degradation, and preserving the biological diversity. Examples are many, like the swimming Amazon rice case and improvements in rice productivity in Brazil, and the discovery of carotene potential industrial source in an Amazon plant.

The fact that many developing countries do not benefit from bio-diversity use, does not mean that they cannot start to do so in the near future. The correct understanding of tropical ecosystems is important in order to find solutions that, while preserving the environment, aiming at providing developing countries population with good living standards, in a way compatible with their traditions. To do this job, efforts in environmental control, monitoring and enforcement, and in research are necessary. The role of the telecommunications infrastructure in this process is crucial.

Some Quantitative Aspects of Environmental Control in Brazil

The Brazilian territorial area corresponds to 8.5 million km^2, distributed in five major regions. The South and the Southeast, the two more developed regions of the country, correspond to 18% of the total territory and 58% of the total population. More than 80% of the population is concentrated in about 20% of the territory, near the coast or in the regions South and Southeast. In other words, roughly 80% of the total Brazilian territory, or 6.8 million km^2 can be considered low populated or remote areas, with a population of around 30 million people. As such, all of this part of the country is eligible to benefit from data collecting platform use and remote sensing.

Going to more specific figures, the Amazon region alone has about 4.8 million km^2, more than half in Brazil. The Pantanal region is another important ecological sanctuary, almost as big as the Brazilian Amazon. Even in the more developed regions, like the South and the Southeast, there are remote areas, like the Canastra Park, Ribeira Valley, and leftover areas of the Atlantic Forest. Many and wide remote areas mean a large number of ecosystems. Brazil has about 129 Ecological parks, 49 Protected Forest Areas with special preservation concerns, besides sea areas of equal interest. The 49 Protected Forest Areas in Brazil cover about 6% of the Amazon Forest and 2.3% of the other forests and relevant ecosystems.

As the principal environment related institution in Brazil, the Brazilian Institute for the Environment – IBAMA, is responsible for disciplining activities in many ecosystems, protecting the Brazilian fauna and flora, and maintaining the national parks. Other institutions do research in biotechnology and its use for sustainable development.

The main Brazilian ecosystems, namely the Amazon Rain forest, the Atlantic Forest, the Pantanal Seasonally Flooded Areas, the Cerrados, the prairie, the Northeast Drought Areas, the Coast Swamps, the Atolls, the Turtle reproduction beaches and the Shrimps Bank all need to be understood in order to allow the country to promote both the ecological zoning and new forms of occupation. In the Amazon, for instance, enhancing the presence of more commercial valued trees in its natural environment, like Rubber Para Nut and medicinal plants, it is possible to assure good life conditions to many people without destroying nature.

As biodiversity in the sense of species' richness is accepted to be a valuable indicator of stability in ecosystems, any multiple species production system, integrated with local ecological system, would be more sustainable than artificially established monocultures, and even some new multiple species cultures with less diversity. Stable ecosystems with native species and buffering zones will be useful in protecting biodiversity reservoirs, and will not change global balance. Good management of some of these areas will have a positive impact in increasing fishery potential on the Brazilian coast. Most of the pilot experiments are not in protected areas, some are under EMBRAPA responsibility, and some are initiative of NGOs. Other government agencies also have interest in monitoring them.

Consolidation of the Brazilian Environmental data needs

Data Collecting Platforms and remote Sensing alone are not able to gather all the environmental related information needed. In many cases, remote sensing systems need local access to some data for validation and calibration purposes.

Research Teams

The control needs for the areas mentioned above require about 3 000 technicians, most of them in areas without telecommunications facilities. These technicians perform many activities: transmit research reports, look for classificatory work information and send and receive images.

Besides these professional tasks, they need safety, and if possible better location facilities. They need to talk to home, in general out of commercial time. This puts a need on personal communications for the research crews. To supply at least one pager for each one of these technicians would be a fair goal, complemented by a telephone for each of around 200 stations, in addition to data collecting lines for the computers being used.

Data Collecting Platforms

The installation of Data Collecting Platforms (DCPs) for continuous monitoring of remote places is very important. If the 6% protected park area of the Brazilian Amazon are covered by the DCP for each 100 km^2, about 2 000 DCPs will be necessary to do the job, meaning investments ranging from $US 1 million to $US 3 million. Extending this approach to other protected remote areas, at least 3 000 DCPs would be necessary. Since other important ecosystems like the Pantanal and the Cerrados are not yet well protected, it is expected that more perks will be created, which would require 1 000 more DCPs.

Sea and River Monitoring

Another important point is sea monitoring, for fishery control, studies and effects of natural insurgencies and so forth. With cheap telecommunications, an increase is expected in the use of all kinds of buoys in the region. A minimum of 500 buoys, in addition to the present ARGOSs in the region, would be needed.

Regarding river control, the Brazilian Government currently uses 200 stations to measure rivers flow rate and to control dam level. The real need is estimated to be about 2 000, and will increase, as a function of the number of private small dams expected to be built in the future.

Control of Vehicles

In order to reduce smuggling by means of possible routes tracking, enforcement activities needs to control the river boat traffic and vehicles on land paths. The data collecting platforms in these places could also verify other useful information for meteorological, biological and economic purposes. An average distance of 40 kilometres among these platforms would result in 3 750 more DCPs. Governmental agents in charge of enforcement activities need telecommunications in terms of voice and pagers or both. A minimum goal would be to have two agents for each 10 000 km^2, which amounts to 1 200 agents.

Agriculture, Health and Security

The production of some of the natural resources threatened like alligators, will also reduce smuggling, but will require teaching people how to produce them. Some of the DCPs could also help the development of new forms of sustainable agriculture and cattle-breeding activities, integrated with the natural environment.

Considering rates varying from 1:1 000 to 1:500, the protection of the remote areas of population requires 30 000 to 60 000 enforcement agents. Using the same rates, an equivalent number of medical doctors, dentists, public health agents, and epidemiological specialists would be necessary. Currently, it is almost impossible to contact people in the field. Even at some health attendance places this is true, which reduces the efficiency.

Simple telecommunication facilities, like pagers, can be of great help in the task of providing health assistance and security to remote areas. Together, the public health care system and the enforcement agents would need from 60 000 to 120 000 2-way paging terminals.

All of the above Brazilian needs are summarized in Table 1.

TABLE 1

Brazilian Needs Consolidated System

Terminal	Quantity	Utilization	Observation
DCPs	6 000	Monitoring protect environment, parks, forests and reproduction sites	One DCP each 100 km^2 in the above 200 protected zones
DCPs	3 750	Enforcement and monitoring of forests, and ecological sanctuary out of protected areas	
DCPs	1 000	Dam Control	
Buoys DCP	500	Fishery control Artificial insurgency studies	Buoy in each important sea site like atolls, shallow neritic life zones
Variable Rate Data Terminal	1 000	Connecting computers of IBAMA remote areas people to Headquarters	
2-way pagers	3 000	IBAMA isolated area people	3 000 agents
Voice terminals	200	IBAMA advanced sites	Around 200
2-way pagers	1 200	Environment Protection enforcement and smuggling repression	Around 1 200 agents
Voice terminals	120	Environment Protection enforcement and smuggling repression	For chief agents
2-way pagers	30 000	Police support in remote area citizen protection	1 policeman to protect each 1 000 inhabitants
2-way pagers	30 000	Health care support in remote areas	1 health specialist to each 1 000 inhabitants
2-way pagers	1 000	Epidemiological surveillance	

Equatorial Belt Preliminary Needs Estimates

Taking the Brazilian data as reference, Table 2 shows very preliminary consolidated data for the equatorial belt of latitudes ranging from 27° South to 27° North, covering Brazil and 100 other countries. These figures represent an indicative framework, not exact figures.

ECCO System: A planned LEO Constellation covering the Equatorial belt

Historically, only telecommunications systems by geostationary satellites have been explored commercially. Improvements in cellular technology and signal processing algorithms are, however, forcing radical conceptual changes. These are leading very rapidly to large scale commercial utilization of Low-Earth Orbit (“LEO”) systems.

TABLE 2

Equatorial Belt Needs Consolidated Data

Terminal	Quantity	Utilization
DCPs	30 000	Monitoring protect environment, parks, forests and reproduction sites
DCPs	24 000	Enforcement and monitoring of forests, and ecological sanctuary out of protected areas
DCPs	12 000	Dam Control
Buoys DCP	3 000	Fishery control Artificial insurgency studies
Variable Rate Data Terminal	6 000	Connecting computers of IBAMA remote areas people to Headquarters
2-way pagers	18 000	IBAMA isolated area people
Voice terminals	1 200	IBAMA advanced sites
2-way pagers	7 200	Environment Protection enforcement and smuggling repression
Voice terminals	700	Environment Protection enforcement and smuggling repression
2-way pagers	200 000	Police support in remote area citizen protection
2-way pagers	150 000	Health care support in remote areas
2-way pagers	10 000	Epidemiological surveillance

Through LEO systems, technical possibilities are provided which guarantee readiness to offer Mobile-Satellite Services (MSS), greatly adding to the coverage and mobility of cellular systems. In addition, and especially for Brazil, constellations of LEO satellites possess unique characteristics to bring telecommunications infrastructure to remote regions or those with low population density.

The Brazilian Complete Space Mission (MECB). Under the coordination of the Brazilian Space Agency (AEB) created the basic conditions for Brazil's technological capabilities. As a consequence, new opportunities for telecommunications have appeared. The MECB achieved its technological development objectives in both satellites – developed at the National Institute of Space research (INPE) – and launching services – developed at the Institute of Space Activities (IAE), as well as the establishment of the Alcantara Launch Centre (CLA), the training of highly qualified personnel and the improvement of the Brazilian industry.

The MECB program culminated with a technical proposal for LEO satellites to provide telecommunications services to rural areas in Brazil. Such a system, denominated ECO-8, aimed at covering the Earth region between the Tropics of Cancer and Capricorn.

The ECCO System (commercial name for Equatorial Constellation Communications), an expected merger of the Brazilian ECO-8 System and the equatorial proposal of the American CCI System, is made up of a constellation of 12 satellites in circular equatorial non-geostationary orbit at an altitude of 2 000 km, covering the belt of 27° latitudes, which include Brazil and 100 other countries.

Besides telephony (fixed, mobile, fax), services of messaging and data communication (including telemetry, telecontrol and radiolocation) will be available. The ECCO target markets are all rural: rural properties, convergence points for payphones (like small villages), vehicles in the rural zones and remote data collecting systems.

Regarding markets, taking Brazil as a reference, there are 17 000 small villages without any form of telecommunications and, out of a total of 1.6 million rural properties with electricity, only 200 000 have telecommunications facilities. Adding to these numbers the demand associated to vehicles in the rural areas and the remote data collecting systems figures shown in Table 1, the rural market in Brazil is significant.

The total investment related to the space segment (12 satellites, four launchings, insurance, two satellite control centres, three network control centres, one digital control network and a 10% margin) is estimated between $US 500 million and $US 600 million.

The capacity of the ECCO System over Brazil is 300 000 access lines. Considering all the equatorial belt, the total capacity adds up to 1.5 million lines. The possibility of dividing the cost of an installed access line by five constitutes a strong motivation for the international use of the ECCO System throughout the equatorial belt.

Considering the low rates generally associated with remote data collecting devices, the total traffic due to the remote data collecting systems for the whole equatorial belt will not require any over dimensioning of the space segment.

Conclusion

The developing countries of the equatorial belt have strong telecommunications needs for environmental monitoring, public health support, law enforcement and smuggling repression. Currently, these needs are not fulfilled due to the lack of systems economically compatible with the overall telecommunications low traffic of the remote and low population density regions. LEO constellations systems, like the planned ECCO System, specially designed for providing telecommunications for rural and remote areas in Brazil, are possible solutions. The extension of the ECCO services to the entire equatorial belt can be economically very attractive for Brazil and also for all the other countries in the region.

4.5.2 European Commission (EC)

EU RTD Programme Activities on Telematics Applications and Services in the Domain of Environment (by Wolfgang Boch, EC Telecom)

The Specific Programme “Telematics Applications of Common Interest” includes in the 4th Framework Programme (1994-1998) on Research, Technical Development and Demonstration of the European Union a total of twelve sectors, among them a new sector, Telematics for the Environment. The Telematics Application Programme deals with the application of information and communications technologies and services and aims to promote the competitiveness of European Industry, help promote the efficiency of services of public interest, and stimulate job creation through the development of new telematics systems and services. The explanatory action on the Environment with a total budget of 20 MECU, aims to investigate and demonstrate the potential value added and the appropriateness of multimedia telematics solutions for protecting and improving the environment and to support corresponding EU policies.

As a result of the first call of proposals (closing date 15 March 1995) 18 projects have been retained and were included in the Commission Decision from 26 July 1995. Twelve demonstrator projects will start their work in 1996 in a number of environmental applications such as integrated air quality control, water quality monitoring, public environmental information services, catalogue of data sources, eco-auditing, or forest fire management. The applications are based on existing technologies such as, Geographical Information Systems, Database Management Systems, Multimedia Graphical Interfaces, Client Server Systems, Remote Sensing, Satellite Communications, ISDN World Wide Web/Internet etc.

Telematics applications are addressed in two major environmental domains: Firstly, environmental monitoring, information and control systems for the purpose of improved reporting, planning, forecasting, and decision making, and secondly, global emergency management systems to improve prevention, risk assessment, risk analysis and crisis management for time critical events, in case of man-made and natural disasters. Furthermore, European environment information services and applications, in support of the objectives of the European Environment Agency (EEA) and the Centre of Earth Observation (CEO) are pursued.

Environmental managers from public authorities from more than 25 European Regions and 20 European Cities are involved in the projects in the form of public-private partnerships, ensuring an efficient implementation of the “user-driven-approach”, stipulated as one of the key objectives of the Telematics Application Programme.

For more information contact:

Wolfgang Boch	Tel:	+32 2 296 35 91
European Commission Telecommunications	Fax:	+32 2 296 23 91
Information Market and Exploitation of Research	E-mail:	wbo@dg13.cec.be
B-1040 Brussels		
Belgium		

4.5.3 Finland
The Role of Telecommunications in the Protection of the Environment (by Eila Rummukainen, Telecom Finland)

Strategic Importance of Telecommunication for the Protection of Environment

Telecommunication has a real strategic role for the protection of the environment. It helps us to use working methods that cause less pollution as well as to monitor pollution and other environmental problems and also give the important information of the protection methods to the public. This contribution covers five different views of the roles of telecommunication in environmental protection:

- telecommunication services in environment monitoring;
- telecommunication services to deliver environmental information;
- telecommunication as a less pollutive way to work;
- telecommunication services in environmental catastrophe situations;
- materials and working methods in telecommunication network from the environmental point of view.

Since the use of telecommunications is a really cost-effective way to protect environment, it is good to use telecommunications wherever it is possible. Telecom Finland has experience in all these five areas.

The role of telecommunication in environmental monitoring

To monitor the environment there has to be monitoring equipment, analysing equipment and software and an ability to transfer this information from the monitoring place to the control centre. Telecom Finland has developed a special network for these monitoring applications. The network concept is named as “Safenet”. It is used by different Finnish authorities and companies for distance monitoring including radiation and forest fire monitoring. The Safenet concept includes the possibility to use different telecommunication networks to transfer the information from the scene to the control centre including PSTN, Data Networks, Mobile Networks and ISDN and also the possibility to deliver the information further to those people who shall take care of the action.

The use of telecommunication services to deliver environment information

If we want to keep people aware of environmental aspects it is important to make the information easily available. One easy way is to develop public bulletin board services or build these bulletin boards based on Internet so that they can be used internationally.

Telecommunication services as a less pollutive way to work

Telecommunication is much more environment-friendly than travelling. Services that can help us to avoid travelling are for instance:

- normal telephone calls;
- telefax;
- electronic mail;
- telephone conference;
- videoconference;
- telemedicine.

In Finland, much of these services are used for distance learning, distance working and negotiations. Telemedicine can be used instead of transfer of patients.

Telecommunication services in catastrophe situations

In catastrophe situations it is really important to get information of the catastrophe as soon as possible. The best and the fastest way to get vocal and pictorial information is using telecommunications. Based on this information it is possible to decide how many and what type of people have to be sent to help in these situations. Also experts can contact people who are working in catastrophe places and give advice.

Selecting materials and working methods to build telecommunication network

Most important points to consider in building networks are:

- select materials from environmental point of view (including recycling and disposal);
- power consumption of the network;
- minimize the use of materials that can attack environment (for instance, different solvents);
- radiation of mobile and satellite communication;
- to reduce travelling in building and maintenance of network by better planning.

Finland PC based weather service (by Auli Keskinen, Ministry of the Environment, Finland)

The Finnish Meteorological Institute (FMI) provide weather, climate and air quality services in Finland. It is a member of WMO and has a national node on Global Telecommunication System (GTS). FMI has a long experience in networking especially Internet as well as in satellite communications. FMI also develops multimedia applications in meteorology for customers.

The PC based weather service provided by FMI has the following features:

- data based on radars and satellites;
- professional interpretations of data added to conventional ground observations and soundings;
- tailor-made forecasts;
- animation used in presentations;
- “Nowcasting” and real time updating.

The Weather Window which is the main software operating on PC/Windows brings up to date weather information to your doorsteps wherever you are and at a very low cost. Communication by Internet, mobile phone or modem is possible. Services include Meteosat satellite animations, radar animations, forecasts, wind forecasts etc. A basic service is available to the general public at low cost. However for more elaborate services, special arrangements would have to be made with FMI.

Advanced Data Transfer in Environmental Monitoring (by Dr. Harri Toivonen and Mr. Janne Koivukoski)

To improve the monitoring of environmental radiation caused by nuclear accidents, the Finnish authorities have built an integrated system for exchange of information and for retrieving monitoring data from remote stations in real time. The modern data communication systems are an essential requirement for a successful management of the radiation situation during an accident.

System Architecture and workstation performance

The main task of the Finnish system, known as SVO+, is to collect, maintain and present an overall view of the current radiation situation in the whole country. The system is based in the client/server architecture and on SQL Oracle database. Radiation measurement results (external dose rate, nuclide concentration and deposition etc.) as well as weather information and air parcel trajectories are collected from various sources and stored in the database (Unix-server HP9000). The end-users have PC workstations for communicating with the server and for presenting the information on digital maps. The data communication protocol is TCP/IP.

Users’ workstations are ordinary MS-DOS personal computers equipped with the Windows operating environment. In addition to communication through the data network, dial-out telephone lines or GSM cellular telephones may be utilized, thus allowing the access of data through portable computers.

The user interface is built above MapInfo desktop mapping facility (MapBasic and C++). The background maps consist of country and district boundaries, towns and population centres, road network, nuclear installations, monitoring sites etc. Additional maps may be easily included.

When the user logs into the system he will automatically receive a basic system information showing the status of the monitoring network, alarms and maximum dose rate during latest interrogation. He will also receive basic data files including radiation and weather data. The workstation can also be used locally in a stand-alone mode.

Usually the user selects the data from a list showing the identifications of the pre-made files but authorized users can access the database freely. The data are displayed as various thematic maps, tables, line graphs and histograms. Data can also be edited.

The workstation incorporates functions for starting and interrogation of the monitoring network, making action plans, attending discussions in a radiation authorities’ bulletin board and preparing reports which may be printed out or faxed directly.

The user interface includes also a group of models that can be used locally to predict, for example, the consequences of a nuclear detonation.

Automatic Data Collection

Most of the external dose rate are collected from the country-wide automatic monitoring network which is connected to the server through public telephone lines. The network has now some 300 automatic stations (Rados Technology Ltd.).

The dose rate detectors consist of two different GM tubes. This allows the detection of a very wide range of radiation levels. i.e., from 0.01 $uSvh^{-1}$ to 10 Sv h^{-1} over an energy range of 50 keV to 3.0 MeV. The measured dose rate values (normally up to 864 readings) are saved in the internal memory of the detector.

The detectors are controlled by special software which is able to poll stations at present or irregular intervals, to receive alarms, to store measuring results and to change the data acquisition parameters. The alarms and the measurement data are sent automatically from the computers (PC) at the district alarm centres to the central Unix server.

The Finnish Meteorological Institute sends to the system via TCP/IP protocol every three hours wind and rain information from Northern Europe. In addition trajectories calculated by the FMI can be used for predicting the fallout areas and the time of arrival of the radioactive cloud; furthermore, trajectories calculated backwards in time can be used in estimating the possible source of detected radioactive substances.

Manual input – enhanced data collection in an emergency

The first warning signal of rising dose rates comes most likely through notification channels or from the automatic monitoring stations. However, the overall view of the radiation situation can be improved via manually operated stations. The routine measurements, carried out once a week, maintain the operative preparedness. When the intensified monitoring is ordered, the manually operated stations record the dose rate in short intervals and report the results to the local governments (12 in Finland) that can transfer them into the central database.

In areas between the fixed monitoring sites radiation monitoring patrols will be used (if necessary). The Finnish civil defence organizations have some 20 000 portable dose rate monitors (GM tubes) and about half of these instruments are modern digital radiation gauge. Local fire brigades take normally care of the patrolling.

Mobile units

The system can receive data, relayed either through a cellular telephone network or a satellite, from mobile radiation patrols utilizing GPS positioning. STUK has an emergency vehicle equipped with the instrumentation suitable for the measurement of dose rate, nuclide-specific air concentration and deposition. The results of these measurements can be seen in the headquarters in real time. The communications are based on cellular phones (GSM or NMT900).

Transfer of results to the database

In a routine situation the system polls the automatic dose rate monitoring stations once a day but the authorized users may select any group of situations for a special interrogation and read the results immediately. The system is capable of calling several stations concurrently and thus the results from the whole country will be obtained in 15 minutes.

The workstation software allows the input of manual data as well. Any point on the map can be chosen and the corresponding radiation monitoring results can be sent to the database. In addition, the data can be transferred from other systems (TCP/IP), provided that they are in a predefined data exchange format.

The server computer not only loads the data into the relational database but also updates files of dose rate figure at intervals of one hour or even at shorter intervals (10-15 minutes). The use of these files facilitates the viewing of the results and reduces greatly the amount of database queries. Once the files in the intensified follow-up mode are ready, the system sends a message to all workstations logged in the system. The workstation screens are then updated automatically (optional service).

Handling of alarms

When the system receives an alarm signal from the monitoring network it will initiate an alarm handling procedure. It sends an alarm message to the pagers defined in a separate alarm list and to the operator of the computer centre. The latest monitoring results are read automatically from the stations located within the radius of 50 kilometres from the station causing the alarm. Thus the radiation situation in a large area is available within minutes from the alarm. Furthermore, authorized users have the possibility of manually sending alarm messages from their workstations.

Conclusion

In a radiation emergency it is necessary to obtain quickly the comprehensive overall view of the situation. The Finnish SVO+ system, combined with automatic monitoring stations and sophisticated data communication systems, has been designed and built to meet this challenge.

4.5.4 India
Forest Fire Modelling Using Remote Sensing and GIS: A Case Study From Northeast India (by Hussin, Yousif Ali, Sharma, Neeraj)

Forest fire has an important influence on the vegetation cover, dependent fauna, soil, stream flow, air quality, microclimate and perhaps even general climate. The loss of the timber is obvious and so is the damage to life and property. The loss of recreation value of the forest and the destruction to wildlife are also readily perceived. However, the damage to the protective value of the forest is not equally discernible. The question is whether the extent and seriousness of the damage justifies the cost and effort of preventing or suppressing fire outbreaks. The obvious answer is to try to avert forest fire by knowing the susceptibility of the disaster previously.

Forest fire, the effect of natural and man-caused catastrophe has emphasized the need for developing a broader view of many natural processes. It is quite clear that an innovative approach on fire hazard area modelling requires the use of new techniques for obtaining, processing and displaying spatial information in a timely and cost effective manner. This brings remote sensing and geographical information systems into the scenario.

This study is focus on a national park situated in the foothills of the great Himalayas in Northeast India. This area has suffered many fires during this and last century. The main objective of this study is to develop a fire hazard rating model using simulation techniques, assist in fire risk zone mapping, and explicitly be used for effective forest fire management in this region.

The results show that the proposed fire hazard model preformed appropriately in identifying the areas subjected to higher fire risk. A comparison with areas actually affected by fire gives perspicacity about the pertinence of the selected variables and the hazard groups distinguished within them. The successful integration of the model into GIS initiates the process of operationalization of this model.

Correspondence:

Yousif Ali Hussin
The International Institute for Aerospace Survey and Earth Sciences (ITC)
P.O. Box 6, 7500 AA Enschede
Netherlands

Fax: 31 53 874 399
E-mail: hussin@itc.nl

4.5.5 Japan

Info-telecommunications Technology as an Environmental Measure (by H. Ikeda, Institute for Posts and Telecom. Policy, Japan)

In Japan, even the basic plan on the environment enacted by the Cabinet on 16 December 1994 pointed out that Info-telecommunications would not only contribute greatly to facilitating communication, by acting as a partial substitute for transportation and by reducing paper usage would also help reduce the burden on our environment. Based on this plan, Japan is conducting various research on the relationship between informalization and the environment from a broader perspective.

NOTE – H. Ikeda, "Info-Telecommunications Technologies as an Environmental Measure".

Calculating the effects of Info-telecommunications technology on the environment

The Ministry of Posts and Telecommunications conducted a quantitative analysis using a case study to see to what extent a system utilizing info-telecommunications technology would reduce the burdens on the environment. The results are:

1) introduction of a teleconference system and its effects on improving the environment;

2) a survey was taken of 200 organizations and firms on their usage of teleconference system;

3) division of service counters at citizen service centres and effects on improving the environment;

4) introduction of personal computer communications and its effect on improving the environment.

A Cross-cultural Study on Transportation Substitution by Telecommunications (by Yudi Wada, IFTECH, Japan)

Aim

In protecting the environment, telecommunication and information technologies have three roles to play. They are transportation substitution, pollution monitoring and saving energy and natural resources. In this study we focus on the quantitative analysis of transportation substitution effect by telecommunications. Urban congestion is a serious problem in many developed or developing countries. In developed countries there are some studies or countermeasures on telecommunication substitution but very few researches existing in developing countries.

Conclusion

In this study we have estimated the transportation substitution effect by telecommunication in the United States, Japan and Thailand. In the United States and Japan related papers and articles were surveyed and in Thailand some field studies were conducted.

Each country or city has its own transportation substitution feasibility and effect. In conclusion there are three conditions which determine this effect. The first is the dominant transport mode in the city, which means automobile or train, mass transit or personal vehicle, and their coverage ratio.

The second is the level of telecommunications infrastructure. In developed countries or metropolitan areas, high penetration of telecommunication network enables the substitution of transportation. On the other hand, in developing countries, the level of telecommunication infrastructure restricts transportation substitution ratio and in other words, telecommunication infrastructure have an important role to play in substituting transportation.

The third is the difference of national character or life style in each country. Acceptability of telecommunication substitution depends on the character whether it is individualistic or collective in communication activities. It is necessary to connect telecommunication infrastructure with regional transportation projects and to define it in the total development planning.

TABLE 3

Penetration Ratio of Telephones

	Tokyo	New York	Bangkok
Telephone Lines	6 041 869	4 750 409	900 941
Population	8 079 000	7 320 000	7 523 000
Penetration ratio (lines/population)	74.8%	64.9%	12.0%

TABLE 4

Trip mode for commuting

Mode	Tokyo	Bangkok	
		Executives	Ordinary staff
Car	8.4	94.7	39.2
Taxi		11.7	24.0
Bus	0.6	11.7	45.9
Motorcycle	1.2	4.3	12.8
Walk		2.1	3.2
Train	89.9	0.0	0.0
Boat	0.0	1.1	3.2

TABLE 5

Saving Emission by Substitution of Transportation

	Emission from Road in Thailand	Emission from Road in Bangkok	Emission from Passenger Vehicles in Bangkok	Emission Saving by Substitution in Bangkok
SO	57 000 t	13 908 t	11 970 t	1 149 t
NO	177 000 t	43 188 t	37 170 t	3 568 t
CO_2	5 404 000 t	1 318 576 t	1 134 840 t	108 944 t

4.5.6 Tunisia
Use of Satellite Imaging for Monitoring and Prevention of Floods in Tunisia (by Mr S. Bacha)

In January 1990, torrential rain poured down on central and southern Tunisia for fifty hours, causing very extensive damage. Following this disaster, the Centre National de Teledetection (CNT) undertook studies using remote sensing with the aim of:

- mapping the damage caused by the floods (first phase);
- finding a speedy solution to the problem (second phase).

During the first phase, a comparative study was carried out, based on digital processing of SPOT XS images between a dry scenario (1988) and a wet scenario (1990), generating maps of the damaged areas.

The aim of the second phase of the study is to produce a risk map according to the return period of the rain. Such a map is obtained by combining different illustrative maps of the plain, some obtained from SPOT images (land use before flooding, effects of the flooding; limits, sand deposits, changes in the wadi bed) and others from outside sources (various networks, pedology, digital terrain model). The approach followed takes advantage of the facilities offered by geographical information systems.

Project for the Establishment of a Transborder Distributed Environmental Data Bank in Tunisia (by A. Kaanicche, S. Ben Abdallah, Ministry of the Environment and Land-Use Planning)

The purpose of this Data Bank is to process and analyse, on the basis of common geographical reference system, all different available data relating to various aspects of the environment and sustainable development. It has three basic functions:

1) Collection of data available in environmental measurement networks such as that of National Land Office (OTED) and in existing project and studies.

2) Transmission of this data through server centres to the nodes of the telecommunication system. In addition to their data transmission functions, these server centres will fulfil an intermediary data filtering and processing function, thus introducing a “value added” dimension; the SDN (Sustainable Development Network) could prove highly effective in this context.

3) Use and interpretation of the data received, drawing on any auxiliary sources available (databases, geographic information system) and any models that may assist in the analysis of the existing and foreseeable environmental situation.

In its operational phase, the prime users of the system will be the central administration of the Ministry of the Environment and Land-Use Planning (DGAT, DEU, DEI, DCNMR), the National Environment Protection Agency, the Coastal Protection and Planning Agency, network operators, in particular the National Public Sanitation Office (ONAS), environment and planning departments in the different ministries, municipal authorities, decision makers, NGOs and neighbouring countries in view of its transfrontier dimension.

Manner of Implementation

Configuration of the System in terms of Information Technology

The Configuration to be adopted for the Transborder distributed Environment Data Bank in Tunisia is that of distributed data processing systems in which data are stored in a number of computers that are interlined by computer networks. This calls for a combination of three facilities:

- intercommunicating hardware (work stations linked to each other and to a server);

- a network connecting the hardware and permitting communication;

- software providing for retrieving and transfer of data to the network.

These functions are to be performed by three types of mutually complimentary software; the operating system, the network management software and the geographical information system software.

The configuration will allow each department or institution to manage its own data at its own work stations, while permitting access to others on certain conditions through a national or international network. Centralized management of the system is also possible by means of a dedicated server whose role would be to maintain the cohesiveness of the database and make it accessible to users.

Economies of scale are possible through a Distributed Environmental Data Bank (the MIPS cost being lower than on a mini or large scale system). It provides more flexible computer structures and facilities data sharing. However, management of distributed data would be much more difficult, especially in the absence of adequate arrangements for transparency of access and data security and sharing. Moreover, resource allocation (disks, power, memory) is less flexible in as much as each operator needs a complete work station even if it is not in permanent use.

Although the idea of a Distributed Environmental Data Bank is very attractive, it poses numerous problems for application managers and makes even more rigorous claims on the system administrator. Three levels of communication may be identified:

- Hardware – there are two ways of making hardware communicate: connection by means of a direct link between each component, or involvement of a medium such as magnetic tape or diskette.
- Software – various types of software are used in the communication process. In the case of a direct connection, the software must be able to control exchanges, from the lowest level (control of signals, coding/decoding) to the application level (software that allows machine X to read from a database on machine Y). Lastly, software is needed to format the data so that they are readable by another machine or another software program.
- Data – once a certain amount of hardware and software is operational, the data must be transferred from one medium to another. Dialogue between machines occurs when computers are interlinked. If the distance is not too great (a few hundred metres), a local network will be used or a gateway between local networks if they are already integrated into different networks. If the distance is as much as a few kilometres, they will be connected by a switched telephone network or a dedicated link.

Description of the content of the prototype

In this prototype phase, Tunisia's TDEDB will contain data on land-use management and the environment. In the area of land-use management it will contain:

1) General basic data by commune, delegation and governorate:
   - carto-graphic records
   - socio-economic indicators
2) Basic data on infrastructure and services:
   - public utilities, private services and businesses
   - industry, sanitation
   - household refuse
   - transport
   - tourist activities and facilities, etc.
3) Basic data:
   - natural resources, energy resources, water resources, arable land, meteorological data, natural hazards
   - socio-economic data
   - infrastructure
   - investment, etc.
4) Study findings:
   - blue prints for land-use planning
   - regional atlases of governorates, etc.

Data on the environment will concern:

a) Industrial environment: air pollution, water pollution, etc.
b) Urban environment: household refuse, noise, polluting agents, etc.
c) Conservation of nature and the rural environment: natural resources, green belts, forests, biodiversity, desertification, etc.

The Transborder Dimension of the Data Bank

As protection of the environment is a global challenge on which the survival of the Earth and the human species depends, it is important, even crucial, to link our DEDB with other global environmental data banks in order to exchange information in both directions.

It is planned to link up with major environmental networks: ENVIRONET of the European Community and the United Nations MERCURE network.

Conclusion

The Transborder Distributed Environmental Data Bank in Tunisia will shortly become an essential tool for day-to-day work and decision-making. Flexible management makes for ease of communication, whenever necessary, with other partners and, in particular, when regional, national, international and sectorial systems have been installed.

Links between the DEDB and other transborder environmental systems would provide an opportunity to study many aspects of the use of environmental data: availability and quality of data, exchanges and standardization, uses and needs.

In its operational phase, the DEDB should make it possible to exchange all kinds of data thus constituting a system of environmental control and crisis management based on the use of geographical information systems as an aid to decision making.

4.5.7 United States
The GLOBE program

The Globe Program is a hands-on environmental science and education program that join the students, educators, and scientists from around the world in studying the global environment. The objectives of the GLOBE program are:

- to enhance the environmental awareness of individuals worldwide,
- to increase scientific understanding of the Earth, and
- to improve student achievement in science and mathematics.

NOTE – "The GLOBE program: Globe Learning and Observations to Benefit the Environment", Document 2/180 contributed by the USA to Study Group 2.

Globe is a worldwide network of K-12 (or equivalent) students working under the guidance of teachers trained to conduct the GLOBE Program. Globe students:

- make a core set of environmental observations at or near their schools,
- report their data through the Internet to a GLOBE data processing facility,
- receive and use global images created from worldwide GLOBE school data, and
- study environmental topics in their classrooms.

The environmental science community is involved in the design and implementation of the GLOBE Program to ensure that GLOBE environmental measurements will make a significant contribution to the global environmental database. Over 100 international scientists have participated in selecting GLOBE scientific measurements, developing measurement procedures, and ensuring overall quality control of data.

Students make measurements in the areas of atmosphere/climate, hydrology/water chemistry, and biology/geology. The data acquired in these areas will support environmental research and other environmental science programs.

Grade-appropriate GLOBE educational materials have been developed by international environmental educators for use in GLOBE schools. GLOBE teachers attend regional workshops to learn how to teach the measurement procedures, how to use the GLOBE data reporting technology, and how to use GLOBE visualization products as instructional materials. Over 2 000 US schools are participating in GLOBE 1995.

Broad international participation is integral to the design of the GLOBE program and to the achievement of its objectives. Over 110 countries have expressed interest in GLOBE and, to date, 28 countries have signed bilateral agreements to participate in the program.

For more information on the GLOBE Program, visit the GLOBE Home Page on the Internet HTTP:// WWW.GLOBE.GOV

5 Guidelines and Recommendations for Implementing Telecommunications Support for Environmental Protection

5.1 Need for Environmental Protection Policies taking into Account the Role of Telecommunications

In the light of the previous chapters, it is evident that telecommunications could play an indispensable role in protecting the environment. Most developed countries use telecommunication means more effectively than most of the developing countries in supporting environmental protection programmes. While environmental protection remains a high priority in most countries, the recognition which telecommunications deserves is yet to be considered. A regulatory framework in order to strengthen and encourage the use of telecommunications has to be established.

It is imperative that the important role of telecommunications be at least indicated in the national environment protection policies so that its appropriate recognition may be achieved thereby ensuring closer coordination between the telecommunications and environment entities nationally, regionally or globally.

5.2 Creating Better Awareness among Policy/Decision Makers

The effective use of new telecommunication and information technologies in protecting the environment is subject to the extent to which these new concepts and ideas diffuse into the regulatory frameworks and barriers. Policy makers play an important role in deciding the direction of such technologies, how they may be combined with related applications, integrated into networks and ultimately achieve full benefits of the final products. The manner in which information is structured and transferred with a view to making it easily accessible and readable is important; creating a better awareness of the concepts among decision makers remains a key issue.

5.3 Creating an Integrated Network for Collecting, Processing and Disseminating Environmental Information

The protection of our environment, be it natural, cultural, social or economic, requires a collective effort from different players in all walks of life not only at national level but also at global level. People do not live in isolation in this world anymore and it is true to say that the world has become a place within reach of virtually every individual living on it. The so called Information Superhighway carries timely information on almost every aspect of human life and it is there to take every advantage of. While most developed countries have entered into an era of information exchange and delivery, most of the developing countries are still struggling to get the basic telecommunications network in place in their rural and remote areas.

An integrated information network has become the essential tool for disseminating information and the modern telecommunication means are capable of establishing such a network in the quickest of times. Collection, processing and transfer of information related to environment such as early warning for possible disasters, weather service, monitoring of environmental conditions, requires such an integrated network. In addition to the numerous services it can offer, the network would act as a means of creating a better awareness and more importantly as an effective tool for decision making.

Achieving Economies of Scale – Integrating Telecommunications for Environmental Protection with other Applications such as Telemedicine and Tele-education

Due to the high costs involved in the implementation of an information network, it is apparent that using the network exclusively for environmental purposes would not justify the investment. However, economies of scale can be achieved through combining several applications and integrating them over one network. Telemedicine is one example of such an application that could be used in conjunction with environmental applications. Tele-education is another important area of application.

5.4 Recommendations

See Document 2/218(Rev.2).

5.5 Annexes

Annex 1 – Results of the Questionnaires

With a view to reflecting the programmes implemented for environmental protection and the extent to which telecommunication is been used in different countries, the response to the questionnaire is simplified in the form of a spread sheet which is shown below. The column headings in this sheet indicates the main questions asked in an abbreviated text while the rows list different countries who responded.

Over 40 countries responded to the questionnaire. It must be noted that out of the countries who responded more than two thirds were from developing countries. The majority of the parties who responded to the questionnaire were Ministries of Environment or Environmental Organizations.

Nearly all of the countries are faced with natural disasters in one form or the other ranging from earthquakes to flooding, tidal waves to forest fires or hurricanes to erosion. One of the major concerns which added to this is the fact that most of the countries do also suffer from various environmental hazards or degradation caused due to human activities such as industrialization, over-fishing, deforestation, urban congestion, solid waste etc.

In most countries telecommunications are being used to some extent to support environmental protection programmes; however, for various reasons, full benefits of using telecommunications network have not been exploited given the wide range of environmentally sound technology which telecommunications could offer. With a few exceptions, all the countries do have national policies related to environmental protection. It is not clear if these policies emphasise the use of telecommunications.

Annex 2 – List of Contributions

Annex 3 – Bibliography

Annex 4 – The Environmental Protection Agencies and Other Related Institutions

ANNEX 1

Results of the Questionnaire

Countries	Who responded?	Natural disasters	Major environmental concerns	Is telecom used in environment protection	If no, are there any future plans to use telecoms?	Environmental conditions monitored by	Information disseminated by	Who has access to information?	Main activities and programmes	Any special studies?	Funding source for projects	Any national policies or regulations related to environment?
Explanatory Notes												
		1. none 2. earthquakes 3. drought 4. volcanoes 5. flooding 6. tidal waves 7. forest fires 8. others	1. air pollution 2. urban congestion 3. industria-lization 4. nuclear waste 5. pollution in rivers 6. overfishing 7. defores-tation 8. others			1. satellite 2. mobile terminals 3. remote sensing 4. others	1. newspaper 2. television 3. radio 4. Internet 5. others	1. general public 2. urban areas 3. rural areas 4. research institutions 5. closed user group 6. others			1. research institutions 2. Ministry of environment 3. Telecom organization 4. foreign aid 5. international aid 6. others	
Belgium	EO	2, 5, spring tides, storm	1, 4, 5	no	–	2, 4, network	1, 2, 3, authority publications	1, 4, 5, 6	?	yes	5	yes
Botswana	ME	3, 5, 7	2	no	no	not sure	1, 2, 3	1	–	not sure	not sure	not sure
Brunei	ME	–	solid waste	yes	–	4, telemetry	workshops		yes	–	–	yes
Burkina Faso	ME	3, 5	2, 5, 6, 7	yes	–	3	1, 2, 3	1, 2, 3, 4	yes	yes	5	yes

Results of the Questionnaire *(continuation)*

Countries	Who responded?	Natural disasters	Major environmental concerns	Is telecom used in environment protection?	If no, are there any future plans to use telecoms?	Environmental conditions monitored by	Information disseminated by	Who has access to information?	Main activities and programmes	Any special studies?	Funding source for projects	Any national policies or regulations related to environment?
Cambodia	ME	3, 5, 7	1, 2, 5, 6, 7	no		4	1, 2, 3, 5	1, 2, 4	yes		1, 2, 4, 5	yes
Canada	TO	5, 7	1, 4, 5	yes	–	1, 2, 3	1, 2, 3, 4	1, 2, 3, 4, 5	yes			yes
Chad	TO	3, 5, 7, 8	2, 5, 6, 7, 8	yes	–	3, 4	1, 2, 3, 5	1, 2, 3, 4, 5, 6	yes	no	–	yes
China	TO	2, 3, 4, 6, 7	1, 2, 3, 4, 5, 6, 7	yes, information for decision making		2	1, 2, 3, publications	1, 2, 3, 4, 5	yes, trans-century green projects	no	1, 2, 4, 5	yes
Colombia	TO	2, 3, 4, 5, 6				1	1, 2	1, 2, 3, 4	yes			no
Cuba	TO	8, hurricanes	2, 7, erosion	yes	–	1, 4	1, 2, 3, 5	1, 2, 3, 4, 6	yes	yes	1, 5	yes
Denmark	EO	1	1, 5	yes		1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	yes			yes
Estonia	ME	2, 3, 5, 7	1, 3, 4, 5, 6, 7	yes		1, 2	1, 2, 3	1, 2, 3, 4	yes		–	yes
Ethiopia	ME	3, 5, 7	2, 5, 7	yes	–	1, 3	1, 2, 3, 5	1, 2, 3, 4	yes	no	4, 5, 6	yes
Ecuador	EO	–	1, 2, 3, 5, 7, 8	yes	–	1, 2, 4	1, 2, 3, 5	1, 2, 3, 4	yes	yes	–	yes
Finland	ME	5, 7	5	yes	–	1, 2, 3	1, 2, 3, 4, 5	1, 2, 3, 4	yes			yes
France	ME	3, 5, 7	1, 2, 4, 5, 8, nitrates	yes		2, 3, 4	3	6			2	yes
Gabon	ME	5, 6	1, 5, 6, 7	yes			1, 2, 3, 5	1, 2, 4	yes	yes	2, 4, 5	yes
Germany	TO	5	1, 4, 5	yes		1, 2	1, 2, 3	1, 4, 5	yes	no	2	yes
Kenya												
Kuwait	ME,TO	1	1, 2, 3, 5	yes, communication for marine pollution control		2, wireless set	1, 2, 3	1, 4	no	no	1, 2, 4	yes
Malta	TO	2, 3, 5	1, 2, 5, 6, 7, waste dumping	no	yes		1, 2, 3, NGO	5, 6	yes	yes	2, 5	yes
Maldives	TO	6	2	no	no	1	1, 2	1		no		yes

Results of the Questionnaire *(continuation)*

Countries	Who responded?	Natural disasters	Major environmental concerns	Is telecom used in environment protection?	If no, are there any future plans to use telecoms?	Environmental conditions monitored by	Information disseminated by	Who has access to information?	Main activities and programmes	Any special studies?	Funding source for projects	Any national policies or regulations related to environment?
Mexico	EO	2, 3, 4, 5, 7	1, 2, 3, 4, 5, 7	yes		1, 3	1, 2, 3	1, 4	yes	yes	2	yes
Moldova	TO	2, 3, 5	1, 2, 3, 4, 5, 6, 7	no	yes	–	1, 2, 5	1, 2, 3, 4, 5	yes	no	–	yes
Monaco	ME	2	1	yes	–	–	1, 4	1, 6	no	no	2	yes
Norway	EO	5, 7, storms, landslides, avalanches	1, 5, 8	yes		water samples, air quality	reports by ME	1	yes	no	–	yes
Oman	ME	3, 5, 7	1, 3, 6, 8	yes	–	4	1, 2, 3	1, 2, 3, 4	yes	no	–	yes
Portugal	TO	2, 3, 4, 5, 7	2, 3, 5, 8	yes	–	1, 2, 3, modems	1, 2, 3, 4, 5	1, 4, 5	yes	yes	2, 3, 6, EC Funds	yes
Saudi Arabia	TO	2	1, 2, 3	yes	–	1, 3	1, 2	4, 5	yes	yes	1, 2	yes
Senegal	EO	3, 5, 7	2, 3, 6, 7	yes	–	1, 3	1, 2, 3	4, 5, 6	yes	no	4, 5	yes
Singapore	ME	5, 8	2	yes, telemetry		telemetry	1, 2, 3	1, 4	resource conservation, public education, noise management	no	1, 2, 4, 5	yes
Spain	TO	3, 5, 7	2, 5, 7	yes		1, 2, 3	1, 2, 5	1	yes	no	2	yes
South Africa	EO	3, 5, 7	1, 3, 4, 5, 7	no	not yet	–	1, 2	4	yes	no	4, 5	yes
Sri Lanka	TO	3, 5	1, 2, 3, 5, 7	no		1	1, 2, 3, 5	1, 2, 3, 5	yes	no	–	yes

Results of the Questionnaire *(end)*

Countries	Who responded?	Natural disasters	Major environmental concerns	Is telecom used in environment protection?	If no, are there any future plans to use telecoms?	Environmental conditions monitored by	Information disseminated by	Who has access to information?	Main activities and programmes	Any special studies?	Funding source for projects	Any national policies or regulations related to environment?
Sudan	EO	3, 5, 7, Desertification	1, 2, 3, 5, 6, 7, waste disposal	yes		1, 3	2, 3, decision makers, NGO	4, 5, 6	yes	no	4, 5, 6	no
Switzerland	ME	2, 3, 5, 7, 8	1, 3, 5, 8	yes		2, 3, 4	1, 2, 3, 4	1, 4, 6	yes	yes	1, 2, 5	yes
Tanzania	EO	2, 3, 5, 6, 7	2, 3, 5, 7	no		1	1, 2, 3	1, 2, 3, 4	yes	no	2, 4, 5	yes
Thailand	ME	2, 3, 5, 7, Land slide, cyclone	1, 2, 3, 5, 6, 7	yes		2, 3	1, 2, 3, at school	1, 4, 5,	yes	yes	2, 4, 5	yes
Turkey	ME	2, 3, 5, 7, erosion	1, 2, 3, 4, 5, 6, 7, noise pollution, oil discharge	yes, for industrial accidents and at sea		2, stationary devices	1, 2, 3	1, 2, 3, 4, press, NGO, univ	yes	no	1, 2, 4, 5, 6	yes
UK	TO	1	1, 2, 3, 4, 5, 6, cars	yes	–	1, 2, 3	1, 2, 3, 4	1, 4	yes	no	–	yes
Uganda	TO	2, 3, 5, 7, 8	1, 2, 5, 6, 7, Famine	yes, met observation		1, 3	1, 2, 3, drama, seminars, education system	1, 2, 3, 4, 5, NGO	environmt education, monitoring, waste management	no	1, 2, 4, 5, local companies, NGOs, schools	yes

TO = Telecommunications Operator

EO = Environmental Organization

ME = Ministry of the Environment

ANNEX 2

List of Contributions

Contributions to the Study Group Meetings

Document 2/5 “Using Mobile Satellite Services to Protect the Environment”, Inmarsat, United Kingdom

Document 2/49 “A study on Environmental Protection and Information Communications”, Noruma research Institute, Japan

Document 2/139 “Highways for Peace – Telecommunication Networks for the Mediterranean”, Telemalta Corporation

Document 2/151 “Services and Technical Development in Telecommunications for Preserving the Environment”, ITU/Telecom 95 Technology Summit Vol. 1

Document 2/180 “The GLOBE program: Globe Learning and Observations to Benefit the Environment”, United States

Final Report Vol. I, World Telecommunication Development Conference, Buenos Aires, March 1994

“Telecommunications for Protection of the Environment: The Role of UNESCO”, UNESCO

“The Use of Remote Sensing for Disaster Mitigation: A Review of some of the International Integrated Systems and Applications”, Anna Spiteri, Consultant to TeleMalta

“Enabling Technologies for Better Quality of Life”, Anna Spiteri, Consultant to TeleMalta

Contributions to the Tunis Symposium, April 1996

1) “Info-Telecommunications Technologies as an Environmental Measure”, H. Ikeda, Institute of Post and Telecom. Policy, Japan

2) “The use of Full Duplex MSS as a Strategic Option for Environmental Applications”, Luis Antonio Waack Bambace (INPE), Joao Mello da Silva (Telebras) and Cassio Bastos, (Brazilian Space Agency) – Brazil

3) “A cross cultural Study on the Environmental Protecting Utilizing Telecommunications”, Yudi Wada, Institute of Future Technology – Japan

4) “The Role Telecommunication for the Protection of the Environment”, Eila Rummukanen, (Telecom Finland – Finland)

5) “Geomatics for Sustainable development”, Mohamed Ben Ahmed, Amor Laaribi (Lab de Recherche en Inform. Arabisée et en Documentique Intégrée – Tunisia)

6) “Guidelines and Associated Conditions on Information Infrastructure and Economic Activities for Sustainable Development and Environmental Protection”, Decio Castilho Ceballos (INPE – Brazil)

7) “The Environmental Impacts of Telecommunications Equipment Manufacturing”, Mikko Jalas (Nokia Research Centre – Finland)

8) “Project for the Establishment of a Trasborder Distributed Environmental Data Bank in Tunisia”, A. Kaaniche (Ministère de l’Environnement et de l’aménagement du Territoire – Tunisia)

9) “The Brazilian and Equatorial Countries Communication Needs in Sustainable Development Support and Environmental Monitoring, Control and Enforcement”, Luis Antonio Waack Bambace (INPE), Joao Mello da Silva (Telebras) – Brazil

10) “Project for the Real Time Management of Water Resources in Oum-Er-Rabia Basin”, M. Derrar (ONPT – Morocco)

11) "Global Radio Spectrum Requirements for Environmental Management" Pekka J. Kostamo (Vaisala Oy – Finland)

12) "Environmental Monitoring of the Amazon Region Using a New Data Acquisition Method", Carlos Eduardo Santana and Castiho Ceballos (INPE – Brazil)

13) "Role of Satellite Technology for Environmental Protection and Management", Dr. Giovanni Canizzaro and M. Ricottilli (Nuova Telespazio – Italy)

14) "Information System for the Conservation and Management of Natural Resources", Mohamed Rached Boussema (Lab de Teledetection a syst. d'information a recherche spatiale – Tunisia)

15) "World Weather Watch – The Global Telecommunication System", Pierre Kerherve (WMO)

16) "Remote Sensing of Earth Environment by Radio and Light Waves", Dr. Ken'ichi Okamoto (Communication Research Laboratory – Japan)

17) "Role of Telecommunications and Information Technologies in Preventing and Combating Natural Disasters", Mademba Cisse (Iridium – United States)

18) "Use of Satellite Imaging for Monitoring and Preservation of Floods in Tunisia", Sinan Bacha (CNT – Tunisia)

19) "PC Based Weather Service", Auli Keskinen (Ministry of the Environment – Finland)

20) "Network Survival in Emergency Conditions", Dr. G. Miranda (Telecom Italia – Italy)

21) "Protecting the Environment with the Help of Mobile Satellite Services", David Wright (Inmarsat – United Kingdom)

22) "The Protection of Telecommunication Networks against Lightening", A. Zeddam (France Telecom)

23) "Satellite Watch in the Sudano-Sahelian Region: the Situation of Senegal", Racine Kane (Centre de Suivi Ecologique – Senegal)

24) "Contribution of Radasat Sapace Radar Data on the Study of Soil Deterioration in the Menzel Habib Region", S. Bacha, A. Belghith, M. Jeddi, H. Khateli (CNT – Tunisia)

25) "Role of Telecommunication and Information technology in the Rural development", M. Boumzebra (ONPY – Morocco)

26) "Information Technology Infrastructure and Environmental Opportunity and Challenge", Hans Bundgaard (LM Ericsson – Sweden)

27) "Processing and Training System for GIS and RS", Dr. A. Cumer (Centro Interregionale di Coordinamento e Documentazione per le Informazioni Territoriali) and Dr. P. Mogorovich (CNUCE – CNR – Italy)

28) "Advanced Data Transfer in Environmental Monitoring & Demonstration", Dr. Harri Toivonen (Finish Centre for Radiation and Nuclear Safety – Finland) and Janne Koivukoski (Ministry of the Interior – Finland)

29) "EU RTD Programme activities on Telematics Applications and Services in the Domain of Environment", Wolfgang Boch (EC Telecom, Info. Market & Exploitation Research – Belgium)

30) Implementation of Information Systems for Environmental Management: "Cost and Constraints – Situation of Benin", Vincent J. Mama and Marcellin Tchibozo (CENATEL – Benin)

ANNEX 3

Bibliography

[1] "An Action Plan for the Human Environment", chapter IV, para. 67-77. Report on Conference on Human Environment, Stockholm, 1972, A/Conf.48/5.

[2] "Report of the Governing Council of the UN Environment Programme", first session, Geneva, 1973, para. 13-87.

[3] Global Environment Monitoring, SCOPE report, 1972.

[4] Intergovernmental Working Group on Monitoring Meeting, Geneva, August 1971.

[5] Report of Intergovernmental Meeting on Monitoring, Nairobi, 1974.

[6] Report of Governing Council of UNEP, third session, Nairobi, 1975, item 7b of agenda.

[7] Report of Governing Council of UNEP, third session, Decision, p. 16 of text on GEMS.

[8] UN General Assembly report of twenty-seventh session, Res. 2997.

[9] Report of Governing Council of UNEP, seventh session, General Debate, para. 83-86; Decision 7/4.

[10] Report on "In Depth Review of Earthwatch", 1981.

[11] Report on "In Depth Review of Earthwatch", 1981.

[12] Report on Governing Council of UNEP, seventh session, Decision 7/II.

[13] Resolution IV of Governing Council at its session of a special character, 10-18 May 1982.

[14] Vienna Convention on the Ozone Layer, Vienna, 1984; Montreal Protocol to Vienna Convention, Montreal, 1986.

[15] Report of Governing Council of UNEP, fourteenth session, 1987, Decision 20.

[16] UN Conference on Environment and Development, Rio de Janeiro, June 1993, Decision.

[17] Report of Government Council of UNEP, thirteenth session, 1985, Report of the Executive Director, p. 8.

[18] Report of Government Council of UNEP, sixteenth session, 1991, Decision 16/37.

[19] UN Conference on Environment and Development, Rio de Janeiro, 1993.

[20] UN General Assembly, forty-eighth session, 1993, Resolution 193.

[21] December 4, 1995 Abstract of the lecture on "Review of the State of the Ozone Layer: Scientific Uncertainty and the Ozone Regime" delivered by Dr. Rumen D. Bojkov of the World Meteorological Organization (WMO) on the occasion of the 10th anniversary of the Vienna Convention for the Protection of the Ozone Layer, Austria Conference Centre, Vienna, 4 December 1995.

[22] ITU Council Document C96/27, 21 May 1996.

ANNEX 4

Environmental Agencies/Institutions

- International Maritime Organization (IMO)
- World Meteorological Organization (WMO)
- UNDHA
- United Nations Environment Programme (UNEP)
- Greenpeace
- European Environmental Protection Agency
- UNESCO
- etc.