

# **R&D to Promote Environmental Protection**



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## 1. Contributing to a Sustainable Society through IT

#### http://www.ntt.co.jp/kankyo/e/2000report/4/411.html

The rapid development of information technology (IT) has fostered radical changes in business models and business styles, making a significant contribution to reduced environmental impact in a variety of fields. Specializing in IT, the NTT Group aims to maximize the potential of information technology for the benefit of society and the environment.

#### **Ecology Networks**

#### ■ Significance of environmental information sharing systems

that go beyond the mere collection of involved in monitoring air and water quality information or isolated local efforts. and studying potential applications of the Environmental information sharing systems resulting information in environmental educan be an effective way to promote environ-cation programs. The environmental mental activities on a global scale. Ideally, education programs are conducted jointly such systems can be constructed to enable with Ecology Community Plazas established the following:

- Understanding not only of the present but of past environmental conditions;
- Communication of a variety of relevant Joint Project information covering social economies, history and culture, as well as the natural environment, to generations to come;
- Cooperation and exchange beyond the boundaries of local communities, promoting enhancement of environmental awareness and unity;
- Broad- based support for environmental initiatives, ranging from individual households and local communities to international efforts.

#### Ecology networks defined

a wide range of environmental activities. pheric environment. (Fig. 4.1-1)

ronmental information by local governments, in general environmental education, and in environmental research at universities and other institutions.

Today, a great deal of effort is required for quantitative definition, comprehensive evaluation, and appropriate disclosure of the potential relationship between environmental, lifestyle and business information when nals for ease of transportation and dealing with environmental protection issues. installation, while enabling remote operation Research to develop solutions to these and and simultaneous measurement at multiple other environmental concerns is being con- locations via telephone networks. The easyducted through ecology networks.

#### ■ IWATE-UNU-NTT Environmental **Network Joint Project**

Launched in September 1998, the IWATE-UNU- NTT Environmental Network Joint Project is a collaboration between Iwate Prefecture, the United Nations University Environmental issues are global concerns (UNU), and NTT Group. The project is by the Iwate Branch of NTT East.



http://www.ias.unu.edu/ecology/

Ecology Community Plazas at Iwate Branch http://eco.iwate.isp.ntt- east.co.jp/

## Nitrogen Dioxide **Monitoring System**

An ecology network is a typical example of aThe NTT Lifestyle and Environmental lifestyle environmental information sharing Technology Laboratories have been engaged system. Environmental information reported in R&D on atmospheric monitoring techby private individuals as well as information nologies since fiscal 1991. This research has gathered by various sensors is accumulated resulted in the successful development of into databases at regional environmental equipment capable of easily measuring airinformation centers. This information is made borne nitrogen dioxide concentrations, a available to the public, providing support for significant step toward improving the atmos-

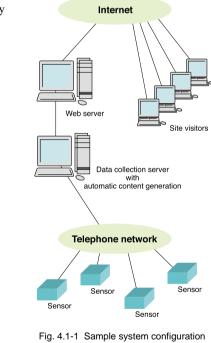
Specifically, ecology networks are Monitoring of nitrogen dioxide is particuexpected to play a role in disclosure of envi-larly important because nitrogen dioxide is:

- Inadequately controlled by existing environmental standards;
- Exhibits fluctuations in density depending on time and place, thus requiring multiple, simultaneous measurements;
- Often generated by unpredictable occurrences such as traffic congestion.

The NTT system features compact termito-operate terminals can also be used as Internet tools for environmental education.

Results of measurements taken at Sendai City Museum of Science and other educational facilities in Miyagi Prefecture

http://sendai- no2.mcon.ne.jp ብ



## **Multimedia**

#### **Communications Services** for Teleconferencing

#### Advantages of multimedia communications services

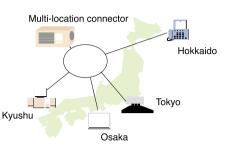
The NTT Group provides a variety of multimedia communications services through its nationwide networks. Multimedia communications enable people to exchange information from remote locations, minimizing the need to transport people and equipment and thus reducing energy consumption and exhaust emissions.

#### Desktop simulation of teleconferencing

The Lifestyle and Environmental Technology Laboratories has conducted desktop simulations to determine the effectiveness of teleconferencing (Fig. 4.1-2) in minimizing environmental impact. At a teleconference, participants in remote locations can interact as if they were present in the same meeting room by exchanging images and voices over a network. As teleconferencing is targeted as an important multimedia communication service, the simulations were structured as follows:

- A total of 1.657 teleconferences were held at NTT (the holding company) during a single year (limited to conferences recorded in the multi-location connector):
- Environmental impact was calculated based on power consumption of system equipment (monitors, cameras, speakers, etc.) and telephone networks used for each teleconference (assumed to last for two hours);
- Hypothetical environmental impact of various means of transportation (trains, buses, planes) was estimated, assuming that conferences had been held on-site with actual attendees (each conference assumed to require two attendees from each remote office and last for two hours);
- Environmental impact of on-site conferences vs. teleconferences were compared and evaluated.

As a result, it was evaluated that teleconferencing reduces CO<sub>2</sub> emissions by approximately 85% and energy consumption by approximately 74% compared to on-site conferences. (Fig. 4.1-3)





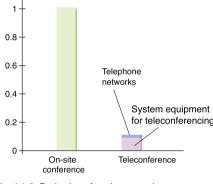


Fig. 4.1-3 Reduction of environmental impact by teleconferencing

The initial simulation evaluated operational aspects only. Further study based on LCA (Life Cycle Assessment) is planned to evaluate the environmental impact of teleconferencing equipment from initial production to final disposal.

## **Electronic Commerce**

In 1999, the number of Internet users in cooperation with participants from the public Japan increased from 17 million to 27 mil-at large, successfully demonstrating the seculion. This increase has been accompanied by rity of electronic cash. a surge in Internet-based trading (electronic commerce). The value of B2C (business-toconsumer) transactions grew from ¥170 The NTT Group will expand its focus to billion to ¥350 billion, while B2B (business- include development of technologies for to-business) transactions grew from \$2 authentication and network security as we trillion to ¥14 trillion. continue our research into applications for electronic commerce.

#### Network-based information distribution

Traditionally, trucks and other forms of transport have played the major role in the physical distribution of goods. With the introduction of electronic commerce, intangi-



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ble information-based products such as music and games have become available through network-based distribution. This eliminates the need to maintain stocks or to rely on media (CD-ROMs, etc.) for distribution of goods. Offering significant reductions in energy consumption, network-based information distribution shows great potential for environmental protection. Digitally recorded music, for example, can be distributed through networks quickly and with much less impact on the environment. On the other hand, as digital data can be copied easily, with no deterioration in quality, certain types of network-based distribution could conceivably interfere with the fair sale and distribution of goods.

#### Overcoming technical difficulties

Electronic commerce requires effective measures against unauthorized data copying. The NTT Group has solved this problem by developing a technology that locks the memory card to which purchased music is originally downloaded and makes it impossible to read any other memory card to which the music is copied. This technology paves the way for widespread network-based music sales.

Payment systems pose another security problem for electronic commerce. Secure and efficient systems for exchanging money and goods are essential for promoting conversion of physical distribution into network-based information distribution.

The NTT Group has developed technologies for electronic cash secured by codes. Reliability and convenience of this technology were tested in actual experiments in



#### 1. Contributing to a Sustainable Society through IT

#### **Intelligent Transport** Systems (ITS)

The traffic situation in Japan can be characterized by the following two facts:

- The national economy incurs a loss of about ¥12 trillion annually from traffic congestion:
- Approximately 11% of automobile fuel consumption is wasted in congested traffic conditions.

Intelligent Transport Systems (ITS) based on advanced information communication technology are under development with the aim of creating transportation solutions in which environmental impact is reduced safely and efficiently by maximizing the synergy of people, automobiles and roads. (Fig. 4.1-4)

Entrance proces Jser's home Exit processing Network Reservation Discounted parking fees retailers, etc. center

> Fig. 4.1-4 Sample ITS system (Intelligent Parking System)

The NTT Group provides and supports a wide range of information for car navigation systems through mobile telephone networks. This useful information includes:

- Optimized reports on road conditions;
- Useful information for drivers (location of parking lots and service stations, etc.);
- Automatic reports of accident locations to emergency centers (rapid rescue systems):
- Reports on obstacles and impediments to traffic flow (advance warning systems).

The Group is also engaged in research and development of:

- IC card-based parking reservation systems:
- Intelligent parking systems for entry and exit from parking facilities;
- Simulators for design and evaluation of communication technology-based ITS services.

Congestion-caused air pollution should be significantly reduced as these and other technologies to smooth the flow of traffic become implemented.

## **Odor-based Water Quality Monitoring System**

Oil and chemical spills are not only sources of environmental pollution but can also cause serious damage to purification plants producing and supplying water for daily use. Measures to minimize pollution damage at the approximately 4,000 purification plants in Japan include early detection, oil fences. and shutdown of water intakes. Water intakes were shut down 32 times in 1998, 2.3 times more frequently than the previous year.

#### Crystal oscillator odor sensor system

The Lifestyle and Environmental Technology Laboratories have developed a crystal oscillator odor sensor system, which can detect petroleum gases at extremely low ppb<sup>1</sup> concentrations. Performing the function of the human sense of smell, the system permits on-line, permanent monitoring of abnormal water odors.

In developing the system, it was necessary to achieve stable environmental conditions for precision performance by controlling fluctuations in temperature and humidity that easily affect the delicate sensor. Another challenge was to ensure effective gasification of pollutants by efficient intake of surface water, where pollutants tend to be concentrated.

#### Characteristics of the system

- Ability to detect petroleum gases at extremely low ppb concentrations in dry atmospheric conditions;
- Automated operation, from sampling of river water to output of measurement results;
- Continuous on-line monitoring.

The basic configuration and an example of kerosene-polluted water detection are outlined below.

Measurement of kerosene-polluted water is indicated by the response of odor sensor output along a time line. Frequencies indicated on the vertical axis correspond with the volume of odor molecules detected by the sensor (1ng/1Hz). Fig. 4.1-6 shows the increase in the volume of odor molecules detected by the sensor with the passing of time.

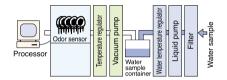
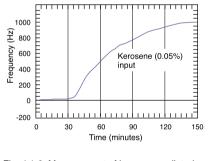
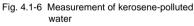


Fig. 4.1-5 Odor-based water guality monitoring system





Further development is underway to achieve higher sensitivity and improve precision in identifying types of pollutants by lowering the regulated humidity requirements.

1ppb Parts per billion. Indicates pollutant concentrations as low as 1/1 billion

# environment.

In addition to adopting specific programs to reduce environmental impact, the NTT Group also emphasizes R&D on new energy sources and state-ofthe-art technologies. Our goal is to reduce consumption of limited natural resources and develop equipment, systems and products that can be put to use with minimal impact on the

http://www.ntt.co.jp/kankyo/e/2000report/4/421.html

and new charging methods, the NTT **Telecommunications Energy Laboratories** have succeeded in extending the life span of nickel metal hydride batteries to approximately eight years. (Fig. 4.2-1) Plans are underway to develop nickel metal hydride batteries with a life span as long as the equip-



To ensure the reliability of communications systems, information communication services utilize various types of batteries, including back-up batteries, which function as life lines in case of power outages. Although sealed lead-acid batteries are typically used as back-up batteries at present, a new generation of light-weight, high-capacity batteries will be needed in the future, when every home is provided with advanced services through optical fiber cables.

#### Nickel-cadmium batteries

Nickel-cadmium batteries are marketed as compact, light-weight back-up batteries to replace sealed lead-acid batteries. The effective life of a nickel-cadmium battery is normally less than three years. By introducing new constituent materials and other innovations, the NTT Telecommunications Energy Laboratory has developed nickelcadmium batteries with a life span of ten years, making them suitable for use as backup batteries for optical access networks.

#### Nickel metal hydride batteries

Currently, research is underway to extend the life span of nickel metal hydride batteries, which are compact, lighter and free from poisonous cadmium. Nickel metal hydride batteries currently on the market are designed to be repeatedly charged and discharged for reuse. With a life span of approximately 1.5 years, these batteries are not suitable for back-up use. This is due to the difficulty of maintaining a full charge for emergency use. By devising new materials

ment that they power. (%) 120



Fig. 4.2-1 The life span of nickel metal hvdride batteries

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## **Stand-alone Photovoltaic Power Systems**

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The NTT Telecommunications Energy Laboratories are developing compact and economical photovoltaic power systems for use as stand-alone power sources for outdoor telecommunications equipment. Solar cells are clean power generators that do not produce CO<sub>2</sub> emissions.

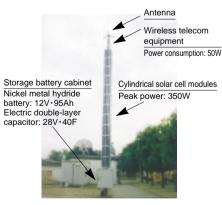
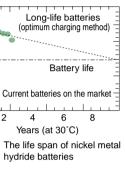


Photo 4.2-1 Stand-alone photovoltaic power system

## 2. R&D to Promote Reduction of Environmental Impact



Conventional stand-alone photovoltaic power systems use flat solar cells and leadacid batteries. These require a large installation area and a concrete base. To reduce both installation area and cost, we developed a system that uses cylindrical solar cell modules and nickel metal hydride batteries. (Photo 4.2-1)

#### Cylindrical solar cell modules

Newly developed cylindrical solar cell modules can be mounted directly on a telecommunications pole. Maximum power point tracking control (MPPT)<sup>1</sup> increases the efficiency of the cylindrical solar cell modules by 15%. Large-capacity nickel metal hydride batteries are installed as storage batteries. An intermittent charging unit using an electric double-layer capacitor was developed to enhance charging efficiency of the nickel metal hydride batteries by more than 85%. Compared with conventional systems, this new system can reduce installation area by 90% and installation cost by 20%.

Reliability of the system is being verified through field tests in preparation for commercial use.

<sup>1</sup>MPPT: An automated control method that can optimize output power from the solar cell in consideration of solar irradiation and the solar cell temperature



#### 2. R&D to Promote Reduction of Environmental Impact

# Recycling of Plastic Using Supercritical Water

The volume of waste recycled by the NTT Group is increasing year by year. Plastic wastes, however, are difficult to recycle due to their massive volume and the wide variety of materials used in their manufacture. To deal with this dilemma, the NTT Lifestyle and Environmental Technology Laboratories are currently developing a new recycling technology to decompose plastics using water. (Fig. 4.2-2)

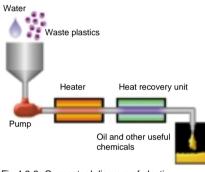


Fig.4.2-2 Conceptual diagram of plastic recycling technology

The plastic recycling technology is based on the properties of supercritical water. Water, when heated to temperatures in excess of 374°C and pressurized to over 218 atm, reaches a supercritical state with properties that can effectively liquefy oil-based plastics. The plastic recycling process in the above diagram can be explained as follows:

- (1) Water and crushed and fragmented plastic are mixed as shown in Fig. 4.2-2.
- (2) The mixture is compressed by a high-pressure pump and sent into the tube.
- (3) The mixture is heated at the halfway point of the tube until the water reaches the supercritical state. Part of the energy generated by the heat is recovered for later cooling of the mixture.
- (4) Oily residues, the raw materials of plastic, are collected at the end of the process as illustrated in Fig. 4.2-2.

A prototype of the system was tested using various kinds of plastics from optical fiber

cables, with the system successfully recovering recyclable organic substances.

By liquefying plastics with water instead of organic solvents, minimizing the generation of volatile toxic substances, requiring shorter reaction time and enabling heat recovery, this system shows significant potential as a recycling technology of the future.

#### Fuel Modification Equipment

Since 1999, NTT Auto Leasing has been engaged in development of fuel modification equipment to reduce black smoke and carbon dioxide emissions from diesel-powered vehicles.

Fuel modification equipment drastically reduces the black smoke, NOx, and other air pollutants generated by fuel combustion, simultaneously reducing the overall volume of CO<sub>2</sub> emissions by improving fuel efficiency.

Efficiency is being field-tested from April 2000, with installation of the devices on large-sized vehicles with diesel engines (trucks: 2 units, buses: 5 units).

#### Multifunctional Rapid Disposal Vehicle for Sewage and Sludge

Since 2000, NTT Auto Leasing has been engaged in development of a multifunctional rapid disposal vehicle to provide a leasable system incorporating combined technology for use against the worldwide spread of river and ocean pollution caused by sewage and sludge.

Today, most of the run-off from construction sites and dye works is not properly disposed of, but simply diluted with huge volumes of water and discharged into rivers and oceans, accelerating the pace of river and ocean contamination. This can be attributed to the huge costs that are involved in the construction of treatment facilities.

NTT Auto Leasing seeks to develop a solution by providing businesses lacking their own treatment facilities with mobile

effluent treatment systems mounted on vehicles.

The multifunctional rapid disposal vehicle is equipped to recycle effluent and sludge from construction sites or stock farms through rapid simultaneous solid/liquid separation and deodorization. With its ability to travel to various sites, this mobile treatment system will promote cost reduction and make a significant contribution to environmental protection.