SUPPLEMENT

to Department of Commerce's Annual Budget Submission for FY 2003

U.S. Department of Commerce

Annual Report on Technology Transfer: Programs, Plans, FY 2001
Activities and Achievements

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Background. This document is the first in a series of reports annually summarizing the Department of Commerce's ongoing technology transfer activities and achievements. This report responds to the new statutory requirement for an annual "agency report on utilization" [15 USC 3710 (f)] under the new federal-wide reporting process established by the Technology Transfer Commercialization Act of 2000. All federal agencies that direct one or more federal laboratories or conduct other activities under Section 207 and 209 of Title 35, United States Code are subject to the requirements of this statute.

At the Department of Commerce (DoC), technology transfer is a significant aspect of the mission and program activities of the National Institute of Standards and Technology (NIST), the National Telecommunications and Information Administration (NTIA), and the National Oceanic and Atmospheric Administration (NOAA). Accordingly, this report focuses on the activities of these DoC labs and agencies.

Each of the major agency sections is organized to summarize the agency's technology transfer priorities, approaches, and plans and to provide specific information about FY 2001 activities and accomplishments. The report begins with a summary of this information for the Department as a whole.

This report was organized and prepared by the Office of Technology Policy/Technology Administration, with extensive participation by the National Institute of Standards and Technology, the National Oceanic and Atmospheric Administration, and the National Telecommunications and Information Administration.

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I. DEPARTMENT OF COMMERCE OVERVIEW

Summary of Current Technology Transfer Activities

The Department of Commerce works in partnership with businesses, universities, communities, and workers to promote U.S. competitiveness. It does this by strengthening economic infrastructure, facilitating the development of cutting-edge science and technology, providing an information base, and by managing national resources.

Within the Department, basic science and technology R&D is conducted chiefly at the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the National Telecommunications and Information Administration (NTIA). Other kinds of research are conducted at the Bureau of the Census, the Economic Development Administration (EDA), and the Technology Administration (Office of the Undersecretary/Office of Technology Policy).

Technology transfer at the Department relates principally to the activities of NIST, NOAA, and NTIA.

DoC Budget for R&D

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Proposed
Departmental budget authority millions (current) $	$5,102	$5,206	$5,192
Total R&D budget authority * millions (current) $	$1,054	$1,129	$1,114
National Institute of Standards and Technology	413	460	472
National Oceanic and Atmospheric Administration	586	644	630
National Telecommunications and Information Administration	51	21	7
Other **	4	4	5

* The R&D figures include budget authority for basic research, applied, development, R&D facilities and equipment.

** R&D activities of primarily the Bureau of the Census, Economic Development Administration, and Technology Administration offices.

Data Sources: President's Budget Proposal for FY 2003 (published Feb. 4, 2002); Office of Management and Budget (Feb. 2002); and the American Association for the Advancement of Science, R&D Budget and Policy Program (Feb. 2002 and earlier documents).

Agency Mission and Principal Channels for Technology Transfer

Mission	Tech Transfer
National Institute of Standards and Technology. NIST's mission is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life. NIST laboratories develop and disseminate measurement techniques, reference data, test methods, standards, and other infrastructural technologies and services that support U.S. industry, scientific research, and the activities of many federal agencies. In carrying out its mission, NIST works directly with industry partners (and consortia), universities, associations, and other government agencies.	The focus of NIST's technology transfer activities in general is the broad dissemination of research results to industry, rather than the creation of patents and associated licenses. As such, NIST utilizes a diverse group of mechanisms to transfer the knowledge and technologies that result from its laboratory research. <u>Principal tech transfer mechanisms:</u> CRADAs, Patents and licenses, Technical publications, Standard Reference Materials, Standard Reference Data, Calibration services, Guest researchers and facilities users.
National Oceanic and Atmospheric Administration. NOAA's primary mission is to transfer environmental data on a wide range of time and space scales in order to protect life and property, and provide industry and government decision-makers with a reliable base of scientific information. As part of this mission, almost half of the organization works to produce the daily weather forecast, which advises and warns the general public and, at the same time, provides a base of scientific and technical information for engineers and managers in federal and state governments and in the heating, construction, manufacturing, transportation, and health industries.	NOAA's broad approach to tech transfer involves licensing intellectual property, cooperative research relationships with industry, and/or direct transfer. NOAA works with each of its laboratories based on its ability to provide the necessary resources. <u>Principal tech tranfer mechanisms:</u> CRADAs, Patents and licenses, Direct transfer.
National Telecommunications and Information Administration. NTIA's Institute for Telecommunication Sciences (ITS) supports agency telecommunications objectives such as promoting advanced telecommunications and information infrastructure development in the United States, enhancing domestic competitiveness, improving foreign trade opportunities for U.S. telecommunications firms, and facilitating more efficient and effective use of the radio spectrum. NTIA/ITS also serves as a principal federal resource for solving the telecommunications concerns of other federal agencies, state and local governments, private corporations and associations, and international organizations.	NOAA's broad approach to tech transfer involves licensing intellectual property, cooperative research relationships with industry, and/or direct transfer. NOAA works with each of its laboratories based on its ability to provide the necessary resources. <u>Principal tech tranfer mechanisms:</u> CRADAs, Patents and licenses, Telecommunications analysis services.

The linkage of each agency's mission and technology transfer approaches is discussed further in subsequent sections of the report (see NIST, NOAA, NTIA).

Summary of DoC Technology Transfer Activities and Achievements

Selected Activity Measures *

MEASURES -- DoT Totals and by Agency	FY 1999	FY 2000	FY 2001
Total number of active CRADAs at the end of the FY	275	221	221
NIST	261	208	208
NOAA	8	10	8
NTIA	6	3	6
Invention disclosures in the FY	38	34	26
NIST	35	32	24
NOAA	3	2	1
NTIA	0	0	1
Patent applications filed in the FY	30	20	12
NIST	27	18	9
NOAA	2	18	9
NTIA	1	0	0
Patents issued in the FY for laboratory inventions	28	16	22
NIST	26	14	20
NOAA	2	2	1
NTIA	0	0	1
Total number of active invention licenses in the FY	41	41	39
NIST	40	39	36
NOAA	0	0	1
NTIA	1	2	2
Total number of active licenses for "Other IP" **	0	0	0
NIST	0	0	0
NOAA	0	0	0
NTIA	0	0	0
Total income from all licenses active in the FY	$421,635	$159,020	$268,568
NIST	$394,387	$122.575	$261,968
NOAA	$0	$0	$0
NTIA	$27,248	$36,445	$5,000
- Income from active invention licenses	$421,635	$159,020	$268,568
NIST	$394,387	$122.575	$261,968
NOAA	$0	$0	$0
NTIA	$27,248	$36,445	$5,000

MEASURES -- DoT Totals and by Agency	FY 1999	FY 2000	FY 2001
- Number of licenses earning royalty income in the FY	19	17	21
NIST	18	16	19
NOAA	0	0	0
NTIA	1	1	1
- Total earned royalty income in the FY	$421,635	$159,020	$268,568
NIST	$394,387	$122.575	$261,968
NOAA	$0	$0	$0
NTIA	$27,248	$36,445	$5,000

** "Other IP" includes computer software; tangible, non-patented research products (such as biological materials); and protected data.

Figures for FY 2001 are required in this year's annual report, under the revised agency reporting process established by the Technology Transfer Commercialization Act of 2000. Corresponding figures for FYs 1999 and 2000 are also provided, as a basis for comparison.

* Various measures are relevant in characterizing the level of tech transfer activities - including some which are agency specific, that focus on unique aspects of an agency's mission and associated tech transfer priorities. Those listed above are among the most frequently cited general measures. Data for a larger set of measures, including some that are agency specific, appear in subsequent sections of this report (see FY 2001 Activities and Achievements for NIST, NOAA, NTIA).

Examples of Technology Transfer Outcomes Provided by the Agencies:

The following cases were selected and described by the agencies as examples of "downstream" outcomes resulting from agency technology transfer efforts:

NIST

- CRADA: Integrated Services Digital Network
- Standard Reference Materials: Healthcare
- Standards and Conformance Tests: Data Encryption Standard

NOAA

- Suite of digital raster nautical charts
- A new type of radar
- Acoustic scintillation liquid flow measurement system

NTIA/ITS

- Personal Communications services
- Local multipoint distribution services
- Digital video communication research
- Video quality assessment system

Details on each of these cases are provided in the agency sections below.

II. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Technology Transfer - Programs, Plans, FY 2001 Activities/Achievements

The mission of the National Institute of Standards and Technology (NIST) is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life. The NIST laboratories develop and disseminate measurement techniques, reference data, test methods, standards, and other infrastructural technologies and services that support U.S. industry, scientific research, and the activities of many federal agencies. In carrying out its mission, NIST works directly with industry partners (and consortia), universities, associations, and other government agencies.

Generally, the focus of NIST's technology transfer activities is the broad dissemination of research results to industry, rather than the creation of patents and associated licenses. NIST utilizes a diverse group of mechanisms to transfer the knowledge and technologies that result from its laboratory research.

To meet the requirements of the Technology Transfer Commercialization Act of 2000 and other relevant legislation, this report has two major sections:

- Section 1: A description of NIST's diverse group of technology transfer mechanisms; and
- Section 2: Data on the usage of key technology transfer tools, such as CRADAs, patents and licenses, technical publications, and Standard Reference Materials, and examples of outcomes from these transfer activities.

1. Agency Technology Transfer Programs, Principles, and Plans

Leading-edge scientific and technical work requires multiple disciplines, high levels of collaboration among organizations and people with diverse capabilities, and highly specialized facilities and tools. For more than a century, the NIST laboratories have successfully collaborated with industry and universities to provide the measurement techniques and technical tools needed by America's innovators. NIST uses many mechanisms-including, but not limited to, CRADAs and patent licensing-to collaborate with industry and to ensure that the resulting knowledge and infrastructural technologies are broadly disseminated.

While NIST does conduct "traditional" technology transfer activities (participate in CRADAs, hold patents, and engage in licensing), the laboratories do not focus on the creation of patents and licenses per se. These mechanisms are used, where appropriate, as tools to accomplish NIST's mission. Other tools also are used to transfer knowledge and technologies to industry. These include:

- **Standard Reference Materials**

  Standard Reference Materials (SRMs) are the definitive source of measurement traceability in the United States. All measurements using SRMs can be traced to a common and recognized set of basic standards that provides the basis for compatibility of measurements among different laboratories. As economic

exchange has become more global, customers are using SRMs to achieve measurement quality and conformance to process requirements that address both national and international needs for commerce and trade. NIST produces and disseminates (sells) SRMs to a large and diverse group of customers, including private sector laboratories, universities, and other federal agencies. NIST SRMs support industrial materials production and analysis, environmental analysis, health measurements, and basic measurements in science and metrology.

The number of SRMs available for sale, currently over 1,300, illustrates the breadth of measurements supported by NIST. Over time, NIST expects slight growth in the number of SRMs available, given its current strategy of focusing on those SRMs that cannot be produced by secondary laboratories and which have broad and/or high downstream impact. In establishing its out-year projections, the NIST SRM Program monitors, among other things, trends in emerging technologies, new regulations that will depend on SRMs for enforcement, and the reference material needs of other federal agencies. Several microeconomic studies of NIST SRM programs have shown the technology transfer mechanisms built into these efforts to be effective, with resulting high economic benefits delivered to industry.

- **Standard Reference Data**

  NIST produces and makes available (sells or distributes for free) many Standard Reference Data titles (SRDs). SRDs provide numeric data to scientists and engineers for use in technical problem solving, research, and development. These recommended values are based on data extracted from scientific and technical literature or on measurements done at NIST laboratories, which are then assessed for reliability and evaluated to select the preferred values. NIST's SRD databases cover many areas of science, including analytical chemistry, atomic and molecular physics, biotechnology, and materials science.

  Historically, NIST has produced two new SRD titles per year. At the same time, NIST also provides numerous upgrades to existing databases. Each year, however, some database titles are eliminated from the NIST catalog. Over time, NIST expects continued modest growth in the total number of SRD titles available. Of those titles currently available, about 70% are available for sale, and 30% are free online systems. Over time, a larger percentage of these titles will be distributed via the Internet. Several microeconomic studies of NIST SRD programs have shown the technology transfer mechanisms built into these efforts to be effective with resulting high economic benefits delivered to industry.

- **Calibration Services**

  The NIST laboratories provide physical measurement services for their customers, including calibration services, special tests, and measurement assurance programs (MAPs). Calibration services and special tests are characterizations of particular instruments, devices, and sets of standards with respect to international and national standards. MAPs are quality control programs for calibrating entire measurement systems. NIST's calibration services are designed to help the makers and users of precision instruments achieve the highest possible levels of

measurement quality and productivity. The services constitute the highest order of calibration services available in the United States. NIST offers more than 500 different types of physical calibrations covering the following measurement areas: dimensional; mechanical, including flow, acoustic, and ultrasonic; thermodynamic; optical radiation; ionizing radiation; electromagnetic; and time and frequency.

Over the past several years, NIST has calibrated approximately 3,000 items per year. Over the next several years, NIST expects to realize a relatively high but slightly declining number of items calibrated. This is in keeping with a long-term trend, over the past several decades, of a decline in the number of items calibrated by NIST. Despite this overall trend, individual years may fluctuate slightly due to multi-year calibration cycles. NIST expects to provide fewer but more highly leveraged calibration services over time. NIST's strategy is driven by the need to effectively manage trends in demand from its major industry and government customers for these services. NIST is pursuing two strategies: (1) performing only those calibrations that require a direct connection to the national standards; and (2) improving calibration accuracy in those areas where new industry demands are emerging. Through this overall approach NIST can efficiently leverage its primary calibration services to support a broader base of secondary calibrations conducted within the private sector. Several microeconomic studies of NIST calibration programs have shown the technology transfer mechanisms built into these efforts to be effective, with resulting high economic benefits delivered to industry.

- **Technical Publications**

  NIST uses publications as one mechanism to transfer the results of its work to the U.S. private sector and to other government agencies that need cutting-edge measurements and standards. Many of these publications appear in prestigious scientific journals and withstand peer review by the scientific community. Others appear in technological forums where measurement standards and technologies developed by NIST staff (at times in collaboration with private sector partners) are disseminated. Of the technical publications produced annually, approximately 80% are approved for external publication (such as in scientific journals), while the remaining 20% are NIST reports and special publications.

  Over time, NIST expects a relatively constant level of high quality publications (2,000-2,200 per year) produced by its technical staff.

- **Guest Researchers and Facilities Users**

  Each year hundreds of researchers visit NIST to participate in collaborative projects and/or to use NIST's research facilities. NIST makes its facilities available for limited periods of time to domestic guest researchers to collaborate with NIST staff on research and development projects of mutual interest or to transfer NIST techniques, procedures, and best practices. NIST provides neither direct salary nor subsistence support to domestic guest researchers. NIST's Foreign Guest Researcher Program offers scientists from around the world the opportunity to work collaboratively with researchers in the NIST laboratories.

Foreign guest researchers enter into clearly defined Guest Researcher Agreements that describe the proposed research project and its mutual benefit to the guest researcher and the NIST host. The majority of foreign guest researchers receive no stipend from NIST. However, NIST has the authority to pay financial assistance to foreign guest researchers when such payment would facilitate a NIST program. This financial assistance is intended to defray expenses while the researchers are performing work or exchanging technical information at NIST. It is not an equivalent of or replacement for salary.

Data for the many technology transfer tools utilized by NIST laboratory staff are provided in Section II below.

2. FY 2001 Activities and Achievements

The data below illustrate the many ways that NIST transfers knowledge and technology to the private sector. As required by the Technology Transfer Commercialization Act of 2000 and other relevant legislation, data are provided for Cooperative Research and Development Agreements (CRADAs), invention disclosures, licenses, and license income. In addition, following on the explanation provided above, data are provided for some of the other technology transfer mechanisms utilized by the NIST laboratories, such as Standard Reference Materials available, technical publications produced, items calibrated, and guest researcher collaborations. The data are divided into three major categories: (A) collaborative relationships for research, development, and demonstration; (B) intellectual property management; and (C) other important mechanisms for technology and knowledge transfer. Examples of outcomes from technology transfer activities also are provided below (see Section D).

A. Collaborative Relationships for Research, Development, & Demonstration

Cooperative Research and Development Agreements (CRADAs)

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total number of active CRADAs at the end of the FY	261	208	174	
Number of new CRADAs executed in the FY	62	40	22	
Number of active, "non-traditional" CRADAs at the end of the FY	n/a	n/a	0	Figures for this measure not requested or reported prior to FY 2001.

n/a = Data not available.

Other Types of Collaborative R, D & D Relationships

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Facility Use Agreements in effect at the end of the FY	n/a	n/a	372	NIST authorizes individuals to use designated facilities. The numbers reported here represent the Facility Use Agreements in effect for the NIST Center for Neutron Research. Figures for this measure not requested or reported prior to FY 2001.
Number of Facility Use Agreements executed in the FY	n/a	n/a	172	
Guest scientists and engineers during the FY	n/a	n/a	Approx. 1,200	"Guest scientists and engineers" includes foreign and domestic guest researchers, and researchers working at NIST under Intergovernmental Personnel Act (IPA) Agreements and CRADAs. Figures for this measure not requested or reported prior to FY 2001.

n/a = Data not available.

B. Intellectual Property Management

Invention Disclosure and Patenting

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Number of invention disclosures in the FY	35	32	24	
Number of patent applications filed in the FY	27	18	9	
Number of patents issued in the FY for laboratory inventions	26	14	20	

Licensing

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total number of invention licenses active in FY	40	39	36	
Number of new invention licenses in the FY	7	3	4	
Total number of "Other IP"* licenses active in the FY	0	0	0	
Elapsed time for licensing (from date of formal license application to date of license execution)	n/a	n/a	Avg:4.75 months Min: 2 months Max: 5 months	Figures for this measure not requested or reported prior to FY 2001
Number of licenses terminated for cause in the FY	n/a	n/a	7	Figures for this measure not requested or reported prior to FY 2001.

n/a = Data not available.

* "Other IP" includes computer software; tangible, non-patented research products (such as biological materials); and protected data.

Income from Licensing

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total income from all licenses active in the FY	$394,387	$122,575	$261,968	
Income from active invention licenses	$394,387	$122,575	$261,968	
Income from active "Other IP" licenses	0	0	0	
Number of active licenses for which NIST received royalty income in the FY	18	16	19	
Number exclusive	n/a	n/a	12	Figures not requested or reported prior to FY 2001.
Number partially exclusive	n/a	n/a	5	
Number non-exclusive	n/a	n/a	2	
Total earned royalty income in the FY	$394,387	$122,575	$261,968	
Distribution of earned royalty income values	n/a	n/a	$1,000-$135,927	Range of values of all royalty bearing licenses in the FY. Disposition
Disposition of income (from royalties and other payments)	Inventors: 36% ($142,262)	Inventors: 47% ($57,423)	Inventors: 39% ($102,040)	
	NIST: 64% ($252,125)	NIST: 53% ($65,152)	NIST: 61% ($159,928)	

n/a = Data not available.

C. Other Important Mechanisms for Technology and Knowledge Transfer

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Standard Reference Materials (SRMs) available	1,288	1,292	1,335	Direct and verifiable count of SRMs available to customers at the close of the fiscal year. The number of SRMs available for sale illustrates the breadth of measurements supported by NIST. Over time, NIST expects slight growth in the number of SRMs available.
Standard Reference Materials (SRMs) sold	33,347	34,020	31,985	Direct and verifiable count of NIST SRM units sold during the fiscal year.
Standard Reference Data (SRD) titles available	60	63	65	Direct and verifiable count of SRD products developed and disseminated by NIST. NIST expects continued modest growth in the total number of SRD titles available. Of those titles currently available, about 70% are available for sale, and 30% are free online systems. Over time, a larger percentage of SRDs will be distributed via the Internet.
Number of items calibrated	3,118	2,969	3,192	
Technical publications produced	2,270	2,250	2,207	Annual number of technical publications generated by NIST's technical staff. The number is a direct count of the number of technical publications cleared for publication by the NIST Editorial Review Boards at the Gaithersburg and Boulder sites. Over time, NIST expects a relatively constant level of high quality publications (2,000-2,200 per year) produced by its technical staff. Of the publications produced annually, approx. 80% are approved for external publication (such as in scientific journals); the other 20% are NIST reports and special publications.

D. Technology Transfer Outcomes

NIST develops and disseminates infrastructural technologies and services required by the U.S. private sector and other non-profit and government partners. The outputs of the NIST laboratories provide a foundation for industry in all stages of commerce-research, development, testing, production, and marketing-and in turn enable socio-economic impacts, such as productivity gains, increased market access and efficiency, and improved quality of life. These impacts are long-term, accruing years after the original infrastructural technologies were developed by NIST (often in conjunction with industry partners).

The three examples below show how NIST's various technology transfer mechanisms-here CRADAs, Standard Reference Materials, and standards and associated conformance tests-have, over the long-term, produced outcomes that benefit consumers and improve the quality of life.

- **CRADA: Integrated Services Digital Network (ISDN)**

  In the late 1980s and early 1990s, a new advanced technology known as Integrated Services Digital Network (ISDN) promised to revolutionize the telecommunications industry worldwide, offering immense potential benefits to government, industry, and personal users with its ability to exchange voice, data, and image information concurrently over telephone lines. With ISDN, computer and communication technologies converge to speed and simplify the flow of information between sender and receiver. Before the full potential of ISDN could be realized, however, government and industry needed to collaborate to overcome barriers to the widespread acceptance and use of ISDN technology. Pinpointing the barriers to the widespread use of ISDN in both the national and international arenas had been difficult because of the complexity and rapid development of the technology. One underlying problem was the lack of standard implementations of ISDN applications.

  NIST collaborated with industry in 1988 to establish the North American ISDN Users Forum (NIUF). A Cooperative Research and Development Agreement (CRADA) with industry was established in 1991 to govern the management of the forum. The purpose of the NIUF was to create a strong user voice in the implementation of ISDN applications. The NIUF provided users of ISDN technology with the opportunity to work with implementers to assure that users' needs were met in the ISDN design process. Through the NIUF, users and manufacturers concurred on ISDN applications, the selection of options from standards, and conformance tests, enhancing the strength of the U.S. telecommunications industry in the world marketplace.

  From 1988 through June 1999, the NIUF met 36 times with the following results:

  - 153 active applications for development of Application Profiles were accepted;
  - Application Profiles were completed for 13 applications;

- 14 Implementation Agreements were completed; and
- 12 Conformance Tests were completed.

The last NIUF meeting was held June 1999. NIST and other NIUF members have agreed that NIUF has successfully accomplished its purposes and goals for which it was created. ISDN has become a mature technology, which is widely deployed (with sales of ISDN lines still increasing), and has wide availability of ISDN products in retail stores.

Standard Reference Materials: Healthcare

Diagnosing and treating cardiovascular disease requires accurate measurements of cholesterol and its constituents. Since 1966, NIST has developed and disseminated measurement methods, standards, and Standard Reference Materials (SRMs) needed to assure the accuracy of cholesterol tests. As a result of NIST's work, clinical laboratories and other users have adopted increasingly accurate measurement techniques and have significantly reduced uncertainties in cholesterol measurement results. Due to better measurements, fewer patients have been misdiagnosed, public health has been improved, and health care costs have been lowered significantly.

The economic benefits of NIST's Cholesterol Standards Program have been analyzed in an independent study by TASC, Inc. The study covered the period of 1986-1999, and estimated a social rate of return of 154% and a benefit-to-cost ratio of 4.5:1 during that timeframe.

Standards and Conformance Tests: Data Encryption Standard

To a large extent, the efficiency of transactions in a market economy is determined by the efficiency of the payments system. Payment services are not cheap - five percent or more of the value of an average consumer's purchase goes to payment costs while the total cost of a country's payment system may account for about three percent of the value of its GDP. Electronic payments usually cost only one-third to one-half that of paper-based transactions, so substantial savings can be realized in shifting from paper to electronic payments.

The electronic transactions occurring routinely today in business and in our personal lives have their basis in technological developments of just a few decades ago. These include vastly improved computing power, increased accessibility to communications through the development of the Internet, and the implementation of "behind the scenes" infratechnologies and associated standards that assure the privacy and security of these various transactions. Encryption algorithms and methods are among those infratechnologies that are less transparent to casual or business users but are central to virtually every funds transfer, business-to-business data transfer, or internal company data input and output.

In the early 1970s, markets for encryption products were just emerging and fragmented. No industry-wide standard existed to guide industry development efforts. Multiple and incompatible products resulted, a situation that discouraged their widespread use. In response, NIST formally issued the Data Encryption

Standard (DES) in 1977. NIST also developed and implemented conformance tests for DES users to help assure correct functioning of their DES implementations. From 1977 to 1994, NIST offered conformance-testing services to encryption hardware manufacturers and software producers. If products were found to be in conformance with various cryptographic standards, their products are listed as "validated." Such validation greatly increased marketplace acceptance.

Markets for encryption products in general, and DES-based products in particular, have evolved over the last 20 years from a situation in which a few DES-based devices were available to one in which a variety of devices, interoperable equipment, and software products are sold worldwide. The financial services industry uses DES extensively and exclusively for retail transactions, plastic card networks, point-of-sale, and large dollar wholesale transactions. DES is also called out in many international security standards. Users of encryption systems (banks in particular) realized significant operational efficiencies from their enhanced ability to substitute secure electronic transactions for more costly paper-based face-to-face transactions.

NIST recently commissioned a microeconomic impact assessment of its DES Program, which revealed significant economic benefits to the users of electronic transactions, such as the banking industry and its customers, and to the companies that supply data encryption hardware, software, and services. The study estimated that the net present value of DES to the banking industry was between $350 million and $1.2 billion (in 2000 dollars), depending on the assumed acceleration in electronic banking due to NIST efforts. These estimated economic benefits translate into a benefit-cost ratio of between 58 and 145. The estimated social (internal) rate of return was approximately 270 percent for the interval of estimated acceleration.

III. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Technology Transfer - Programs, Plans, FY 2001 Activities/Achievements

1. Agency Technology Transfer Programs, Principles, and Plans

The National Oceanic and Atmospheric Administration's (NOAA) primary mission is to transfer environmental data on a wide range of time and space scales in order to protect life and property, and provide industry, government and the public with a reliable base of environmental information. As part of this mission, over half of the organization works to produce the daily weather forecast, which advises and warns the general public and, at the same time, provides a base of scientific and technical information for engineers and managers in federal and state governments and in the heating, construction, manufacturing, transportation, and health industries. As NOAA's primary technology transfer mechanism is the direct transfer of information, this program cannot be fairly measured in terms of CRADAs, patents, and licenses.

For FY 2001, NOAA carried out an extensive tech transfer program to provide daily weather forecasts and warnings of weather hazards. Much of the agency's technology is transferred to private sector organizations, ranging from consultants to the media to information service companies, who serve as critical intermediaries to make weather information available to all and to provide specialized services.

The NOAA web page at http://www.noaa.gov details the voluminous amount of additional technology made available to all in the form of data and information products and services, such as tides and currents, satellite imagery and direct readout, fishery statistics and information on protected species, climate forecasts, air quality, state of the coasts, beach temperatures, and nautical charts, as well as extensive data bases on climate, oceans, geophysics, and the sun.

In future years, NOAA will continue to carry out these considerable tech transfer activities, while working towards seven strategic goals: advancement of short-term warnings and forecast services, implementation of seasonal to interannual climate forecasts, assessment and prediction of decadal to centennial climate changes, promotion of safe navigation, building sustainable fisheries, recovery of protected species, and sustaining healthy coastal ecosystems. To secure Intellectual Property rights in laboratory innovations with commercial promise, NOAA plans are based on the individual laboratory's ability to provide the necessary resources. To advance the agency's mission and benefit the competitiveness of U.S. industry, NOAA will continue to license intellectual property, to provide it to industry through CRADAs, or to transfer it directly.

2. FY 2001 Activities and Achievements

A. Collaborative Relationships for Research, Development, & Demonstration

Cooperative Research and Development Agreements (CRADAs)

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total number of active CRADAs at the end of the FY	8	10	8	
Number of new CRADAs executed in the FY	1	3	3	

B. Intellectual Property Management

Invention Disclosure and Patenting

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Number of invention disclosures in the FY	3	2	1	
Number of patent applications filed in the FY	2	2	3	
Number of patents issued in the FY for laboratory inventions	2	2	1	

C. Licensing

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total number of invention licenses active in FY	0	0	1	
Number of new invention licenses in the FY	0	0	1	
Total number of "Other IP"* licenses active in the FY	0	0	0	
Elapsed time for licensing (from date of formal license application to date of license execution)	--	--	8 months	
Number of licenses terminated for cause in the FY	0	0	0	

* "Other IP" includes computer software; tangible, non-patented research products (such as biological materials); and protected data.

n/a = Data not available.

D. Income from Licensing

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total income from all licenses active in the FY	0	0	$1,600	
Income from active invention licenses	0	0	$1,600	
Income from active " other IP" licenses	0	0	0	
Number of active licenses for which NOAA received royalty income in the FY	0	0	1	
Number exclusive	0	0	1	
Number partially exclusive	0	0	0	
Number non-exclusive	0	0	0	
Total earned royalty income in the FY	0	0	$1,600	
Distribution of earned royalty income values	0	0	--	Same as total ERI value (since only one active license)
Disposition of income (from royalties or other payments)	0	0	Inventor: 100%	

n/a = Data not available.

-- = Data category not applicable.

E. Technology Transfer Outcomes

- **Suite of digital raster nautical charts**. The NOAA/National Ocean Service's Office of Coast Survey created a bundle of technology, intellectual property, expertise, and collaboration to permit a private company, Maptech , Inc., to develop a national suite of digital raster nautical charts. These charts are used by commercial mariners, recreational boaters, the U.S. Navy, and the Coast Guard in ship-board, computer-based navigation systems. A CRADA was used to transfer the government files to Maptech, which then developed a commercial system, which includes an Internet-based Mapserver that gives limited free distribution to the public (see http://www.maptech.com/bp/mapserver/index.cfm.). In addition to 200 domestic licenses, the NOAA/Maptech technology has been licensed to companies or governments in Argentina, Australia, Brazil, Canada, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, and the United Kingdom. In addition, technology arising under the CRADA between NOAA and Maptech strengthened the capabilities of the NOAA laboratory when quality control software developed by Maptech was transferred back to NOAA for use in its paper nautical chart production process.

- **A new type of radar** that can run continuously and inexpensively for years, and automatically measure all types of clouds that occur in the atmosphere, was transferred by a CRADA from NOAA's Environmental Technology Laboratory to Radian International Corporation, who then developed a commercial version. The prototype radar has been run unattended by NOAA for several years. The commercial version has been sold to the Department of Energy for its Atmospheric Radiation Measurement program. It is also being considered by the FAA for better icing warnings and for finding cloud-free airspace for increased airplane safety, and by NASA for better missile launch decisions.
- **Acoustic scintillation liquid flow measurement system**. Technology was licensed by NOAA to the Canadian Ministry of Fisheries and Oceans who licensed to ASL Environmental Sciences, Inc., a Canadian company, that made commercially available an acoustic scintillation liquid flow measurement system for use in dams, hydroelectric plants, ports, harbors, and irrigation canals.

IV. NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, Institute for Telecommunication Sciences

Technology Transfer - Programs, Plans, FY 2001 Activities/Achievements

1. Agency Technology Transfer Programs, Principles, and Plans

The Institute for Telecommunication Sciences (ITS) is the chief research and engineering arm of the National Telecommunications and Information Administration (NTIA). ITS supports such NTIA telecommunications objectives as promotion of advanced telecommunications and information infrastructure development in the United States, enhancement of domestic competitiveness, improvement of foreign trade opportunities for U.S. telecommunications firms, and facilitation of more efficient and effective use of the radio spectrum.

NTIA/ITS also serves as a principal federal resource for solving the telecommunications concerns of other federal agencies, state and local governments, private corporations and associations, and international organizations.

At NTIA/ITS, cooperative research and development agreements (CRADAs) based upon the Federal Technology Transfer Act of 1986 are the principal means of aiding the private sector. This Act provides the legal basis for and encourages shared use of government facilities and resources with the private sector in advanced telecommunications technologies. These partnerships aid in the commercialization of new products and services, and enhance the capabilities of our laboratories.

In FY 2001, NTIA/ITS participated in technology transfer and commercialization efforts by fostering cooperative telecommunications research with industry where benefits can directly facilitate U.S. competitiveness and market opportunities. These efforts will continue in future years. NTIA/ITS has also participated for a number of years in CRADAs with private sector organizations to design, develop, test, and evaluate advanced telecommunication concepts. Not only does the private industry partner benefit, but the Institute is able to undertake research in commercially important areas that it would not otherwise be able to do.

To date, major contributions to personal communication services (PCS) and local multipoint distribution service (LMDS) technologies have been and will continue to be carried out under these CRADAs to aid U.S. efforts to rapidly introduce new communications technologies for the benefit of society.

2. FY 2001 Activities and Achievements

A. Collaborative Relationships for Research, Development, & Demonstration

Cooperative Research and Development Agreements (CRADAs)

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total number of active CRADAs at the end of the FY	6	3	6	
Number of new CRADAs executed in the FY	4	3	1	

Other Types of Collaborative R&D Relationships:

NTIA/ITS operates its Telecommunication Analysis Services (TA Services) to provide a valuable service to private industry and public agencies in wireless system design and evaluation as well as site selection. This service is provided on a cost reimbursable basis and is available 24 hours a day-7 days a week throughout the year. TA Services is an Internet service that currently reaches numerous government and private sector users across the nation and makes available the latest models, databases, and tools developed by NTIA/ITS in the telecommunications field.

The service is available through Web-based electronic CRADAs, making this service available to the users in a short time and on a cost reimbursable basis. The CRADA partner using this on-line service provides evaluation of the NTIA/ITS software that is used on TA Services, and through this evaluation contributes to improvements of these software tools and the development of new tools. This CRADA agreement also allows NTIA/ITS to gain valuable insight based in part upon feedback from users about the rapidly changing needs of industry and Government in telecommunications technology. NTIA/ITS uses the CRADA partner's evaluation data to improve the tools for wireless system design and analysis, for the Institute's own research use as well as use by the CRADA partner. As NTIA/ITS develops new engineering models and tools which are deemed useful to public and private agencies, these models and tools are made available to all who may benefit from them.

At the end of FY 2001, there were 59 active users of this service.

- **Benefits of Collaborative Research for Lab Performance:**
  Cooperative research with private industry has helped NTIA/ITS accomplish its mission to support industry's productivity and competitiveness by providing insight into industry needs. This has led to adjustments in the focus and direction of other Institute programs to improve their effectiveness and value.

B. Intellectual Property Management

Invention Disclosure and Patenting

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Number of invention disclosures in the FY	0	0	1	
Number of patent applications filed in the FY	1	0	0	
Number of patents issued in the FY for laboratory inventions	0	0	1	

Licensing

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total number of invention licenses active in FY	1	2	2	
Number of new invention licenses in the FY	0	1	0	
Total number of "Other IP"* licenses active in the FY	0	0	0	
Elapsed time for licensing (from date of formal license application to date of license execution)	--	6 months	--	
Number of licenses terminated for cause in the FY	0	0	0	

* "Other IP" includes computer software; tangible, non-patented research products (such as biological materials); and protected data.

-- = Data not available.

Income from Licensing

MEASURE	DATA			NOTES
	FY 1999	FY 2000	FY 2001	
Total income from all licenses active in the FY	$27,248	$36,445	$5,000	
Income from active invention licenses	$27,248	$36,445	$5,000	
Income from active "other IP" licenses	0	0	0	
Number of active licenses for which NTIA/ITS received royalty income in the FY	1	1	1	
Number exclusive	0	0	0	
Number partially exclusive	0	0	0	
Number non-exclusive	1	1	1	
Total earned royalty income in the FY	$27,248	$36,445	$5,000	
Distribution of earned royalty income values	--	--	--	Same as total ERI value (since only one active license)
Disposition of income (from royalties or other payments)	Inventor: 30%	Inventor: 30%	Inventor: 30%	
	NTIA/ITS: 70%	NTIA/ITS: 70%	NTIA/ITS: 70%	

-- = Data category not applicable.

C. Technology Transfer Outcomes

Commercial Availability:

- **Personal communication services (PCS).** Much of NTIA/ITS' work in PCS, over several years, has been accomplished through CRADAs with partners such as U.S. WEST, Bell South, Telesis Technology Laboratory, and Motorola. PCS has now been commercialized worldwide, and new developments continue as PCS is extended to third generation PCS and beyond. NTIA/ITS has continued this work in FY 2001 through a CRADA with Lucent Technologies' Bell Laboratories that is investigating multiple-input/multiple-output antenna arrays, a technology that is targeted to dramatically increase the capacity of PCS systems and, therefore, reduce the problem of spectrum crowding. This technology is 3 to 5 years from commercial application.
- **Local multipoint distribution services (LMDS).** NTIA/ITS has been a premier laboratory in millimeter wave research for two decades. CRADAs with private industry have enabled NTIA/ITS to apply this unique expertise while conducting research into radio propagation considerations for LMDS. LMDS will provide broadband wireless communications for business and residential applications and

is now being commercialized. Deployment of systems is beginning in the U.S. and a number of U.S. companies are exporting systems and services. Research into LMDS has been conducted with CRADA partners such as Hewlett Packard, U.S. WEST, and Lucent Technologies.

Data derived from these CRADAs provided a foundation for domestic and international standards development and efficient allocation of radio frequency spectrum resources. To date, major contributions to PCS and LMDS technologies have been and will continue to be carried out under these CRADAs to aid U.S. efforts to rapidly introduce new communications technologies for the benefit of society.

Strengthened Capabilities of the Laboratory:

- **Digital video communication research**. In FY 2001 NTIA/ITS performed research with two university CRADA partners (University of Pennsylvania and East Carolina University) that provided the laboratory access to Internet 2 capabilities and medical imaging, which would not have been otherwise available to the laboratory. Through these CRADAs, NTIA/ITS continued related research in digital video communication performance, addressing such emerging and future applications as video telephony and teleconferencing, telemedicine, and interactive video distribution. The lab was also able to continue its development of multimedia test capabilities. These user-oriented test capabilities are extremely valuable in implementing and optimizing the national and international information infrastructure, including the Next Generation Internet (NGI).

- **Video quality assessment system**. A CRADA during FY 2001 was targeted at research relating to the development of a Windows-based video quality assessment system. The Windows-based system will provide a user friendly video quality assessment system that will be usable by anyone concerned with video quality, without the need for large computer systems. This CRADA provided the laboratory with a computer system for this development and software that was developed by the CRADA partner, greatly increasing the capabilities of the laboratory. The Windows-based video quality assessment system, that will be developed under this CRADA, will incorporate technology covered by two patents and one patent application owned by NTIA/ITS. It is targeted for commercial development, with the potential of producing a royalty income for the laboratory within two years.