A Counterdrug Research and Development Blueprint Update

Executive Office of the President
Office of National Drug Control Policy
Counterdrug Technology Assessment Center

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OFFICE OF NATIONAL DRUG CONTROL POLICY
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The Counterdrug Technology Assessment Center was established by Congress within the Office of National Drug Control Policy "to serve as the central counterdrug enforcement research and development organization of the United States Government." This letter promulgates the "Counterdrug Research and Development Blueprint Update," the third periodic report on the status of the national counterdrug research and development program.

This report includes those priority counterdrug research and development requirements identified by the Counterdrug Technology Assessment Center. The program described is consistent with the goals and objectives of the National Drug Control Strategy and provides the guidelines and future plans for counterdrug technology development efforts. The report specifically responds to enabling legislation (P.L. 101-510).

Lee P. Brown
Director

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EXECUTIVE SUMMARY

"... The committee expects multi-agency research and development programs to be coordinated ... through the Counter-Drug Technology Assessment Center in order to prevent duplication of effort and to assure that whenever possible, those efforts provide capabilities that transcend the need of any single Federal agency."

Conference Report to Accompany H.R. 4539
Treasury, Postal Service and General Government Appropriations Act of 1995

The Counterdrug Technology Assessment Center (CTAC) within the Office of National Drug Control Policy (ONDCP) is the central counterdrug enforcement research and development (R&D) organization of the U.S. Government and has been coordinating the Federal counterdrug R&D program since 1992.

CTAC's goal has been to advance technologies that improve the effectiveness of law enforcement, drug interdiction and substance abuse research. This has been accomplished by providing leadership and coordination among 21 Federal agencies and the more than 200 individual projects in the national counterdrug R&D program. One major CTAC thrust includes advancing viable technologies for use by State and local law enforcement agencies.

CTAC prepares periodic reports to provide updates on the national counterdrug R&D program to the community at-large.

MAJOR CTAC ACCOMPLISHMENTS

CTAC, in conjunction with Federal, State, and local agencies, has initiated 52 specific technology projects, and by the end of 1995, 34 projects will be completed. The following examples are discussed in detail in the report.

- A prototype multimedia and data fusion system applying a new networking technology is being developed with law enforcement agencies in Pinnellas County, Florida. (pages 5 and 14)

- An investigative tool, which replaces massive parallel computers with desktop PCs, to analyze patterns of traffickers' cellular phone calls has been developed for multi-agency task forces and local law enforcement agencies. (page 11)

- A performance evaluation of two firearms ballistic imaging systems produced a Federal guideline for ballistic imaging systems. (page 10)

- A cocaine blocking agent that uses artificial enzymes is being developed for use in drug treatment and rehabilitation. This extremely important work could provide a breakthrough in providing effective therapeutic drugs that block cocaine for extensive periods of time. (page 9)

- The Border Research and Technology Center was opened at Otay Mesa, California. This center was established jointly with ONDCP and the Departments of Justice and Treasury and will be used to test new technologies for drug detection and interdiction along the Southwest border. (page 14)

- A prototype cocaine antibody field test kit provided evidentiary support to a $6 million drug-related asset seizure. These kits are now in operational use. (page 6)

- A Global Positioning System laptop computer mapping and tracking system has been developed to allow police to track their vehicles and improve drug-related criminal investigations. Units are being used by Federal, State and local police departments. (pages 5 and 14)

- Prototypes are being developed to detect drugs in drums and tankers by nonintrusively measuring the acoustic properties of the transported substance. (page 7)

- An automated targeting system is being developed with the U.S. Customs Service for identifying cargo that has a high probability of containing contraband. (page 7)

FUTURE PLANS

Drug Interdiction

For the past four years, U.S. Customs Service, Advanced Research Projects Agency (ARPA), U.S. Coast Guard, Drug Enforcement Administration (DEA), Central Intelligence Agency, Immigration and Naturalization Service (INS), and Federal Bureau of Investigation (FBI) have worked with CTAC to develop a family of technologies for inspecting cargo and containers for hidden illicit drugs and contraband. (page 10)

- CTAC will perform a Congressionally mandated engineering study to integrate advanced technologies into future inspection systems for our borders and ports of entry. (page 16)

Those R&D projects undertaken for wide area surveillance with INS will produce technology prototypes for testing in FY 1995 and FY 1996.

- The development of an open architecture modular sensor system design for the Southwest border will be completed. (pages 8 and 13)

- A fieldable prototype "ultra wide bandwidth" sensor communications system will be ready for testing. (pages 8 and 13)

- Advanced algorithms are being developed to improve the use of facial recognition technology at ports-of-entry. (pages 8 and 13)

With the completion of these projects, the wide area surveillance thrust will be directed toward projects for command and control functions along the U.S. Southwest border and toward the transfer of the more promising technologies into the inventories of those State and local law enforcement organizations with a drug control mission.

Law Enforcement Technology

Both CTAC and ARPA are expected to continue developing promising tactical technologies, leveraging defense-related technology where practical. Specific technology areas which show promise for continued development include:

- command, control and communications,
- tracking and surveillance,
- acoustic monitoring and surveillance,
- data compression and miniaturized electronics, and
- low probability of intercept and detection communications.

The FBI and DEA will continue to be the lead agencies pursuing drug-related tactical technology development programs. While the Federal law enforcement agencies provide the lead for much of the testing program, many of the prototype tests will include State and local organizations. (page 12)

Drug Treatment and Rehabilitation Research

For demand reduction, advancements will be made in medical research to improve therapeutic treatment for drug abusers and in information technology to share progress on successful treatment modalities with researchers and treatment clinics across the nation. (page 13)

For drug testing applications, a bracelet is being developed to be worn by a patient, prison inmate or parolee which can continuously monitor the subject for drug abuse. (page 13)

1. INTRODUCTION

The Counterdrug Technology Assessment Center (CTAC) is the central counterdrug enforcement research and development (R&D) organization of the U.S. Government. In this capacity, CTAC was established within the Office of National Drug Control Policy and has been coordinating the counterdrug R&D program for the Federal Government since 1992. CTAC prepares periodic reports to provide updates on the national counterdrug R&D program. This report is the third Counterdrug R&D Blueprint Update and provides the status of the national counterdrug R&D program, descriptions of technology and infrastructure development projects, and a summary of plans for future counterdrug R&D initiatives.

CTAC has established and oversees the national counterdrug R&D program, sponsors high-priority R&D projects to fill gaps in technology and coordinates the counterdrug R&D activities of Federal agencies with drug law enforcement and substance abuse prevention and treatment missions. The national counterdrug R&D program is based upon the premise that the introduction of advanced technologies can enhance the effectiveness of counterdrug law enforcement, strengthen substance addiction medical research, enhance interdiction and international activities and improve the overall use of personnel resources.

Consequently, the goals of the national counterdrug R&D strategy are:

- to identify research and engineering opportunities which address community needs that are common to both the supply and demand reduction, and
- to initiate fiscally sound advanced technology projects responsive to these needs.

This report provides a summary of the national counterdrug R&D program and describes those plans for the next set of R&D initiatives. Appendices to this report contain updates to the priority listing of short, medium, and long term scientific and technological needs and a summary of current R&D projects.

1.1 Counterdrug Technology Assessment Center

CTAC's strategy to accomplish its mission can be segmented into four areas:

- identify the short, medium, and long term scientific and technological needs of Federal, State and local drug enforcement agencies,
- develop a national counterdrug R&D strategy that validates technological needs, prioritizes such needs according to technical and fiscal feasibility, and sets forth a plan (including budget) to test and develop the highest priority technology projects,
- implement a national counterdrug R&D program, including technology development in support of substance abuse addiction and rehabilitation research, and
- coordinate counterdrug research and development activities of all Federal agencies with counterdrug law enforcement and substance abuse prevention and treatment missions.

The motivation to establish CTAC and to appropriate a separate annual R&D budget for CTAC stemmed from an understanding that funding shortfalls existed in counterdrug R&D and that a central organization should be established to manage a national counterdrug R&D program. It was also recognized that CTAC R&D projects would:

- require multi-year funding to complete,
- be directed towards advanced technology applications providing the broadest support to the various counterdrug activities of Federal, State and local agencies,
- not be a substitute for projects conducted with other agencies' internal funding, and
- address gaps in technology and fulfill high priority "out of cycle" funding requirements.

Since FY 1992, CTAC received $43.5 million of funds appropriated from the Special Forfeiture Fund (SFF). This budget has provided crucial funding for advanced technology not covered by other agencies, significant support for infrastructure needed to evaluate technical feasibility and measure the effectiveness of proposed innovations of emerging technology in realistic environments, and an outreach program consisting of technical symposia to inform law enforcement and demand reduction agencies of progress on the development of these advanced technologies and to assist them in inserting appropriate technologies into their daily operations.

With the assistance of the law enforcement community, CTAC has sponsored a series of infrastructure and prototype technology initiatives to assess the technical complexity and cost aspects of planned and ongoing prototype projects and research. These initiatives have been established to assure that resulting systems would have a realistic initial acquisition cost, low maintenance and support costs during their operational lives, and an operational simplicity to user personnel.

1.2 The National Counterdrug Research and Development Program

The national program of enforcement-related counterdrug R&D consists of 222 R&D projects. The projects have been monitored since CTAC was established during FY 1991. Projects within the national program have been organized into four technical thrusts: tactical technologies, nonintrusive inspection, wide area surveillance, and demand reduction. Each thrust addresses a general technology area needed to combat drug trafficking and substance addiction. The counterdrug R&D program has benefitted greatly from prior investments made to support national defense. In particular, the Advanced Research Projects Agency (ARPA) has made a significant contribution under its prototype technology development program for contraband detection and cargo container inspection.

The national program includes an infrastructure program to evaluate advanced technology prototypes being developed and to measure the effectiveness of the R&D activities of all Federal agencies with counterdrug missions. The infrastructure program consists of three components: technology testbeds, benchmarking, and laboratory facilities and instrumentation. To be successful, the infrastructure program fosters close working relationships among Federal, State and local law enforcement, prevention and treatment agencies, and the research and development laboratories from the Government, academic and private sectors.

The technology testbed program includes testbeds established to provide engineering test and evaluation facilities. These operational testbeds emulate the environment in which future systems will be required to operate. The benchmark evaluation programs compare technical performance using accurate measures of effectiveness and scientific comparison criteria to evaluate system performance in operationally correct scenarios. The laboratory instrumentation activity provides modern facilities and equipment to be used to evaluate law enforcement technology prototypes and to enhance the performance of medical research teams working in the area of drug addiction treatment and prevention.

Technology Testbeds

During FY 1992, ARPA, in support of the U.S. Customs Service, began a major Contraband and Cargo Container Inspection Program to evaluate various candidate technologies and prototype system concepts for a future, advanced technology, nonintrusive inspection system for finding drugs hidden within the vast amount of cargo entering our borders. Projects were initiated on neutron, chemical, x-ray and sonic techniques with the highest priority assigned to the application of neutron and x-ray imaging technologies.

The penetration depth and imaging density achievable with neutron and high energy x-ray technologies are needed to inspect fully loaded cargo containers for hidden drugs. Medium energy x-ray systems lack the penetration depth and imaging density for inspecting loaded containers but may be useful for verifying that empty containers and trucks are indeed empty.

In cooperation with U.S. Customs Service, ARPA constructed operational testbeds at Tacoma, Washington and Otay Mesa, California to support test and evaluation of x-ray technology. ARPA recently completed the engineering tests of high energy x-ray technology at Tacoma and backscatter low energy transmission x-ray systems at Otay Mesa. This x-ray technology evaluation and testbed program represents a significant success of the ARPA Contraband and Cargo Container Inspection Program.

With the completion of high energy x-ray testing, the requirement for a testbed at Tacoma no longer exists and the testbed has been dismantled. U.S. Customs Service now has sufficient engineering data to proceed with the next step of formulating plans for a first generation nonintrusive inspection system including a high energy x-ray inspection system for finding drugs hidden in cargo.

During the preceding four fiscal years, ARPA sustained a level of R&D investment in x-ray and neutron interrogation nonintrusive inspection technology of approximately $15 million annually. By the end of FY 1995, ARPA will have completed the evaluations of the nuclear physics related projects. With the successful completion of these projects, these ARPA investments in nonintrusive inspection technologies in support of the national counterdrug R&D program will be reduced.

Because ARPA had been providing the lead for the development of nonintrusive inspection prototype technology and evaluation testbeds, the national program thrust in this technology area also will be reduced. At that juncture with the completion of three parallel, relocatable cargo inspection technology development programs in FY 1996, ARPA will have provided U.S. Customs Service with the requisite engineering base to pursue an aggressive inspection policy and strategy employing a family of technologies from which to configure a first generation nonintrusive inspection system for detecting drugs at our ports-of-entry.

Based on this knowledge, the U.S. Customs Service should undertake a course of action to ensure that a modern nonintrusive inspection system is installed at the land and seaport terminus of the U.S. entry zone by the end of FY 2001. This modern nonintrusive inspection system should achieve an inspection throughput sufficient to promote the free flow of legitimate commerce while meeting aggressive drug seizure and inspection rate standards. The performance standards should contain such measures of effectiveness as percentage of inspection required and probability of success rates to ensure that the flow of illicit drugs through the terminus of the United States entry zone is stopped.

Laboratories and Instrumentation

For the prevention and treatment community, engineering infrastructure projects have been initiated to improve the state of the art of laboratory equipment and technology available to the scientists working on drug addiction research. The goal is to apply technology to make more effective use of our limited medical research and scientific personnel resources.

Summary

Each effort to develop technology, establish testbeds, perform benchmarking, or reach out to the public has been keyed to one overriding objective - *the development and application of better technology to fight the drug problem in the United States.*

2. ACCOMPLISHMENTS

This section summarizes those accomplishments achieved since the last report. While the concentration of discussions herein concerns primarily CTAC sponsored R&D, the entire counterdrug R&D program is discussed in the following section, entitled Program Summary. CTAC sponsored R&D focuses on technological gaps in the overall program.

Fifty-two projects have been initiated by CTAC since 1992. These projects include:

- Thirty-four specific R&D projects were begun to produce advanced technology prototypes for user personnel to evaluate, modify and ultimately, based on successful completion of an evaluation, initiate procurement actions.

Eighteen projects were conceived by those Federal law enforcement agencies with a counterdrug mission. A Broad Agency Announcement (BAA 92-15) for counterdrug technology was published and closed with 16 R&D projects competitively selected and funded from 69 industrial and academic proposals.

- Fourteen infrastructure support initiatives were begun to establish testbeds for evaluating developmental technology prototypes, to perform a wide range of special studies and assessments in support of community-based scientific and technological requirements, and to develop a radiochemistry laboratory at the Addiction Research Center for improvements in using brain scanning technology for drug abuse research.

- Four outreach program initiatives were begun. These efforts spanned the globe, making significant contributions to technical symposia throughout the United States and at international technical and professional gatherings in Canada, the United Kingdom, France, and Greece.

Full descriptions of these and other projects being conducted to further counterdrug technology are provided in the remainder of this document.

3. PROGRAM SUMMARY

Under the counterdrug R&D program, all agencies conduct R&D to determine the technical feasibility of using technology to improve certain functions. As each technology is evaluated for technical feasibility, the R&D portion of the effort is thoroughly documented and then terminated. In most cases, if the R&D proved that the technology was feasible, the resultant technology is transitioned to the end-user for implementation which generally includes continuing development and eventually acquiring the system or device.

Since potential counterdrug technology transcends many missions, both enforcement and treatment related, CTAC has attempted to strike a balance in consonance with the National Drug Control Strategy. Consequently, CTAC has pursued both supply and demand reduction research and development efforts.

Supply reduction technology generally relies on the disciplines of physical, chemical and information sciences. To support law enforcement, CTAC has focused on integrating advancements in these technologies and applying improved capabilities to tactical operations where we can use equipment to perform many of the highly dangerous surveillance and forensic data collection activities. Many of these applications, such as global positioning systems (GPS) and personnel communications, have been made possible by past investments made by the Department of Defense and ARPA.

Demand reduction technology relies upon the disciplines of biochemistry, psychology, physiology and social sciences. CTAC research and development programs in demand reduction apply advancements in medical research to improve therapeutic treatment for drug abusers and information sciences technology to exchange information on successful prevention and treatment modalities among clinics networked across the nation.

A complete survey of those scientific and technological needs for counterdrug law enforcement has been completed by CTAC and is summarized in Appendix E. Broad Agency Announcements have been used to survey industry for technological solutions to these needs.

The following paragraphs provide a summary of the technology areas and types of projects that are being performed in response to identified gaps in capability. Project descriptions are organized by technical thrust. A complete listing of R&D project titles for each agency is given in Appendix F.

3.1 Tactical Technologies

The tactical technology program provides for the development of tools and systems to support field agents and headquarters personnel in their mission to counter drug trafficking organizations. Technology thrusts include data fusion and processing, command, control and communications, tracking and surveillance, miniaturized electronics and data compression, and forensics technology.

Field and headquarters personnel amass vast amounts of drug criminal investigative information in their daily tactical operations against drug trafficking organizations. The tactical technology program has been structured upon the premise that an information management research program focused on data processing, sorting and analyses technology will enhance the performance of these agencies.

Projects in this thrust focus on development of advanced techniques for merging diverse law enforcement, industry and public databases in a manner which maintains data security and integrity while enhancing our intelligence collection, fusion, and data sharing capability. This thrust includes advanced technology projects for data fusion, data processing, search algorithms based upon artificial intelligence and neural networks, computer mapping information systems, voice print recognition, and information management and exploitation systems.

Developing technologies in information sharing and networking is one of the cornerstones of the national R&D program. Our goal is to accelerate the transfer of this type of technology to State and local agencies for use against drug traffickers operating in multiple jurisdictions. Significant decreases in time spent in supporting investigations through data organization, faster data analysis, and better communications will allow law enforcement agencies to more effectively share information across jurisdictional boundaries.

The tactical technology thrust also addresses technology for covert radios and recorders capable of spread spectrum, low probability of interception, and low probability of detection communications. These devices should be made smaller and more concealable than current radios and covert surveillance recorders. Research efforts should lead to improved body worn microphones undetectable by metal detectors, commercially available frequency scanners, or other counter-detection devices available to the drug traffickers on the open market.

To defeat drug traffickers using commercially available cellular telephones, personal command systems using computer supported communications technology should be developed for use in time-sensitive, multi-agency drug enforcement operations.

Data Fusion and Processing

Cooperative agreements have been executed for a prototype data fusion system to be developed by the Tennessee Valley Authority and University of Tennessee. The system will permit the seamless integration and extraction of a variety of criminal information from various databases, on various computer systems, regardless of type of computer or physical location.

In the area of ballistics, a high performance matcher computer algorithm was developed to scan large numbers of cartridge cases rapidly and to integrate a neural network into the FBI DRUGFIRE system.

In the area of money laundering, an initiative with the Financial Crimes Enforcement Network is underway to increase our capacity to automatically process textual information from Treasury forms and banking affidavits into usable data.

Tracking and Surveillance and Command, Control, and Communications

Tracking and surveillance operations are extremely important to effectively disrupting drug traffickers and improving the safety of our law enforcement personnel. In support of this area, several initiatives have been pursued to improve tracking and communications technology.

A GPS tracking system has been developed to allow police to track their vehicles and improve drug-related criminal investigations. One prototype system is being field tested with the Yonkers Police Department Narcotics Division. Modifications are being studied for expanding this capability including testing the concept in more complex urban environments in support of the FBI.

An airborne counterpart to the land based system is under development by the Mayo Clinic in Minnesota for deployment with their medevac helicopter. The system will be tested for medical

response and drug law enforcement missions by the Minnesota Highway Patrol.

A location and tracking system is being developed in conjunction with the FBI that uses radio frequency transmissions from a concealed transponder. The transponder remains in semi-sleep receive mode until activated by a query from the host system. When queried, the transponder emits a short-duration data burst making the system immune to detection from scanners.

Electromagnetic propagation prediction models are being developed in conjunction with the FBI to predict and optimize the use of cellular communications for tracking, surveillance and communications in urban and rural environments.

Using spread spectrum technology, a low probability of detection, body-worn transmitter is being developed in conjunction with the FBI for use in undercover operations. This system will also be immune to detection and intercept by commercial scanners.

In conjunction with DEA, an enhanced real-time voice identification system is being developed for use on a personal computer with an easy-to-use interface. The system will be used to monitor conversations to automatically identify voices.

Miniaturized Electronics and Data Compression

In conjunction with the FBI, development of the Small Look video system, a high quality, miniaturized, video recording device, has been continued. This device can be used undercover to monitor and execute covert surveillance operations, as well as to collect evidence for prosecution.

The prototype system uses a modified version of the micro miniature, forensic quality audio recorder program module developed for the ARPA Small Talk program. Small Look can be programmed from remote locations to operate as desired (turn on/off, record/playback). The signal processing and data storage technologies common to the reprogrammable modules within the two devices provide a responsive, less costly alternative to conventional technologies.

By reconfiguring the Small Talk common miniaturized reprogrammable data storage device, the counterdrug law enforcement agencies have access to a new innovative family of surveillance devices at a price they can afford. Tests of Small Talk and Small Look devices are being conducted along the Southwest border with State and local organizations and in California and New York by the DEA and FBI.

Forensics Technology

Improved field test kits to detect trace amounts of narcotics residue on hands and surfaces have been developed in conjunction with the FBI. These detection kits use protein antibodies that bind to cocaine and heroin particles to discretely and positively identify the contraband or the conveyances, property and money involved in narcotics trafficking. Positive indications confirm the presence of cocaine and allow the inspector to continue the search of the suspect container.

For criminal prosecution, the kit will positively identify the forensic material to be seized as evidence. While being tested, a field test kit provided evidentiary support to a $6 million drug-related asset seizure.

3.2 Nonintrusive Inspection

Each year, U.S. ports-of-entry process some 400 million passengers and pedestrians, 10 million cargo containers, 125 million cars and trucks, 450 thousand commercial aircraft, 150 thousand private aircraft, 100 thousand cargo ships and 170 thousand pleasure craft.

Our most pressing goal in nonintrusive inspection is to develop a rapid, modern automatic system to inspect shipment and cargo containers for contraband without physically removing all the contents for a manual inspection. Indeed, a family of technologies is needed to provide systems capable of inspecting other modes and conveyances, such as cars, break-bulk shipments, and railroad cars as well.

The completion of the ARPA Tacoma and Otay Mesa testbed program represents a significant step forward in using x-ray technology to inspect these conveyances.

Now that x-ray systems can be used to nonintrusively detect anomalies within the cargo (substances that do not correlate with the reported cargo contents), suspicious shipments can then be diverted to more sophisticated inspection systems to classify the specific substance "pinpointed" by the x-ray. Neutron inspection systems use beams that penetrate the container to react with the cargo contents. These systems may classify the contents specifically by identifying types and ratios of light elements; thereby distinguishing between cocaine or heroin and legitimate benign materials. Many other substances can also be identified including explosives.

In the area of neutron interrogation, separate systems have been investigated using different types of neutron interaction mechanisms.

- The pulsed fast neutron analysis (PFNA) system uses a high-energy beam that generates secondary neutrons. The system requires a 7 to 8 million-electron volt (MeV) source to generate the image.

- Another system uses neutron elastic scatter technology at lower power levels. The penetrating neutrons are scattered back from the target chemicals and secondary neutron emission is not used. Elastic backscatter and resonant elastic backscatter use 1.78 to 2.35 MeV neutrons from an appropriate source.

Neutron pulsed source development has encompassed a series of prototype generators capable of use with several different types of cargo container inspection systems. One is a 2.5 MeV low-rate fusion generator with continuous operation. Another generator that produces 14 MeV neutrons is considered to be a more efficient unit for use in existing thermal neutron activation systems.

Tests of PFNA technology by ARPA are scheduled for completion later this year.

In the area of expert systems technology, an automated targeting system is being developed with the U.S. Customs Service for identifying cargo that has a high probability of containing contraband. The system automatically downloads, sorts and screens manifest and entry data. Using an expert system, it will increase the efficiency and effectiveness of customs inspectors by facilitating the flow of low-risk cargo and concentrating the focus of inspections on the cargo with the highest risk.

Five advanced development prototypes are being developed to discriminate the contents of drums, and possibly tankers, by nonintrusively measuring the acoustic properties of the transported substance. The systems, which use technology derived from the U.S. Navy, can also detect hidden compartments and concealments located within the tank or drum.

Similarly, to inspect large containers designed to carry liquified substances, such as propane, a prototype gamma-ray detector is being developed in conjunction with the U.S. Customs Service. Gamma-ray detectors provide low-clutter images and are transportable. They will be used to ensure that presumably empty tankers, which may be hazardous to open because of their previous contents, are indeed empty.

A prototype fixed system for detecting narcotics materials swallowed by drug smugglers is being developed using nuclear magnetic resonance technology. This system will be useful in detecting both cocaine hydrochloride and heroin-based drugs.

In support of detecting trace and ultra-trace vapor associated with selected narcotics, a gas chromatography system prototype is being developed in conjunction with the U.S. Customs Service.

For detecting illegal drugs using chemical means, two prototypes systems are being developed for testing. Results from the field tests with the U.S. Customs Service will provide information for developing specifications for production systems.

3.3 Wide Area Surveillance

Intelligence agencies estimate that 70% of the cocaine enters the U.S. through the Southwest border. Consequently, additional concentration has been placed on technology development that can be used to increase our effectiveness along the border.

Data Fusion and Processing

A facial recognition system is being developed with the Immigration and Naturalization Service to rapidly match faces and textual documentation of known traffickers at our border crossings. Further advancement in the computer software, such as automating some of the system software, is under consideration. A system demonstration and test are being conducted at El Paso, Texas.

Ultra Wide Band Communications

Ultra wide band communications technology is being developed for relaying real-time audio and video data from sensors along the Southwest border. This system will improve the flow of information from the border to border patrol monitoring stations. This improved capability will dramatically reduce the false alarms currently experienced along the Southwest border by providing real-time audio and video data at the monitoring station. This in turn can improve how the Border Patrol employs its limited resources. With the Immigration and Naturalization Service (INS) as lead, testing will include participation of several Federal, State and local law enforcement agencies located in Arizona.

Sensor Technology

A "modular sensor" design effort was completed by Lawrence Livermore National Laboratories under the operational guidance of INS. This system employs an open architecture to permit using state-of-the-art technology with "downward" compatibility with those existing sensors already in place. Many innovative commercial designs have been received at INS in response to this effort. INS is evaluating these potential configurations for use along the U.S. border.

A prototype Transportable Observation Platform has been developed that uses night vision technology to increase the effectiveness and safety of our Border Patrol agents, especially during night operations. The prototype will be tested along the Southwest border this summer.

A project with Sandia National Laboratories has been completed to field a miniature tracking beacon that draws its power from an interrogating radar. Ten prototypes have been produced and are being tested by the U.S. Customs Service. The designs produced from this effort will enable any agency to configure beacons that work with their indigenous radar systems.

A project to investigate the feasibility of inspecting the hulls of ships for drug-laden external "pods" using off-the-shelf side-scan sonars as they enter U.S. ports of interest was completed with the U.S. Customs Service.

Extensive R&D is being pursued by DoD to enhance the performance of Over the Horizon radars that are used extensively for interagency and international interdiction of air drug smugglers. Such technology enhancements include: advanced clutter rejection, impulse noise rejection, enhanced tracks, and reduced positional errors. An average of three to five operational enhancements are produced and installed each year.

3.4 Demand Reduction

Technological advancements in both computer science and tactical technologies, some developed for defense purposes, are being investigated for application to drug abuse treatment efforts. Near-term improvements center on introducing computer technology advancements in networking and software to support better and faster communications, as well as computer assisted analysis.

In conjunction with the Addiction Research Center, research in advancing imaging technology to carry out medical research specific to drug addiction also is being supported. Finally, technology applications to support noninvasive drug testing and monitoring are being developed.

The following paragraphs provide summaries of the efforts in each of these areas.

Artificial Enzymes

Columbia University College of Physicians and Surgeons is developing artificial enzymes that interfere with the cocaine molecule's ability to provide drug-related sensations. The enzyme is designed to stimulate a reaction to destroy the cocaine molecules in the blood. This extremely important work could provide the breakthrough in providing effective therapeutic drugs that block cocaine for extensive periods of time. Additional research includes performing a series of experiments using positron emission tomography (PET) scans to observe the effects of the enzyme on Rhesus monkeys. During this phase, the research team will obtain pharmaceutical support to synthesize the enzymes in larger and purer quantity.

Therapeutic Treatment Development

An on-site radiochemistry laboratory for a PET facility at the Addiction Research Center in Baltimore, Maryland is being developed. This facility will produce the radio-isotopes needed for researchers to map the exact areas of the brain that are activated by drugs of abuse. This research, in turn, will help in identifying and evaluating therapeutic drugs that will inactivate these sites or otherwise block the effect of illicit drugs on the brain.

Drug Testing

For drug testing applications, a research team led by the Naval Research Laboratory is evaluating using a subject's hair, sweat or saliva for monitoring drug use under a variety of conditions. Such issues as passive exposure, false identification of drug use, and matrix bias among individuals are being considered to evaluate the best biological matrix to use in developing a noninvasive drug testing alternative to urine.

4. INFRASTRUCTURE SUPPORT

Effective near-term fielding of technology requires the capability to perform independent technical assessments and evaluations of prototype technology in realistic operational environments. These evaluations must consider acquisition strategies, as well as logistics, reliability, training and cost.

A technology testbed program was initiated to establish "laboratories in the field" where objective data could be collected from independent field evaluations on advanced technology prototypes in an unbiased environment. In this environment, scientist, engineers and user experts can work together.

Nonintrusive Inspection Technology Testbeds

ARPA and the U.S. Customs Service have completed a highly successful series of tests at the testbed in Tacoma, Washington using an 8 MeV high energy x-ray to detect drugs hidden within cargo containers. During these tests, an overall detection probability of 70% was achieved over all types of cargo. A correct inspection decision of the contents of a fully loaded container was achieved 92% of the time by minimally trained operators. The high energy (8 MeV) beam x-ray test series has demonstrated that fieldable systems are technically feasible.

A medium energy (450 KV) x-ray system was tested on empty containers and trucks at an operational testbed located in Otay Mesa, California. During these tests, an overall detection probability of 30% was achieved for all types of containers and vehicles. A correct inspection decision was achieved 90% of the time by minimally trained operators.

Based on these test results and U.S. Customs Service operational requirements, ARPA initiated the development of three transportable systems capable of inspecting trucks and other vehicles. During FY 1995, ARPA will establish a testbed at Fort Huachuca to evaluate combinations of nonintrusive technology for inspecting vehicles, including transportable x-ray systems and chemical sensors.

Drug Signatures and Phenomenology

A Community Technical Evaluation Center (CTEC) has been developed where joint technical evaluations of off-the-shelf equipment and advanced technology prototypes can be conducted in a secure, fully instrumented, operational setting.

This program with the U.S. Customs Service and the member agencies of the Contraband Detection Working Group (CIA, U.S. Coast Guard, FBI, DEA, INS, Secret Service, ARPA, Army, Navy and FAA) is underway to perform periodic technical assessments on off-the-shelf detection systems to determine limitations experienced under field conditions. Documenting these limitations assists the manufacturers in producing better systems and informs our operators of certain equipment limitations.

The current program addresses two phases: vapor/particle detection systems and bulk detection systems. Idaho National Engineering Laboratory (INEL), Argonne National Laboratory and the Houston Advanced Research Center (HARC) are providing the working group with technical expertise on phenomena for detecting cocaine, heroin and marijuana. INEL is modifying vapor signature generators (first developed for the FAA's explosives detection efforts) to generate vapor signatures for illicit drugs. Currently, Argonne provides technical support for evaluating nuclear detection techniques, and HARC supports evaluations of chemical detection techniques.

Over the past year, field assessments have been performed at Harvey Point NC, Otay Mesa and San Ysidro CA, Miami FL, and Kennedy Airport NY.

Canadian customs recently participated in a series of tests conducted at CTEC in November 1994. U.S. Customs Service plans to install a full scale port-of-entry inspection station at CTEC to evaluate improvements in inspection methods and technology.

Measures of Effectiveness

Project Breakthrough is an ongoing cooperative effort with the Department of State and Drug Enforcement Administration to quantify cocaine production by determining the yield and alkaloid content of coca crops in Bolivia, Peru and Columbia. It also attempts to determine the efficiency of clandestine laboratory operations in processing coca leaf to cocaine. Key findings from last year's effort have significantly improved the reliability of the estimate of cocaine production in Bolivia.

Technical Evaluations and Assessments

At the request of the Office of Management and Budget, a benchmark evaluation study was performed on the Federal Bureau of Investigation DRUGFIRE™ and the Bureau of Alcohol, Tobacco and Firearms BULLETPROOF® ballistic imaging systems.

Ballistic imaging systems substitute a computer work station for the traditional manual method of ballistic evidence examination used by forensic examiners for the past 70 years. A ballistic imaging work station allows a firearms analyst to scan images of weapons evidence into a computer data base, to retrieve and examine the stored images using powerful image enhancement tools, and to view, via wide area networks (WANs), images of evidence stored at other locations within a region. These new tools allow firearms examiners to consider open case files during an examination without concerns for chain of custody problems associated with moving and handling the evidence. Exploitation of this new technology could dramatically improve the way examinations are done on ballistic evidence collected from crime scenes.

The ballistic imaging evaluation project team of computer and algorithm development engineers was supported by two firearms examiners with national reputations. This team evaluated the technical performance of the two systems against 10 measures of effectiveness (MOEs).

The MOEs used were predominantly standard performance measures that would be used to evaluate any computer-based image matching system. Several MOEs, however, such as overall processing capability, network compatibility, computer requirements and architecture, are

specific to ballistic imaging and showed a clear distinction between the two systems.

The evaluation report provided 17 recommendations to FBI and ATF. The key recommendations include Federal guidelines that a work station capable of examining both cartridge and bullet evidence should be developed and that these common work stations should be integrated onto regional and national WANs.

The full list of recommendations and the results of the technical performance have been published in ONDCP Report, "Benchmark Evaluation Studies of the BULLETPROOF and DRUGFIRE Ballistic Imaging Systems," November 1994.

Rapid Prototyping

In collaboration with a state organized crime task force, a multi-phased effort was initiated to analyze the use of cellular phones in drug trafficking. A prototype system was rapidly developed and has been successfully tested in the operational environment. This capability has been made possible through an innovative application of computer networking which allows inexpensive PC-based computers to replace extremely costly large-scale processors for performing similar analysis problems. The next phase of this project provides for simultaneous analysis from multiple cellular carriers. Replication of the system for use at other locations is being discussed with Federal and State organizations.

5. OUTREACH PROGRAM

An outreach effort was initiated to encourage frequent technical interactions between world-class scientists, engineers and law enforcement personnel. These efforts concentrated on bringing the best minds in the world together to combat drug abuse and the crime it spawns.

International Technical Symposia

Technical symposia, conferences and workshops have been used to foster a free exchange of technical information among researchers, scientists and user personnel. CTAC attempts to sponsor one major international technology symposium each year. Our goal was to perform a complete survey of the state of the art for selected technology areas and publish the results in a widely distributed conference proceedings.

The first symposium was the Contraband and Cargo Inspection International Technology Symposium held in October 1992 in conjunction with the National Institute of Justice. This was the third such international gathering on these technologies in the past five years. While the first two such meetings concerned explosives detection, this conference focused on applying these same detection technologies to inspecting cargo containers for hidden drugs.

The second symposium was the Wide Area Surveillance and Tactical Technology Symposium held in November 1993 in conjunction with the Department of Energy and Argonne National Laboratories. This conference focused on those technologies applied to surveillance, tracking, communications, and command and control counterdrug missions.

A third symposium on law enforcement technologies is planned in 1995.

Community Access

Each year CTAC supports the ONDCP regional conference series where broad-based discussions on drug abuse prevention, treatment and counterdrug law enforcement technology are taken to the experts in the field. In FY 1994, these conferences were held at four central sites across the country to elicit information from the field and to disseminate drug control policy. The results from this regional conference series were used to formulate changes to the national policy for drug control and to modify the national counterdrug R&D strategy.

CTAC also participates in a wide variety of activities with technical and professional associations, such as the Armed Forces Communications and Electronics Association and the International Association of Chiefs of Police. Each of these endeavors targets specific audiences for participation in the counterdrug R&D program,

either as providers or as users of advancements in technology.

A drug-related Broad Agency Announcement (BAA) also has been published for historically black colleges and universities. That BAA solicits responses from the academic community with unique insights into the modalities of drug abuse prevention and treatment.

6. FUTURE PLANS

CTAC has formulated a multi-year R&D program for counterdrug technology development. The plan includes completion of the follow-on phases of successful research projects. Those projects funded specifically by CTAC are described in Appendix D.

6.1 Tactical Technologies

Technology prototypes for tactical operations support will continue to be developed in FY 1995 and FY 1996. Both CTAC and ARPA are expected to continue development of promising projects, leveraging DoD-related technology wherever practical. The FBI and DEA will continue to be the lead agencies pursuing complementary drug-related tactical technology development programs over this period. The FBI is undertaking a significant effort in the area of digital telephony which complements the ARPA and CTAC programs.

Specific technology areas which show promise for continued development include:

- Command, Control and Communications,
- Tracking and Surveillance,
- Acoustic Monitoring and Surveillance,
- Data Compression and Miniaturized Electronics, and
- Low Probability of Intercept/Detection Communications.

In the area of Command, Control and Communications, technology advancements in mapping, three-dimensional displays and line-of-sight, fade-resistant communications are planned.

In tracking and surveillance, projects for developing smaller and more powerful locating and tracking devices are underway. Positional displays for these devices will be compatible with those systems being developed under command and control technology.

For acoustic monitoring and surveillance, the follow-on phases of currently active projects to develop advanced acoustic linear arrays including innovative adaptive beamforming algorithms and real-time data processing technology will be executed.

Projects for miniaturizing the size, reducing the power requirements, and increasing the data volume for tracking and communications equipment are underway and are expected to continue.

Efforts to reduce the vulnerability of our communications systems to detection or intercept by commercial scanners are expected to continue. Specific efforts to improve system reliability and reduce fading in urban environments are underway at this time.

6.2 Nonintrusive Inspection

The national program has begun to change emphasis. With the completion of the test series in Tacoma, investments in high energy x-ray technology development will be curtailed as the U.S. Customs Service begins the process, over the next several years, of installing a first generation nonintrusive inspection system at the major U.S. ports of entry.

The nonintrusive inspection technology program will then consist of testing and evaluating advanced technology prototypes employing x-ray, gamma-ray, gas chromatography, chemiluminescence and ion trap spectrometry. Testing of these prototypes should be completed by the end of FY 1996. At that time, ARPA also will reduce its investments in neutron interrogation technology development. The nonintrusive inspection technology thrust then will be directed toward developing transportable neutron interrogation and mobile chemical sensor technologies.

Engineering and analytical support to the U.S. Customs Service for cataloging drug emissions, evaluating off-the-shelf technology, and using expert systems for evaluating cargo manifests will continue. In fact, a special Congressionally directed study has begun to assess tradeoffs among cost, performance, and operational parameters for advanced nonintrusive inspection systems. To be completed in FY 1996, the study will define a first generation nonintrusive inspection system and will provide top level specifications for an engineering system design for installing advanced inspection systems at selected sites along our borders and at ports of entry.

6.3 Wide Area Surveillance

Those R&D projects undertaken with INS for improved sensor design, facial recognition technology, and ultra wide band communications will produce technology prototypes for testing in FY 1995 and FY 1996. In FY 1995, the development of an open architecture sensor system design for the Southwest border will be completed. Advanced algorithms will be developed to improve the use of facial recognition technology at ports-of-entry and "detention" facilities. These improvements will assist in correlating people being detained with known drug traffickers, terrorists and criminals.

In FY 1996, a fieldable prototype "ultra wide bandwidth" sensor communications system will be ready for testing. This prototype will be tested in conjunction with INS engineers along the Southwest border.

With the completion of these projects, the wide area surveillance thrust will be directed toward projects for command and control functions along the U.S. Southwest border and toward the transfer of the more promising technologies into the inventories of the State and local law enforcement organizations with a drug control mission.

6.4 Demand Reduction

For demand reduction, advancements will be made in medical research to improve therapeutic treatment for drug abusers and in information technology to share progress on successful treatment modalities with researchers and treatment clinics across the nation.

Data Networks

A computer-based drug treatment research information network is being developed that will link the research community and drug treatment centers throughout the nation. This effort is intended to improve the way drug abuse treatment is administered by facilitating collaboration among various research efforts, identifying the most successful prevention and treatment programs, and providing real time communications and analysis between the various clinics and research centers. The initial pilot network will be centered in the Northeast.

Drug Testing

For drug testing applications, a bracelet is being developed to be worn by a patient, prison inmate or parolee which can continuously monitor the subject for drug abuse. Ultimately, the system will automatically relay adverse information back to a central processing unit. Promising techniques for those sensors needed for the noninvasive detection of illicit drug use from hair, sweat and saliva are being investigated. An ongoing study of first-time offenders in the New Orleans Parish, Louisiana will be employed to evaluate the best methods for detecting drug abuse in the criminal justice system.

6.5 Infrastructure Support

In FY 1995 and FY 1996, advanced technology prototypes will become available for testing. The infrastructure support program provides testbeds, instrumentation and engineering support to perform testing of prototypes in operational environments. While the Federal law enforcement agencies provide the lead for much of the testing program, many of the prototype tests will include State and local organizations.

The following paragraphs describe plans for testing and evaluating prototypes as they become available.

Command, Control and Communications

In the area of command, control and communications, prototype mapping, tracking and display systems will become available for test and evaluation in FY 1995. Current plans include conducting pilot projects with Yonkers Narcotics Division, the FBI Field Office in New York City, Pima County Sheriff's Department working with the U.S. Army Electronic Proving Ground at Fort Huachuca, Arizona, and Minnesota State Police working with the Mayo Clinic in Rochester, Minnesota. Each pilot project addresses unique aspects of technology for tracking and surveillance, command and control, and communications, including coordination with airborne operations. Results from each project will be documented in a series of technical reports which will be made available to the law enforcement community at-large.

Arizona Alliance Planning Committee

The Arizona Alliance Planning Committee has been established to test technology prototypes along the Arizona portion of the Southwest border. Cochise and Pima counties have agreed to evaluate a pilot "border interagency communication" system being installed by the Army Electronic Proving Grounds in Fort Huachuca.

Miniaturized Electronics and Data Compression

In the area of tracking and surveillance, advanced technology prototypes for real-time voice recognition, acoustic surveillance, video/audio data recorders and transmitters, low probability of intercept communications and propagation modeling for cellular communications will become available for testing. While DEA and FBI provide the lead for testing these prototypes, arrangements have been made to make prototypes available to State and local agencies for testing along the Southwest border including southern California.

Border Research and Technology Center

A Border Research and Technology Center has been established to serve as a focal point for evaluating specialized law enforcement technologies to increase our drug-related mission effectiveness along the Southwest border. This Center was established jointly by the Department of Justice, Office of National Drug Control Policy and the Department of Treasury.

Information Management and Exploitation

A survey of automated information management and data analysis systems used by State and local drug task forces has been completed recently. Portions of that effort were used to formulate the initial technology thrust for a State and local support program in information management and sharing.

Pilot projects for one state organized crime task force and several local law enforcement agencies have assisted them in applying advanced technology to target drug trafficking organizations safely and more effectively by analyzing patterns of traffickers' cellular phone calls. Additional support in this technology is planned on a pilot basis at several sites across the nation from New York City to Miami, in New Orleans and Chicago, and along the Northern and Southwest borders.

Jurisdictional Information Exchange Networks

A high bandwidth, digital network is planned for assisting State and local law enforcement organizations to access and share criminal information. Pinellas County, Florida has agreed to run the initial prototype system with the assistance of TVA and University of Tennessee.

Initial testing of the pilot system will begin in August 1995 with a Florida law enforcement consortium centered with the Pinellas County Sheriff's Office. Approximately eight Federal, State and local law enforcement agencies will be involved in the initial testing. Once completed, this prototype system can be exported to any law enforcement agency with basic computer network capability at a low cost.

Money Laundering

Working with the Arizona Attorney General and other state authorities, an advanced system for case-based reasoning methodologies is being developed to identify target groups and then select

appropriate data elements from diverse information domains for finance, real estate, and motor vehicles. This information will be used to define and explore complex illegal activity and assist in gathering leads and evidence to dismantle drug trafficking and money laundering operations.

Advanced Forensic Development Program

Several hundred forensic laboratories around the world provide scientific services for their own and other police agencies for the investigation of crime and associated case work. Continued research is required for forensic science to benefit the courts and society as a whole.

Beginning in April 1995, this program, in cooperation with the FBI, provides a system of competitive contracts to support leading-edge forensic research and development. The goal of the program is to provide for the applied development of high priority forensic analytical, methodological, and instrumental capabilities which substantially advance our ability to process scientific evidence in support of investigations involving illicit drugs.

Projects will be funded as limited-term, competitive contracts across the full spectrum of forensic science subdisciplines. Each award will promote a reliable, valid, fieldable approach within a relatively short time period (less than one year). Partnerships between forensic laboratories and universities, institutes or commercial scientific and engineering organizations also will be encouraged. Participants include FBI, DEA, Secret Service, and several State and local organizations.

Broad Agency Announcements for Innovative Research and Development Projects

During 1990 and 1992, ARPA (then DARPA) and CTAC used BAAs to solicit private sector ideas in the areas of nonintrusive inspection, tactical technologies, and wide area surveillance. CTAC's BAA included a request for demand reduction technologies, as well. Industrial responses to these solicitations formed the basis for the ARPA and CTAC R&D programs. These solicitations provided a comprehensive market survey of advanced technology and prototype systems concepts for counterdrug law enforcement. The awards made from these BAAs represent the developmental technology base for the national counterdrug law enforcement R&D program.

In late 1994, several highly focused BAAs were sponsored by ARPA, FBI and CTAC. These BAAs request support in the following areas:

- forensics for evidentiary analyses of biological and physical materials,
- advanced command and mapping information systems,
- technology enhancements to over-the-horizon radars,
- transportable nonintrusive inspection systems,
- a set-aside for historically black colleges and universities (HBCU).

In the area of forensics, technologies will be identified which provide near and mid term improvements to the forensic capabilities of Federal, State, and local law enforcement agencies in drug cases. The forensics BAA is focused on nine major forensic disciplines: chemistry; portable instrumentation; biological and DNA analysis techniques for the determination of source country or species identification of coca, poppy, or marijuana plant material through DNA analysis; toxicology; firearms and toolmarks; computers and computational research; document examination; photographic and video techniques; and fingerprint technology.

In the area of advanced command and mapping systems technology, innovative state-of-the-art technologies are being sought for immediate use in the areas of advanced command and mapping information systems. These concepts should be based on open-architecture systems using existing technologies to graphically display, in real time, relative position and location information of various position and location systems.

Position and location systems which include Teletrack, GPS or LORAN types of systems were demonstrated for Federal, State and local law

enforcement agencies in January 1995. Additional system capabilities, as a minimum, should include: acquiring and tracking multiple vehicles simultaneously; distinguishing each vehicle with a different attribute or marker; zoom capability down to street level resolution; and accessing position information of the various vehicles being tracked from remote locations.

Research teams will be selected from HBCU respondents in early 1995 to perform innovative research in drug abuse treatment and prevention. Each team will be required to include both undergraduate students and graduate students.

Drug Signatures and Phenomenology

The Narcotics Detection Technology Assessment Program, begun in 1992, will be expanded to provide accurate information on those detectable signatures emitted by drugs (or precursor chemicals) in the operational environment. This drug phenomenology assessment field measurement series ensures that off-the-shelf and prototype detection systems that test successfully in the laboratory also will perform in the field.

Standard detectable emissions will be determined for use by those equipment manufacturers who design drug detection equipment and by those agencies who procure the detection devices. These signatures are what the substances emit under field conditions where the agent is working, not just as they appear under more predictable and controlled laboratory conditions.

From these tests, a series of technical reports will be published and distributed to share the results with the community at-large, including our international counterparts in scientific research and law enforcement.

6.6 System Tradeoff Studies

A special study has begun to assess tradeoffs among cost, performance, and operational parameters for advanced nonintrusive inspection systems. The study will specify the first generation nonintrusive inspection system and will provide top level specifications for an engineering system design for installing advanced systems at selected sites along our borders and at ports-of-entry.

The current approach entails developing a family of subsystems which can be configured to meet the needs of a variety of sizes of ports-of-entry. The fielded nonintrusive inspection system is envisioned to consist of two principal classes of subsystems: (1) shipment document examination subsystems to pre-screen exporter and importer documents; and (2) chemical and physics-based subsystems to detect and characterize illicit substances hidden among legitimate cargo.

Any advanced system also must satisfy constraints inherent to customs inspections, such as not impeding the legitimate flow of commerce, health and safety considerations, and manpower and training constraints. Systems must scale in size for individual ports and border crossing locations and must satisfy requirements for mobility. This study will use the results of the recent x-ray system tests conducted by ARPA and the U.S. Customs Service as a starting point.

Fixed Site X-Ray Systems

The 8 MeV high energy test series performed at the Tacoma testbed provided cost estimates, land area requirements, and depth of material penetration requirements for a high energy x-ray inspection system capable of inspecting fully loaded, standard size containers and trucks.

Availability of space was identified as a major factor that the U.S. Customs Service must consider whenever it plans to install any new inspection equipment at port areas or land border crossing locations. The contractor performing the Tacoma testbed tests reported that approximately 10,000 square feet of land would be required at a port-of-entry to install an operational high energy x-ray inspection system for inspecting fully loaded trucks and cargo containers.

A $136 million cost estimate was projected for deploying 20 sites. This cost estimate was for a minimum capability inspection facility that could inspect 4-6 fully loaded containers per hour. This estimate results in an average cost of $6.8M per site. These projected costs could be reduced

substantially by achieving lower subsystem costs for accelerators and detector arrays. Since the cost of the detector arrays dominate the cost of the x-ray system, cost reduction efforts should be focused on reducing the cost of the detector arrays. An overall total system cost of $96.5 million for 20 sites should be achievable. This lower cost could make high energy x-ray systems more affordable to the U.S. Customs Service.

Relocatable X-Ray Technology

One advantage to medium powered x-ray systems is that they require less shielding and thus offer potential for use in relocatable system configurations. Medium beam system concepts are being evaluated by ARPA, in cooperation with the U.S. Customs Service, at the operational testbed located at Otay Mesa, California. Medium beam energy systems, however, could lack the penetration to image a fully loaded container or truck. For example, the ARPA 450 KV medium beam energy backscatter x-ray system at Otay Mesa was designed to inspect empty trucks and conveyances.

A fully instrumented facility is being constructed at Fort Huachuca, Arizona with a complete team of experienced scientists, engineers and customs inspectors. This facility will be used to examine and test chemical and medium energy x-ray inspection techniques on streams of commercial cargo in proximity to a port-of-entry and border crossing. ARPA has structured a program to develop three relocatable systems, test them at Fort Huachuca and provide five prototypes to the U.S. Customs Service for operational evaluation.

For finding illicit drugs, the U.S. Customs Service must have systems capable of inspecting fully loaded trucks and cargo containers, however. Inspecting fully loaded containers and trucks requires a system with sufficient energy to penetrate through the entire truck contents. Because the technical performance curve connecting 450 KV and 8 MeV is nonlinear, measurements should be taken at beam energies between these two limits to determine the optimum energy level. Without a full range of tests from 450 KV to 8 MeV, the U.S. Customs Service does not have sufficient engineering data upon which to select the most effective operating energy level for a fielded x-ray inspection system. It is not clear how measurements at other beam energies can be obtained without the Tacoma testbed or a facility with the capabilities of Tacoma.

Before it can finalize an approach to acquire nonintrusive inspection systems, the U.S. Customs Service will need to quantify the correct inspection and overall probability of detection requirements to ensure border inspections will deter smugglers from using vehicles or cargo containers to transport drugs in addition to other contraband. During FY 1995, Congress has directed ONDCP to conduct a system performance and tradeoff study and to recommend a candidate first generation nonintrusive inspection system to be deployed for finding drugs entering our borders.

Destruction of Drugs and the Environment

In conjunction with the DEA, a benchmarking task has begun to evaluate the current technologies available to destroy confiscated drugs and contraband. This study will support the needs of the DEA and other interested agencies, such as the U.S. Customs Service, for cost effective methods to destroy those seized drugs and contraband upon completion of an investigation.

7. PROGRAM ISSUES

Since FY 1992, CTAC has relied on continued annual appropriations from the Special Forfeiture Fund and supplemental access to the fund to support emerging scientific and technological requirements until a permanent program account is established. Many of the Federal counterdrug law enforcement agencies, as a consequence of diminishing fiscal resources, have come to rely on CTAC to develop some of the core technologies for use in the mid to long term. In this manner they are able to apply more immediate resources toward operations and near term needs.

As CTAC supports ONDCP in the annual budget review process, this involvement assists in identifying and removing any R&D efforts that may be duplicative across individual agency programs. The recent benchmark evaluation

CTAC performed on the FBI's DRUGFIRE and the BATF's BULLETPROOF ballistic imaging systems for the Office of Management and Budget is an example of the potential benefits from this ongoing technical and programmatic review process.

Projected Requirements for FY 1996 CTAC Funding

The motivation to establish CTAC with its own budget in FY 1992 stemmed from an understanding by Congress that the law enforcement agencies had serious shortfalls in funding for counterdrug research and development. CTAC was established as the central organization to develop a comprehensive R&D program to overcome these shortfalls which were estimated to exceed $600 million. CTAC also was directed to prevent duplication of effort and assure that wherever possible R&D efforts provided capabilities that transcended the needs of any single Federal agency. The appendices to every CTAC Blueprint have contained listings of these shortfalls, or scientific and technological requirements, in priority order.

The national counterdrug R&D program includes 222 research projects including 52 projects sponsored directly by CTAC. By the end of FY 1995, 34 of the current 52 CTAC-sponsored projects will be completed. Although the baseline phases of these 34 projects will be completed by the end of FY 1995, the remainder will require incremental funding to complete during FY 1996.

Figure 1 presents a summary of the counterdrug R&D funding by all agencies with counterdrug missions. Counterdrug R&D funding has experienced a steady decline in support since its peak in 1991 of $130 million to its current 1995 level of $59 million. Of the 21 Federal agencies with counterdrug missions, Department of Defense and CTAC funding accounts for 90% of the total counterdrug R&D budget for 1995. By the end of fiscal year 1995, the national counterdrug R&D funding will be less than one-half the peak.

As part of the President's budget, CTAC has developed a request for an FY 1996 program which restores the level of funding back to one-half the peak 1991 level. As in earlier years, the FY 1996 program will consist of the following elements:

- projects recommended by the Science and Technology Committee (their list of projects will be reviewed in early August 1995),
- incremental funds to complete successful multi-year R&D projects,
- projects to develop tactical technologies for information management, communications, tracking, surveillance and field support to agents,
- projects for technology advancements to assist INS and U.S. Customs Service nonintrusive inspection operations along our borders and at ports-of-entry,
- projects to develop wide area surveillance radar and IR system technology to assist Coast Guard and U.S. Customs Service air and maritime border operations,
- projects to advance demand reduction technology for therapeutic drug research and advanced medical research equipment, and
- infrastructure support projects to evaluate new generations of equipment for analyzing drug signatures and evaluating drug detection devices in realistic settings.

Those organizations chosen to perform these projects will be drawn from the Government laboratories, academic institutions, and industrial sector. CTAC has interagency agreements and broad agency announcements in place to support executing each element of the program immediately.

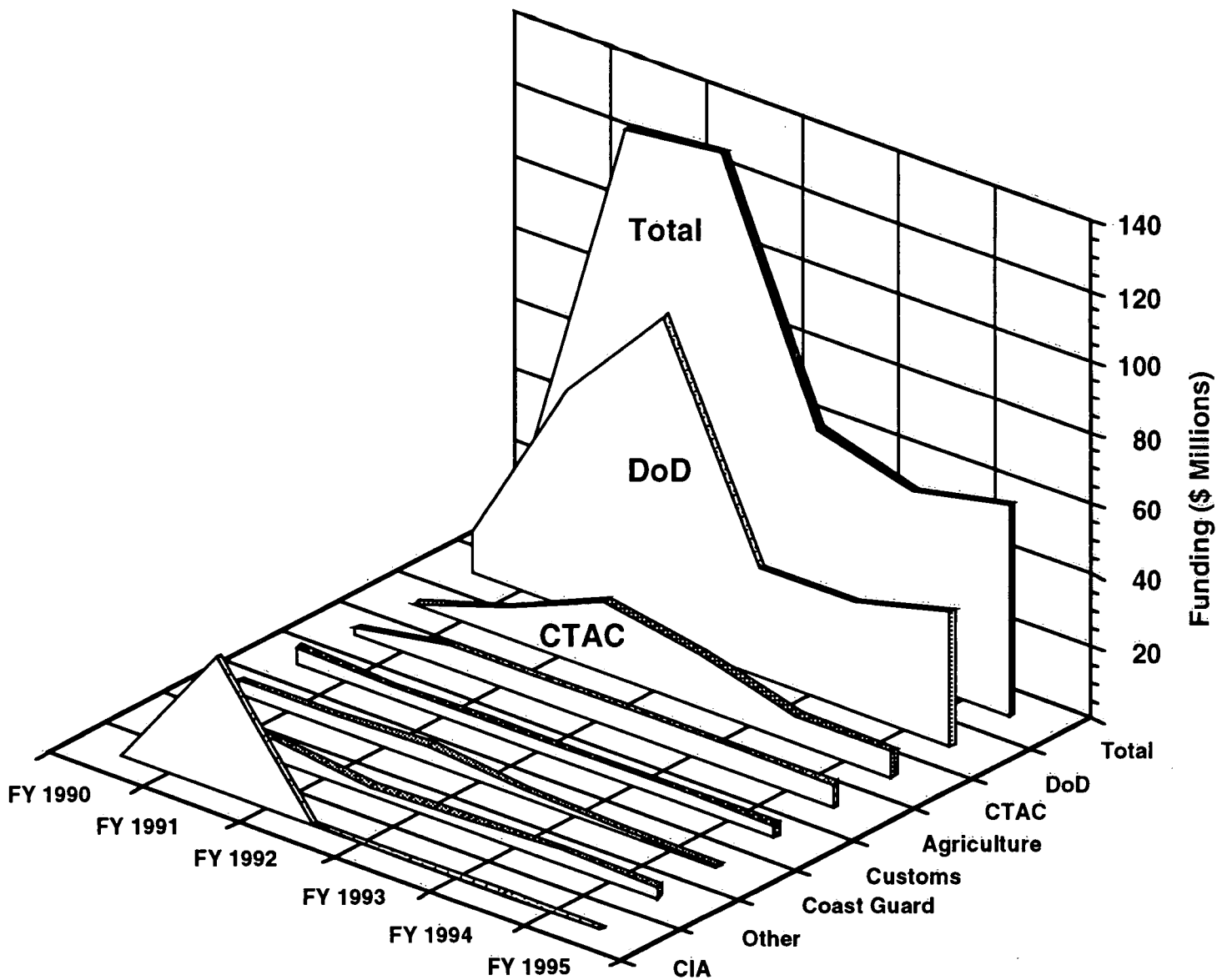

Figure 1. National Counterdrug Enforcement R&D Spending

APPENDIX A - APPLICABLE LEGISLATION

The Counterdrug Technology Assessment Center (CTAC) functions are fundamentally based in legislation. The following highlights provide an update of applicable legislation and Conference reports pertaining to CTAC.

A.1 Public Law 103-329 of September 30, 1994 - Treasury, Postal Service, and General Government Appropriations Act of 1995

"For necessary expenses of the Office of National Drug Control Policy; for research activities pursuant to title I of Public Law 100-690; ... of which $3,100,000 shall be available for ballistics technologies; ... of which $8,000,000, to remain available until expended, shall be transferred to the Counter-Drug Technology Assessment Center for counternarcotics research and development projects and shall be available for transfer to other Federal departments or agencies."

A.2 House Committee Report 103-534 to Accompany H.R. 4539 - Treasury, Postal Service, and General Government Appropriations Bill, 1995

"The conferees have included $3,100,000 to expand testing of new ballistics technologies. The ... additional testing should focus on the ability to coordinate among multiple jurisdictions."

"The conferees have provided $8,000,000 for research and development activities of CTAC in fiscal year 1995. Of this amount, $500,000 is provided for a nonintrusive inspection system assessment and engineering tradeoff study."

A.3 Conference Report to Accompany H.R. 4539 - Treasury, Postal Service, and General Government Appropriations Act of 1995

"The Anti-Drug Abuse Act of 1988, Public Law 100-690, was amended during 1990 to provide for the establishment of a Counter-Drug Technology Assessment Center within the Office of National Drug Control Policy. This office is authorized to serve as the central counternarcotics enforcement research and development organization of the U.S Government. The law provides for the appointment of a chief scientist ... to make a priority ranking of scientific needs according to fiscal and technological feasibility as part of the national counterdrug enforcement research and development strategy."

"The committee expects multiagency research and development programs to be coordinated... through the Counter-Drug Technology Assessment Center in order to prevent duplication of effort and to assure that whenever possible, those efforts provide capabilities that transcend the need of any single Federal agency."

"The committee believes that CTAC should work closely and cooperatively with the individual law enforcement agencies in the definition of a national research and development program which addresses agency requirements with respect to timeliness, operational utility, and consistency with agency budget plans. CTAC should develop a true blueprint for the program to include identification and assignment of priority projects, expected results, and funding projections .... This effort should be led by CTAC with input, review and consensus from the agencies. The national blueprint shall also include a rationale for allocation of funding among demand, supply, and State and local efforts."

APPENDIX B - ARTICLES AND PUBLICATIONS OF INTEREST

This appendix provides a listing of those recent publications applicable to CTAC's endeavors to formulate and implement the national counterdrug research and development program.

Publications

A Counterdrug Enforcement Research and Development Blueprint (UNCLASSIFIED), Counterdrug Technology Assessment Center, Office of National Drug Control Policy, August 7, 1992, 33 pages

A Counterdrug Research and Development Blueprint Update (UNCLASSIFIED), Counterdrug Technology Assessment Center, Office of National Drug Control Policy, October, 1993, 35 pages

Tactical Technologies and Wide Area Surveillance International Symposium (Unclassified), U.S. Department of Energy, Argonne National Laboratory, November 2-5, 1993, Proceedings, 917 pages

4th International Conference on Applications of Nuclear Techniques: Neutrons and Their Applications, Presentation: "Risk Assessment of technologies for detecting illicit drugs in containers" (Unclassified), SPIE, June 12-18, 1994, Crete, Greece

SPIE Conference - Nonintrusive Inspection Technology for Detecting Cocaine in Containers, Presentation: "National Perspective on Application of Technology to Cargo Inspection," (Unclassified) SPIE, July 25, 1994, San Diego, CA

Operation BREAKTHROUGH Coca Cultivation and Cocaine Base Production in Bolivia, Drug Intelligence Report (DEA-94032), Drug Enforcement Administration, Intelligence Division, July 1994, 19 pages

Benchmark Evaluation Study of the Bulletproof and Drugfire Ballistic Imaging Systems (Unclassified), Counterdrug Technology Assessment Center, Office of National Drug Control Policy, November 1994

Thirteenth International Conference on the Application of Accelerators in Research and Industry, Presentation: "Risk Assessment for Real Time Detection Technologies" (Unclassified), November 7-10, 1994, Denton, TX

Test to Detect Contraband within Multiple Cargoes in Freight Containers at the Tacoma Nonintrusive Inspection Technology Testbed, (Unclassified), Advanced Research Projects Agency, November 30, 1994, Test Report, 52 pages

APPENDIX C - CTAC TECHNOLOGY OUTREACH PROGRAM

Workshops / Symposia

Tactical Technologies and Wide Area Surveillance International Symposium (Unclassified), Office of National Drug Control Policy, November 2-5, 1993, Proceedings 917 pages

American Correctional Association, Winter Conference , Presentation: "A National Counterdrug Research and Development Program," ACA, January 17, 1994, Orlando, FL

Narcotics in the 90's, Regional Information Sharing Conference, Presentation: "Law Enforcement Technology for the 21st Century: Criminal Information, Command and Control Technology," (Unclassified), Middle Atlantic - Great Lakes Organized Crime Law Enforcement Network (MAGLOCLEN), April 20, 1994, Pittsburgh, PA

National District Attorney Association Annual Summer Conference, Prosecution in the Next Century, Winning with Technology; Presentation: "Emerging Drug Technologies," (Unclassified) NDAA, July 27, 1994, Newport Beach, CA

International Symposium on Criminal Justice Systems and Technology: Building the Infrastructure, (Unclassified), SEARCH, August 2, 1994, Washington, DC

Southwest Border Symposium, (Unclassified), AFCEA, August 3, 1994, El Paso, TX

Office of National Drug Control Policy National Drug Control Strategy Southern Regional Conference, (Unclassified), September 18-20, 1994, New Orleans, LA

Seventh Joint Service Data Fusion Symposium - Data Fusion: The Model for Information Sharing and Exploitation, (Unclassified), JDL - Department of Defense - TPC3, Data Fusion Group; 24-28 October 1994, Laurel, MD

Thirteenth International Conference on the Application of Accelerators in Research and Industry, Presentation: "Risk Assessment for Real Time Detection Technologies" (Unclassified), November 7-10, 1994, Denton, TX

Conference - *Hair Testing for Illicit Drugs: Applications for Criminal Justice*, (Unclassified), Presentation: "A National Strategy The Alternative Matrix Program," December 2, 1994, New Orleans. LA

Office of National Drug Control Policy Regional Conference - Chicago, IL

Office of National Drug Control Policy Regional Conference - Boston, MA

APPENDIX D - CTAC and ARPA R&D PROJECTS

This appendix provides brief descriptions of current or recently completed R&D projects sponsored by CTAC and funded from the Special Forfeiture Fund. The CTAC projects are listed according to applicable technology thrust or infrastructure support category. Where appropriate, the principal end-user organizations have been identified for those projects nearing completion. The ARPA counterdrug program represents a significant investment in counterdrug technology development. Brief descriptions of those R&D projects sponsored by ARPA and funded from through the DoD counterdrug account. The ARPA projects also are listed according to applicable technology thrust category.

CTAC SPONSORED PROJECTS

INFRASTRUCTURE

TITLE: *Community Test and Evaluation Center Instrumentation*

DESCRIPTION: A community test and evaluation center was established at a secure Government facility in FY 1991. The facility is available for use by all law enforcement agencies with a counterdrug mission. U.S. Customs Service is installing a complete, full-scale, port of entry inspection station at the center. CTAC is installing instrumentation to allow law enforcement agencies to test and evaluate prototype equipment in realistic operational environments.

TITLE: *Narcotics Detection Technology Assessment*

DESCRIPTION: A controlled series of field evaluations of existing, commercially available narcotics detection equipment has been sponsored by CTAC and the Contraband Detection Working Group. Four systems were tested during the first testing cycle, which was completed in November 1994. These tests constitute the first comprehensive controlled, multi-agency performance assessment of detection systems in an operational environment. The U.S. Customs Service is the lead on this project. U.S. Customs Service, U.S. Coast Guard, FBI, Federal Aviation Administration and DEA have all put their own resources behind this project to include tests at major ports-of-entry from San Ysidro, California to JFK Airport, New York to Port of Miami, Florida.

TITLE: *Phenomenology Support to Nonintrusive Inspection*

DESCRIPTION: This project develops a signature phenomenology program for non-mobile concept standardization to support the evaluation and analysis of technical risk reduction activities for developing large, fixed systems for nonintrusive inspection. Argonne National Laboratories will provide the lead responsibility for analysis and evaluation of all candidate nuclear interrogation systems.

This project is especially important to the evaluation of the Pulsed Fast Neutron Analysis (PFNA) technology being developed within the national counterdrug R&D program. This technical effort also supports the development of test standards for chemical and particulate sensors.

The scope of work is divided into two major parts: support in the area of nuclear-based techniques and support in chemical-based detection techniques.

TITLE: *Project Breakthrough*

DESCRIPTION: This project provides for the Drug Enforcement Administration to lead a multiple agency initiative to determine those factors that increase and limit coca leaf production and processing. Initial results have been obtained regarding two of the three countries being quantified. U.S. Department of Agriculture and Department of State are involved with the planning and coordination of this project.

PREVENTION AND TREATMENT

TITLE: *Drug Abuse Brain Scanning Research*

DESCRIPTION: CTAC has provided a state-of-the-art linear accelerator for isotope production at the Positron Emission Tomography facility at the Addiction Research Center in Baltimore Maryland. The accelerator technology provides for higher resolution by producing short half-life radioisotopes for measuring the interaction of cocaine with neuroreceptors in the brain. The PET facility at the Addiction Research Center is the only Federal facility *totally dedicated* to drug abuse research.

TITLE: *Cocaine Catalytic Antibodies*

DESCRIPTION: Under funding from Counterdrug Technology Assessment Center, Columbia University, College of Physicians and Surgeons, is developing an artificial enzyme which would reduce the serum cocaine concentrations by destroying the drug immediately after it enters the blood stream and before it reaches the brain. This "immunization" would deprive the cocaine abuser of the behavioral reinforcing effect of the drug and could last up to three weeks for each immunization.

Catalytic antibodies are artificial enzymes elicited by immunization with a stable analog of the evanescent transition-state for a reaction. Cocaine can be metabolically deactivated by hydrolysis at its benzoyl ester group and an analog designed to mimic the transition-state of this ester hydrolysis reaction will elicit antibodies that can act as highly specific hydrolases against cocaine. Such catalytic antibodies directed against cocaine would bind, hydrolyze and deactivate cocaine and thus would free themselves for further binding.

TACTICAL TECHNOLOGIES

TITLE: *Concealed Audio Transceiver Surveillance System*

DESCRIPTION: This communications system satisfies an immediate need to provide crucial, dependable communications for law enforcement officers who perform covert surveillance during counterdrug enforcement operations. Modularity and flexibility permit using established networks with other teams if necessary. Key features of the system are small size, low power, easy to use, hands free operation, and readily concealed. The system works well in rural, urban, and office building environments. The system imposes no special operational requirements on the user(s).

The FBI is providing the technical oversight for this project.

TITLE: *Enhanced Real Time Voice Recognition System*

DESCRIPTION: This project will provide the capability to identify individuals under surveillance through voice recognition. The system will allow analysts to develop a suspect voiceprint reference database using information acquired through conventional wiretaps or existing recordings and match suspect voice data to voiceprints on file.

The DEA is providing the technical oversight for this project.

TITLE: *Location and Tracking System*

DESCRIPTION: This project employs a concealed transponder that can be used to track and locate vehicles or containers. This hidden component remains in a semi-sleep mode until activated remotely by the field portable base unit.

The FBI is providing the technical oversight for this project.

TITLE: *Body-Worn Transmitter*

DESCRIPTION: This is a Low Probability of Intercept and Low Probability of Detection (LPI/LPD) system worn by agents to support both surveillance and communications requirements. The system is designed to provide a secure voice communications link that is resistant to interception by unintended listeners and allow agents to monitor and/or record transmissions while providing, on a non-interfering basis, communications between agents.

The FBI is providing the technical oversight for this project.

TITLE: *Cocaine & Heroin Impurity Testing*

DESCRIPTION: This project will develop microcomputer based Advanced Neural Network (ANN) simulation software enabling forensic experts to compare cocaine and heroin impurity signatures and use the results of this comparison to link separate seizures to a common source. To date more than 3000 cocaine signatures have been processed and are stored in the database. Under this project efforts are also being pursued to determine the applicability of ANN-based and other promising techniques such as fuzzy logic, to the heroin "country of origin" program being conducted by the DEA.

TITLE: *Small Look*

DESCRIPTION: This system is a derivative of the Small Talk miniature audio receiver. The miniaturized video camera and video processing circuitry permits the collection unit to be easily hidden in areas such as building entrances where it could take video pictures of each person entering the building. The self-powered ultra compact collection unit is capable of storing up to 4000 images in memory. The portable interrogation unit can be carried by an agent in a briefcase or in a vehicle and is used to transfer commands and download images from the collection unit. Data transfer is conducted via an LPI radio link that can operate over unobstructed distances of up to 1000 feet. The interrogation unit is then carried to the desktop processing unit where the data is transferred between the units using a hard-wired link. The processing unit will display and store the collected images along with time tags and operator notes.

The FBI is providing the technical oversight for this project.

TITLE: *DRUGFIRE Matching Algorithm*

DESCRIPTION: An advanced processing algorithm was developed for the DRUGFIRE system. The new module enables the rapid sharing of evidence crucial to solving drug-related violent crimes by multi-jurisdictional task forces. The FBI is providing technical oversight for this project.

TITLE: *Topographic Maps*

DESCRIPTION: This project will result in the development of a site-specific software tool to provide modeling capability of radio propagation characteristics in and around built up environments. This information can then be used to determine the best locations for beacons or receiving posts for radio detection and tracking. The interactive software will execute on a workstation and will use topographic maps with building overlays to predict signal coverage and channel characteristics for user specified antenna locations. The tool will also predict locations within a city that are unable to acquire fixes from Global Positioning System satellites due to shadows of buildings.

The FBI is providing the technical oversight for this project.

TITLE: *3D Map Vector*

DESCRIPTION: This project will produce computer based map vectorization and 3-dimensional presentation tools providing the capability to rapidly and accurately generate maps of new areas of operation. This will enable law enforcement agencies to use geographical information in 3-dimensional form to enhance mission-planning and command and control activities. These capabilities are being incorporated into both mobile and stationary platforms.

The FBI is providing the technical oversight for this project.

TITLE: *Airborne System for Information, Navigation, and Command (ASINC)*

DESCRIPTION: The project will demonstrate that the ground command and control systems as well as the navigational capabilities of helicopters used in Medevac and law enforcement agency applications can be significantly and even drastically improved, for special missions conducted at night, in bad weather, and over uncertain or unfamiliar terrain. The project includes rapid prototyping of ground command and navigational aid systems, development of ground-to-air communications and enhancement of on-board information support systems, and

development of information management and exploitation capabilities. At various stages throughout these three phases, prototype systems will be integrated into a Medevac helicopter, and will be tested and evaluated in flight. The FBI is providing technical oversight for this project.

TITLE: *Top Water*

DESCRIPTION: This project's technical objective is to develop an operational prototype system capable of detecting conversations in an urban environment at a much greater distance than is possible with existing capabilities. The program was funded in FY 1991 as a feasibility study and proof-of-concept demonstration under the ARPA Program. The results of that effort were sufficiently encouraging to move forward with an effort to concentrate on improving the system for an urban environment and collecting and analyzing isotropic noise measurements for improved signal processing development.

The Federal Bureau of Investigation is the lead on this project and testing of brassboard prototypes will be performed in conjunction with the Tactical Operations Support Working Group.

NONINTRUSIVE INSPECTION

TITLE: *Miniature Gamma Ray Backscatter*

DESCRIPTION: This project develops a miniaturized electronics package with an improved source/detector ratio to reduce the source size and permit a lighter, smaller device to be produced. This new contraband detector will be mounted on an inspector's belt and be readily available for examining hard-to-inspect areas and items for illicit drugs.

The U.S. Customs Service is the lead on this project and testing of a prototype system is scheduled for summer 1995.

TITLE: *Gamma Ray Detectors*

DESCRIPTION: The goal of this project is to develop a non-intrusive portable or mobile, prototype field inspection system to detect contraband in empty containers which transport liquids. A high-energy, low intensity gamma ray source can easily penetrate the steel walls of a tanker truck and produce a gamma ray picture of the contents as the unit moves along the length of the tanker. A feasibility study conducted by the U.S. Customs Service demonstrated the system's capability to reveal small samples of simulants with minimum clutter from the tanker truck itself.

TITLE: *Narcotic Detection in Mail Packages*

DESCRIPTION: This project employs a flexible, modular, nuclear quadrupole resonance (NQR) system to scan letter mail and small packages for narcotic materials. The modular design will allow components to be easily interchanged which in turn will enable the system to be applied to a wider range of applications such as larger mail packages and boxes of frozen seafood cargo.

TITLE: *Gas Chromatograph/Ion Trap Mass Spectrometer*

DESCRIPTION: This system will provide for the non-intrusive detection of illicit drug materials through the acquisition and analysis of chemical vapors. The system will be able to detect the presence of specific drugs by separating the molecules of the substances from the air surrounding the container or package and processing them through the analytical portion of the gas chromatograph/mass spectrometer (GC/MS).

TITLE: *Portable Detector*

DESCRIPTION: A portable detector is being developed which will be a self contained, light weight, field-operable drug detector for rapid on-site analysis of cocaine and heroin. The system will use principles of gas chromatography and chemiluminescence, and will provide compound analysis confirmation using dual GC columns. With a system weight of less than 40 pounds and the capability to operate using either 110/220 VAC or a 12 VDC battery pack, the instrument will be capable of rapid deployment and stand alone operation under its own power. The system will provide improved capabilities for the nonintrusive inspection of vehicles, containers, vessels, buildings and persons.

TITLE: *Detection of Illicit Substances*

DESCRIPTION: This project will focus on research to evaluate nuclear and chemical non-intrusive inspection techniques for illicit substance detection within containers. This project will foster the development of analytical tools necessary to support the analysis, evaluation and relative comparison of nuclear based non-intrusive detection systems. In addition, models will be developed that enable relative comparisons of the various candidate nuclear techniques. A system requirements analysis will be conducted to determine accelerator specifications and detection error rates related to information processing limits. A database can then be developed for nuclear parameters and phenomenological signatures of candidate detection techniques. A separate system requirements analysis and evaluation will then be conducted for chemical-based detection methods and a corresponding database for substances signatures will be maintained for chemical and vapor techniques.

TITLE: *Detection of Illegal Drugs*

DESCRIPTION: This project will produce a portable system for the detection of a wide range of illicit drugs in biological fluids and hair. The system will be able to detect trace quantities of illicit drugs in urine, blood, perspiration, saliva and hair. The Toxic Chemical Analyzer (TCA) uses the technology of Surface-enhanced Raman Spectroscopy (SERS). Detectable drugs include amphetamines/ methamphetamines, cannibiniods (primarily THC), cocaine, morphine/codeine (heroin), and phencyclidine.

WIDE AREA SURVEILLANCE

TITLE: *Ultra Wideband Sensor Support System*

DESCRIPTION: This project applies a time coded monocycle wave form to provide a revolutionary improvement in Low Probability of Intercept / Low Probability of Detection voice and data communications for use by Law Enforcement Agencies in support of drug interdiction and border surveillance activities.

The project is intended to yield a well defined Sensor Support System based on Ultra Wideband technology that is responsive to challenging user needs. This will be accomplished by graduating a laboratory tested wave form to the field. The wave form is propagated across a fully allocated spectrum that is a finite resource in great demand for a wide range of civil telecommunications services and personal mobile communications, allowing simultaneous communications without interference to existing users.

The Immigration and Naturalization Service is providing technical oversight for this project.

DEMAND REDUCTION

TITLE: *Hair, Saliva, & Sweat*

DESCRIPTION: ONDCP/CTAC has a goal of developing a bracelet worn by a patient, prison inmate or parolee that can continuously monitor the subject for drug abuse and that can automatically relay adverse information back to a central processing unit.

Efforts under this project concentrate on expanded research of drug testing methodologies involving hair, saliva and sweat; that could be used in conjunction with or as a replacement for traditional urinalysis. The project is designed to improve detection capabilities for occasional drug use and prevention of recidivism during drug treatment. Issues being explored relating to hair analysis include passive exposure and dose response.

The development of promising techniques for those sensors needed for the noninvasive detection of illicit drug use from hair, sweat and saliva is being investigated. Each of these techniques employs advanced analytical technology for detecting drugs in the matrices for hair, saliva, sweat and urine to extend the window of detection and provide more effective drug testing.

Preliminary data indicate that saliva appears to offer advantages in determining level of intoxication and may be useful for driving while intoxicated cases. This project will also gather base-line data for the development of a real-time sweat monitoring badge.

An on-going study of first-time offenders in the New Orleans Parish, Louisiana will be employed to evaluate the best matrix for detecting drug abuse in the criminal justice system.

TITLE: *Drug Evaluation Network System*

DESCRIPTION: ONDCP/CTAC is sponsoring a drug treatment evaluation project is to answer several questions concerning the quality of our national drug treatment programs. Do we know how to treat drug abusers effectively so that recidivism is minimized? How do we maximize our limited resources? Are there efficiencies of scale, techniques, treatment paradigm, or aftercare that can be found?

The Drug Evaluation Network System (DENS) project will develop the computer backbone network to resolve some of these issues and questions.

Treatment data on patients will be aggregated and organizing by the central computer system using the latest database and executive information system technology and made accessible to treatment providers, researchers and managers. The provider could ascertain desired information from the database and send an electronic mail message to those centers specializing in a selected area. A policy analyst at the national level could extract and compile statistics on various topics, such as drug of choice or treatment success, across the nation. Of course, the databases would provide a wealth of information to researchers on a nationwide basis.

ARPA SPONSORED PROJECTS

ARPA COUNTERDRUG RESEARCH AND DEVELOPMENT PROJECTS

This section provides descriptions of current or recently completed major ARPA counterdrug system development projects. The project descriptions are categorized by technology thrusts of nonintrusive inspection, tactical technologies, wide area surveillance, and demand reduction.

NONINTRUSIVE INSPECTION

Introduction A major investment has been made in evaluating the technical feasibility of nuclear interrogation for detecting and identifying contraband hidden within legitimate cargo. Nuclear interrogation techniques rely on bombarding the various nuclei in the interrogated object with high-energy particles causing them to emit detectable characteristic radiations, such as high energy gamma rays or interacting neutrons. The attributes of the probing particle or radiation intensity, the scattered energy and spatial distribution of the detected radiations, and any supplemental information concerning the interrogated object are used in the decision process. The following several paragraphs provide descriptions and status summaries of the major ARPA nuclear interrogation prototype technology projects.

High Energy X-ray System. A high energy X-ray system was developed and evaluated to determine capabilities to inspect large cargo containers and vehicles for drugs, weapons, and other contraband. A specially constructed testbed facility was established at the Port of Tacoma, Washington to evaluate the High Energy X-ray System. Evaluations, performed jointly with personnel from the United States Customs Service (USCS), were successful and demonstrated the system's ability to identify the presence or non-presence of operationally significant quantities of hidden drugs more than 90 percent of the time. The high energy x-ray project has been completed and the Tacoma facility dismantled.

Relatively high energy (8 MeV) X-rays were used to penetrate the large targets (overseas cargo containers up to 8x8x40 feet). The system is specifically designed to detect drugs and other contraband hidden within compartments, structural cavities, walls, and other areas in fully loaded trailer tricks and vehicles and shipping containers. The vehicle or container is moved between the X-ray systems and detectors, and an X-ray image is generated in the horizontal and vertical plans. These images display on a video screen for analysis. A variety of contrast maps, false color, and other video enhancement techniques are available to aid in the visual analysis.

Advanced X-ray Inspection System. This project consists of an X-ray system using transmission and side/back scatter images in a operational facility at the Otay Mesa, CA, border crossing station. The system is specifically designed to detect drugs and other contraband hidden within compartments, structural cavities, walls, and other areas in small vehicles and empty cargo trucks. The system uses two low energy (450 KeV) X-ray sources to provide conventional transmission and low atomic weight side/back scatter detection modes. Although the system is capable of non-intrusively inspecting approximately five tractor trailer rigs per hour, the throughput rates are limited by the time required for image analysis. When reviewing the X-ray images, trained analysts can detect an operationally significant quantity of drugs within areas of the conveyance not normally visible to the naked eye. The transmission X-ray sub-system penetrates up to four inches of steel.

The system was installed in July, 1994, at an operational testbed within the new U.S. Customs border inspection station in Otay Mesa, California. Evaluations conducted jointly with Customs personnel have been highly successful. The U.S. Customs Service has assumed operational control of the system.

Pulsed Fast Neutron - Time of Flight (PFNA - TOF). A full-scale prototype of a PFNA-TOF analysis system has been developed and is undergoing evaluation at the contractor's plant. The prototype PFNA-TOF system uses 8.2

MeV pulsed neutron beams to scan and excite the nuclei of atoms in the cargo. Cargo containers 8 feet high by 8 feet wide and 20-40 feet long can be inspected.

Each excited nucleus deexcites by emitting distinct and unique gamma rays characteristic of the carbon and oxygen atoms within the molecule being interrogated. A PFNA-TOF system has the unique attribute that it could discriminate drugs, such as cocaine hydrochloride, from benign materials. The beam delivery system defines and controls the direction of the path of the neutron beam. The direction of the neutron beam scan is controllable, allowing the operator to switch from a basic interrogation scan to a specific region scan. The position of the object is further defined by measuring the time between the neutron pulse emission and detection of the gamma ray.

Tests are being conducted to determine how effectively it could look for amounts of oxygen and carbon at the same location or volume elements (voxels) inside the container. The tests should also determine whether it is feasible for automatic elemental imaging to detect operationally significant quantities of drugs concealed within the cargo or in hidden compartments inside the conveyance.

Chemical vapor and particle detection system, biological, and transportable x-ray system prototype technologies

Introduction: Chemical techniques include examination by mass spectrometry, ion mobility, gas chromatography, optical spectroscopy, total carbon vapor and pre concentrators. These techniques specifically identify the substance in particulate quantities down to one nanogram or less. Chemical sensing devices have the advantage of small physical size, but the disadvantage that the container must still be opened. They are used to detect cocaine residue or vapor emissions.

Biological techniques employ immunochemical assays, animal olfaction, electrochemical biosensors and acoustic wave biosensors. These techniques are also highly specific at the nanogram level and are used to detect cocaine residue or vapor emissions.

The ARPA projects in chemical, biological detection technologies and transportable systems require less costly investments of R&D funds than the major investments in neutron interrogation techniques.

Southwest Border Mobile Detection System. A family of mobile, transportable non-intrusive inspection systems is being developed to inspect cars, trucks, and tractor trailer rigs. The deployment strategy is to be able to relocate the systems among border crossing points. Relocatable detection systems would be placed at the border sites on a random basis, thereby creating a deterrent to drug smuggling in these locations.

The prototype systems will be tested at an integration testbed facility at Fort Huachuca. The systems will then be tested operationally at facilities located at U.S. ports of entry on the Southwest border established to test and evaluate transportable cargo container inspection systems. Other prototype non-intrusive inspection systems such as chemical vapor or particle sensor systems will be integrated into the testbed and evaluated jointly with the US Customs Service.

Chemical and Chemical Microsensor. A portable surface acoustic wave (SAW) microsensor for drug interdiction has been developed and successfully evaluated. The device is a hand-carried system to detect drug particles. The suspect particles, collected via a common "Dust Buster" in a disposable filter, are pyrolyzed (heated) to decompose into chemical vapor by products. The SAW is covered by a thin selective coating that has an affinity for the target pyrolysis products. Upon a change in mass due to the target vapor absorption, a change in the SAW frequency propagation characteristics occurs which is sensed, processed and used to trigger an alarm.

The sensor has a wide variety of applications including screening cargo containers and searching ships by boarding parties. The entire system (collector, sensor, and processor) is battery powered, and weighs seven pounds. The system is capable of detecting 50 nano-grams of cocaine and will be upgraded to detect heroin.

Quick Screen Nuclear Quadrupole Resonance (NQR). Quick Screen NQR is a small system to pre screen small containers and luggage for the presence of illegal drugs. The system quickly scans for a NQR response from chlorine in cocaine hydrochloride and a similar signal from heroin. The system is based on low-power radiation of the test container with a swept radio frequency that covers the resonant frequency of the drug chemical's atomic nucleus. The resonance is detected to trigger an alarm. This technique has been successfully demonstrated on small quantities of drugs in a laboratory. Development for a prototype system is planned. An operational scenario could involve setting up the system in an area where baggage is moved on conveyer belts to aircraft loading areas. The conveyer belt would move through the detection system for non-intrusive screening. If alerted by a chemical signature, the container could be automatically marked or set aside for a visual inspection. The goal is for the system to provide an 80 to 90 percent detection rate of a one kilogram or larger package of concealed illegal drugs.

Chemical Detector - Neural Net. This project is developing a hand held contraband detection instrument for large cargo container inspections using correlated gas chromatography. The system breaks down a collected vapor into components and measures their thermal conductivity. Neural nets analyze the detected signals to identify the vapor by-products of illegal drugs and discriminate against background substances. An inspector would use the system to collect and analyze vapors immediately upon opening a large cargo container. If alerted by a vapor signature, the container could be marked for unloading and visual inspection, or routed to another nonintrusive inspection device, such as an X-ray system, for further verification. The system will conduct a non-intrusive inspection of a large cargo container in approximately three minutes.

Particle/Vapor Generator. This is a project to design and fabricate a drug particle/vapor signature generator for the constituents in cocaine and heroin (and their common salts). A reliable means to accurately produce low concentrations of drug particles and vapor products (including degradation products and impurities) is needed to serve as a reference and standard for comparative evaluation of drug detection devices including canines.

Enhanced Canines. This project analyzes the complex aspects contributing to the effectiveness of trained canines to detect drugs, and will identify procedures and techniques to achieve higher reliability and improved biosensor detection capabilities. This project will evaluate canine sensory absolute and discrimination sensitivity thresholds and determine which environmental/health or training parameters reduce or enhance a canine's operational sensory standards. In examining a variety of canines, testing and studies will be non-invasive in nature.

Advanced scientific methods, sophisticated laboratory equipment, and advanced olfactory evaluation techniques (electroencephalograph and operant conditioning olfactometers) will be used. Standards of reference and calibration will be established. The effects of breeding techniques, selection, operational use, general health, nutrition, toxic materials, and attractants/detractants on performance will be documented. The project will be structured to effectively integrate with on-going canine olfactory investigations involving explosive detection. Information reported will be provided to law enforcement agencies and the services for distribution to canine training facilities and to dog handlers in the field as a means of improving training procedures, care, and performance. The information could assist in developing artificial biosensors to detect the presence of illegal drugs.

Acoustic Imaging. A new technique using acoustic technology adapted from medical echo sounding technology will be investigated to determine applicability to nonintrusive inspection. This technology will complement other nonintrusive inspection techniques such as x-ray. It is a candidate technology for fungible bulk products where illicit drugs can be commingled.

Small Package Inspection System. A small X-ray system designed to inspect small packages, such as passenger luggage, air freight and mail, will be developed. Prototype fabrication and testing will begin in FY 1995. The system could be installed in an airport location that would allow for high volume conveyer screening of passenger

luggage, freight cargo, and mail without impacting commercial aircraft arrival and departure schedules.

Cocaine/Heroin Chemistry. This project is a study to characterize the chemical and physical properties of the constituents of cocaine and heroin (and their common salts). Specific objectives include head space analysis, effects of temperature and humidity (hydrolysis), and decomposition products of cocaine and heroin. A reasonable estimate of the chemical properties of illicit drug chemical emissions is required to optimize the development of detection hardware.

Cocaine and Heroin Database. Existing databases of the chemical properties of illicit drug chemicals and their emissions are not detailed and often conflict. The illicit nature of these drugs promotes wide variances. This project will produce a single national database which can be utilized by drug law enforcement officers and technicians, detection product designers, and product evaluators. The first edition of a "Cocaine Handbook" has been distributed.

Interdiction System Effectiveness. This project uses advanced simulation and modeling to evaluate the operational benefits of drug interdiction systems. The model will examine every facet of drug trafficking, to include the growing fields, production laboratories, transportation networks, entry into the United States, distribution and use, and the money laundering activities that return the profits back to the cartels. The program will be integrated with decision support technology that will allow the Department of Defense and drug law enforcement agencies to examine how drug trafficking, availability, and use are affected by supply and demand reduction systems and operations. The program will enable law enforcement personnel to develop a better understanding of cartel operations, and how to support the law enforcement agencies in countering these operations. At a broad level, policy makers can examine how policy decisions will impact illegal drug production, trafficking, and use.

TACTICAL TECHNOLOGIES

Modular Tag. This project will develop a family of miniaturized location finding devices and communications systems for overt and covert tracking of people, cars, airplanes, ships, and cargo containers. It will consist of modularized components that can be interchanged depending upon mission requirements. The modules will use common data protocols (PCM for example). Components include Loran, GPS, Inmarsat, inertial navigation, cellular radio, and cesium clocks.

Automated Facsimile (FAX) Workstation. The automated FAX workstation consists of an Arabic language Optical Character Recognition (OCR) system that reads machine printed characters. The system will include a workstation with the necessary software and associated hardware, such as scanners. A page of printed Arabic text can be entered by using a scanner with 200x400 dots per inch resolution. The output will be in code suitable for electronic databases. An extensive data base of Arabic text images will be collected from modern and country important newspapers, magazines, and books. An Arabic and Farsi text database was collected during FY 1993-94. During FY 1994, the work stations and data bases were integrated into and tested on a neural net based Arabic OCR system. A document exploitation analyst at the headquarters level and/or a law enforcement agent in the field will insert seized or intercepted material into an Arabic language OCR system to accomplish rapid and automated search and sorting translation functions. This automated process will allow the analyst to quickly isolate important information linked to an illegal activity or known criminal.

Special Techniques. The special techniques project has developed a tracking device composed of a miniaturized global positioning system (GPS), a cellular phone reporting link, and a laptop computer base station. The system positions data from the tracking device to be displayed on a computer screen map. GPS location is stored in non-volatile RAM with battery back-up in order to maintain the GPS almanac when power is disconnected. A motion sensor input connector powers up the cellular phone when the target vehicle is in motion. Additionally, the tracking units are configured to receive input from an external microphone.

Facial Recognition. The facial recognition project consists of algorithm development for real-time recognition of persons from a defined photographic database and a testbed (camera, detector, and face server). The testbed will simulate environments ranging from a crowded open concourse to single persons in police booking stations. The data base used for testing systems contains thousands of faces with varying resolution. This testbed will be the prelude to a final prototype face-recognition system. Systems could be set up at passport checking areas in major air terminals. When intelligence indicates a wanted criminal might be passing through the terminal, the individual's face could be entered into the data base. The "face in the crowd" system would scan individuals as they had their passports checked. An advanced system could scan a crowded concourse for a real-time match of a person's face and a photograph in the data base.

Small Talk. Small Talk is a pocket-sized solid state voice recorder for use by field agents. It is based on off-the-shelf electronics, which are miniaturized using Multi-Chip-Module technology. Field agents would covertly carry these recording units on their person or place them in hidden locations. The recorded audio could be used to support on-going investigations or criminal prosecutions. Unit capability allows recording and storage of approximately 3.5 hours of forensic quality mono audio or approximately 1.7 hours of forensic quality stereo audio. The recorded audio can be stored in the unit for approximately 8 hours. The module, without power supply, is thin and less than 6 square inches in size. The recorder has no moving parts thus eliminating noises that could compromise its presence.

Passive RF Tag. The passive RF tag is a small, low power transponder tag used with an APS-138/145 radar for overt/covert long range tracking. The tag signal generates a unique symbol on the radar display and allows the radar to quickly discriminate the tags from other radar targets. It utilizes previously verified radar tag concepts (serrodyne modulation and doppler shift). The passive transponder tag could be placed on suspected or known drug trafficking aircraft to allow covert tracking by a U.S. Customs Airborne Early Warning (AEW) P-3 aircraft. It has been successfully demonstrated. The tag will be miniaturized to less than 10 cubic inches.

Tracking and Location System. This is a tracking beacon and receiver/processor that can provide range and angle to the vehicle being tracked and display the information visually on a computer screen. The beacon transponder is battery powered and small enough to be covertly attached to a target vehicle. The receiver/processor and antenna is portable and operates off the power of the chase vehicle. The system can be integrated with mapping software and a processor to provide a more sophisticated presentation in the chase vehicle. The system uses spread spectrum technology and short pulse signals to accurately measure range. The beacon transmits on interrogation only. One operational scenario is to plant the beacon on a target vehicle to allow tracking during a controlled drug delivery. The receive antenna is a steerable low profile array, approximately 3/4 inch thick, and 12x12 inches in size. This design allows the antenna to operate eon the roof of a chase vehicle with minimum signature. The tracking tag battery power allows for up to 2 hours of continuous transmission and a reception range of about 2 ground miles in a city environment or 20 air miles with the receiver on an airborne platform. This system was successfully demonstrated in a suburban environment between two cars.

Personal Command System (PCS). PCS is an enhanced "laptop" personal command system for field agents that combines voice, location, data, video imagery, and communications between agents and/or their reporting headquarters. The system, an enhanced baseline unit demonstrated to the FBI, has a radio and modem interface for encrypted transmissions. Algorithms compress and store video imagery. Software includes applications such as terrain analysis, map orientation, and access to remote databases. The system is based on commercial, off-the-shelf "laptop" computer hardware and peripherals. The portable computer can be used by law enforcement and military personnel during field operations. For example, as a team leader communicates with his deployed team, he will simultaneously receive updates on their locations. These locations are, in real time, automatically integrated onto a map and

visually displayed to the team leader on his personal command system. The system will also assist DLEAs in reviewing, compiling, analyzing, and communicating surveillance video imagery during field operations.

Micro GPS. This is a microminiature global positioning system (GPS) receiver using Multi-Chip-Module technology. The receiver is approximately 1.4x1.4x0.2 inches and consumes a maximum of 1.5 watts. The end product is embedded into other systems. The microminiature receiver would be used by DLEA agents and military personnel to improve the accuracy of locator information received from tagging devices or while embedded covertly in other devices.

Meteor Burst. Meteor burst is a communications system for sensor and tag applications that transmits and receives using meteor burst propagation. In practical terms, VHF transmissions are reflected from ionized trails resulting from micro-meteor collisions with the atmosphere. The technique provides private, robust, reliable, all terrain, long-haul, worldwide communications. The atmospheric variations that degrade HF long-haul communications do not affect meteor burst communications. Additionally, communications are free from channel allocation limitations associated with satellite communications. At one end of the network is a small mobile or "disadvantaged" communications unit with a small antenna and low power source; at the other a base station with a large power source and a directional antenna array. The "disadvantaged" unit is adaptable to existing portable data communication systems or remote sensor systems. Data for transmission is compressed to allow transmissions of less than a second. The system was successfully demonstrated in various fixed and mobile configurations, and showed excellent connectivity from voice, data, and imagery transmissions.

GPS/Clocks. A microminiature cesium cell atomic clock to be used by Global Positioning System (GPS) receivers is being developed. It is an accurate clock with a stability of one part in 10^{-12}. The clock will be used as part of a GPS tag to minimize the time the tag needs to reacquire the GPS signal after dropouts or receiver power turn off. Other applications range from expanded channel cellular radio synchronization to two-satellite GPS operation (with altimeter). The use of the clock module will enable a 10 fold reduction in tag electrical energy consumption in typical scenarios. Physical size will be approximately 25 cubic centimeters.

Project M. A system comprised of a computer work station, software, and peripherals to intercept, read, and process FAX communications has been developed. While the user will determine the system's, there are several possible scenarios. An agent could use the system during investigations with wire tap authorizations to conduct an automated intercept of FAX communications. Intelligence analysts can use the system to collect foreign intelligence relating to drug trafficking operations.

Project Rhubarb. This is a man-pack, portable device used to intercept cellular voice communications on multiple channels. The system would be used by field agents to intercept voice communications. It is approximately 6x24x12 inches, and weighs 25 pounds.

Project Tipster. The Tipster Project is the application of artificial intelligence to message understanding and data analysis with applications to defense and civil agency intelligence missions. It is funded by multiple agencies to assist intelligence and evaluations in a variety of scenarios including counterdrug. As part of Tipster technology, a probabilistic language understanding model is being developed to both learn data from examples and to control its search algorithm. An ARPA funded FY 95 new start will scan Spanish and English language text from seized financial crimes documents and learn how to identify the names of people and corporations. Databases will be automatically populated as new data is identified. The Tipster Project directly supports financial crime analysis.

Bank Secrecy Act Data Analysis. This project consists of an operational prototype advanced database analysis system for use on Bank Secrecy Act data. The prototype system has link analysis features and other powerful data abstraction methods, as well as the capability to

perform complex data searches quickly. The software operates on a massively parallel processing computer. The system allows for an automated multilevel search of interrelated data. A proof of concept was demonstrated during FY 94. In an operational system, agents could initiate a proactive analysis with this system to cluster and classify data using non-relational grouping methods, then evaluate the resulting statistics and other aggregate measures that indicate trends and flag unusual or suspicious activity. This will greatly enhance the capabilities of agencies to find and investigate criminal activities such as money laundering activities.

WIDE AREA SURVEILLANCE

Detection and Monitoring Study. This project is an in-depth analysis addressing all aspects of the detection and monitoring process for the counterdrug transit and source zones (i.e., Central and South America and the Caribbean). This analysis provides an assessment of air and maritime interdiction operations in the transit zone with particular emphasis on the surveillance potential of the U.S. Navy's Relocatable Over-the-Horizon Radar (ROTHR). The specific issues to be addressed include: (1) reviewing the air, land and maritime cocaine transport modes and quantities shipped from the source countries to the U.S.; (2) assessing the performance of detection and monitoring resources in time and space; (3) determining response times; (4) assessing employment tactics; (5) determining current operations of traffickers; (6) assessing potential countermeasures to interdiction; and (7) developing measures of effectiveness (MOEs) for detection and monitoring in the transit zone.

OTH Enhancements. Currently, a Relocatable Over-the-Horizon Radar (ROTHR) is operating in Virginia, with an area coverage over the Caribbean. Installation of a second ROTHR site in Texas and a third site in Puerto Rico was approved by the DoD Drug Coordinator. New technology can enhance the operational capabilities and ARPA is investigating technology enhancement that can be applied directly to the ROTHR. Enhancements are being developed in the following areas:

- Atmospheric noise detection: Removing of the effects of impulsive noise events (lighting) from temporal data;
- Improved target resolution: Using an enhanced dynamic algorithm to improve weak target detection and tracking;
- Improved tracking of slow and maneuvering targets: Improving tracking algorithms in areas of Kalman filtering, track initiation, returns association, and peak detection;
- Coordinated registration enhancement (range error) by dynamic optimization (CREDO): Using CREDO to achieve ionospheric definition and true target range;
- Equatorial clutter reduction: Investigating methodologies to minimize the impact of equatorial spread doppler clutter that reduces OTH radar performance and creates range ambiguities;
- Imbedded communications: Using a portable system to receive an OTH radar waveform, modify it to carry data, and retransmit the signal in time synchronization with the next incoming OTH signal;
- Extended range cover: Enhancing the current range capability of OTH radar to distances of 2000 to 2500 miles;
- Altitude readout: Developing algorithms and technology that will allow an accurate reading of the altitude of a tracked target;
- Beacon-Assisted Vectoring: Using repeater beacons at known locations to improve target location accuracy. Some of the technology enhancements have already been installed in the ROTHR.

DEMAND REDUCTION

The Demand Reduction Project will examine ways for DoD to continue its aggressive testing programs in a more cost efficient manner. Currently, each service has different procedures for this process with varying costs. Drug screening procedures

will be examined to determine if a more uniform and efficient process can be developed. The Department has sponsored educational programs to discourage the use of drugs by military dependents, some of which included the civilian communities in the immediate vicinity of military installations.

APPENDIX E - PRIORITY LISTING OF SHORT, MEDIUM AND LONG TERM SCIENTIFIC AND TECHNOLOGICAL NEEDS BY THRUST AREA

As required by the legislation which established the Counterdrug Technology Assessment Center, the counterdrug enforcement scientific and technological needs have been identified and placed into a priority order. This report provides a comprehensive updated listing of top priority scientific and technological needs according to short, medium, and long-term requirements in the supply-side reduction technology thrusts for Tactical Technologies, Nonintrusive Inspection, and Wide Area Surveillance.

TACTICAL TECHNOLOGIES

Priority Operational Needs

Ultra-miniature RF beacon

Unattended remote site video collection and data forwarding

Ultra-miniature radio

Real-time GPS-like tracking system

Transportable, wireless audio collection system

Portable capability to control/disable transport craft (cars, trucks, boats, planes)

Chemical coding/tags

Identify low detectable images with day/night camera (electronic infrared camera filter)

Small/Powerful Information Management System

Personnel safety and security system for counterdrug agents for world-wide coverage including personnel locator

High-speed software encryption

Remote monitoring of crowds and detection of suspect individuals

Capability to process voice and data intercepted from telecommunications networks

Identification using face, voice, fingerprint identification

Capability to automatically extract pertinent information from text

Alternative to traditional polygraph for "guilty knowledge" assessment

Track recording capability sufficient to reveal land/sea/air drug trafficking routes

Capability to standardize English representation of foreign language names, especially those typical of source countries.

Ability to retrieve and fuse information from heterogeneous databases, including text.

Identification of potentially suspicious activity and of aggregate patterns and trends from large databases, by linking together relevant information and by searching for similar (vice identical) information.

Short-Term S&T Requirements

Small, self-contained, quickly deployable, concealable video image collection and transmission system for remote use.

Inexpensive, noninterfering, electronic infrared video camera filter for use with a wide range of systems used by law enforcement agencies.

Nonaccess, covert, transportable audio collection system without wire connection between target and listening post.

Covert, pager-sized communications transceiver for undercover or surveillance use, which avoids detection by electronic and physical countermeasures.

A more accurate, less threatening alternative to traditional polygraph for the detection or corroboration of "guilty knowledge" of criminal investigative information or illicit activity.

Covert low power audio transmitter that can be worn during undercover operations that is not subject to detection by either commercially available frequency scanners, metal detectors or field effect sensors.

Low probability of detection and low probability of intercept transmitters and receivers that employ spread spectrum and other techniques to be used in place of the current generation of undercover audio surveillance transmission systems.

Low probability of detection and low probability of intercept video transmission system for use with current operational surveillance video transmission systems.

Improved interception capabilities for wireline and cellular telephone conversations and data transmissions.

Enhanced capability to intercept cellular phone communications and still meet wiretap warrant restrictions.

Portable system to monitor select audio signals in urban areas.

Ability to identify individuals through voice recognition.

Portable and mobile high resolution night vision devices that do not rely on bulky or noisy cooling systems.

Provide improved battery technology so that other covert systems can be further miniaturized.

Geographic information system capable of displaying location and identification information for officers and suspects in urban and rural environments.

Local tracking of target personnel, vehicles, containers, aircraft and watercraft at central location.

Short-range beacon detectable at several meters with local monitor.

Covert passive beacon for stand-off line-of-sight tracking of suspect vehicles or other contraband transporting conveyances.

ADP information access system that permits an individual with a particular security clearance to access various computer systems from a single work station and then filters system information to match the individual's security clearance.

Information Management System that associates financial transactions and analyzes the flow of those transactions to identify and correlate suspicious fund transfer activity.

Fixed system that automatically images suspects after they have been arrested and compares those images with criminal databases to assist in the rapid booking of those offenders. This will also identify outstanding warrants or related criminal activity.

Mobile system that will image people's faces, transmit those images to a central location and compare those images with a database to identify suspect traffickers and other dangerous criminals.

Capability to optically scan non-formatted data into a database and the ability to retrieve data through a text-based query system.

Software to automatically extract pertinent information from text.

Information Management System for matching suspected activities with addresses to target surveillance and apprehension.

A system which performs facial and voice recognitions via an automated digital auto-correlation algorithm.

A Pattern Recognition and Profile Development ADP system for targeting suspect traffickers as they pass through our international ports of entry.

Mobile device with capability to remotely monitor areas where crowds of people congregate and then

alert the operator when suspect individuals are present in that crowd.

Provide low detectable images from hidden sensors.

A non-lethal capability to stop aircraft, vessels and vehicles which refuse to respond to law enforcement officials request to stop for inspection.

Mobile push-to-talk low probability of intercept communications.

Improved information processing capability to analyze voice and data intercepted over wireline or cellular communication networks.

A micro-miniature audio recorder to record and store conversations.

System for central control and management of frequency and crypto/privacy codes.

Continue development of psychological profile program which characterizes individual narcotraffickers.

A financial information management system that associates financial transactions and analyzes the flow of those transactions to identify and correlate suspicious fund transfer activity.

Biological, chemical, genetic controls for cannabis grown on public land in the U.S.

Environmental economic assessment of impacts of substitute crops compared to illicit cultivation and processing.

Illicit crop modeling to determine production/yield potential.

New systems to safely and inexpensively destroy the vast amounts of seized illicit narcotics.

The ability to render inert and safe for disposal chemicals which are seized during drug raids.

An air deliverable coca plant eradication capability.

Airborne system for delivering crop eradication chemicals with the pinpoint accuracy for treating individual plants, small groups, or rows of plants.

Recommendations for substitute crops to replace the income lost due to the eradication of coca.

Software to automatically extract name (person or business), place, and role information from text.

Software to process error-full text which results from use and limitations of current OCR technology.

High performance data base systems which allow for aggregate queries on arbitrary criteria.

Medium-Term S&T Requirements

Low probability of detection and low probability of intercept transmitters and receivers that employ spread spectrum to be used in undercover audio surveillance transmission systems.

Low probability of detection and low probability of intercept video transmission system for use with current operational surveillance video transmission systems.

A personnel safety and security system for counterdrug agents for worldwide covert use.

High Frequency radio system enhancements to improve HF utility in the law enforcement environment.

Portable radio and navigation handset with world-wide geolocation and LPI radio communications.

Enhanced tactical radios including dual-band portable radios and multi-band mobile radios with multiple crypto capabilities.

Software to standardize English representation of names from multiple languages.

Software to automatically extract information from text and populate databases.

Improvements to OCR technology to handle non-uniform document sizes, fonts, angles, etc.

Data analysis software which allows for discovery of non-linear relationships between data items (i.e., those not retrievable by statistical techniques).

Long-Term S&T Requirements

Video imaging systems that are smaller, more power efficient, and have greater resolution than those currently available.

Fixed, high-power microwaves or mechanical devices to stop cars that run through checkpoints to reduce number of high-speed chases.

Software to automatically extract information from text and create new database schema which captures previously unknown relationships.

Software to transliterate names from multiple languages into English.

OCR capable of handwritten material.

Software to automatically extract pertinent information from speech.

NONINTRUSIVE INSPECTION

Priority Operational Needs

Accurate signatures for detectable illicit drug emissions in operational environments for physical and chemical detection

Portable/transportable capability to detect and classify drugs, contraband and false compartments in vehicles and containers

Fixed capability to detect and classify drugs, contraband and false compartments in vehicles and containers

Short-Term S&T Requirements

Develop Technologies for Large Container and Vehicle Inspections (1000 cubic feet).

Develop Technologies for Medium-Sized Container and Vehicle Inspection (50-1000 cubic feet).

Develop Technologies for Small Container Inspection (50 cubic feet).

Information Management System that merges law enforcement, industry, and public databases to improve the prescreening of manifest information of cargo containers for more detailed examination for concealed drugs.

Portable device to detect false compartments in containers, vehicles and vessels.

Portable device to detect drugs and other contraband hidden in tires, car doors, container walls, etc.

Fixed system to quickly pre-screen containers for the presence of cocaine and heroin by-products.

Capability to identify hull irregularities and detect hull appendages that are attached under the waterline of drug trafficking vessels.

Portable device to locate drugs hidden in the interior walls and cavities of containers, vessels and vehicles.

Fixed container inspection system to detect drugs transported in aircraft cargo and baggage containers.

Fixed container inspection system to detect drugs transported in SEA-LAND size containers.

Portable device to rapidly scan a suspect for swallowed drugs.

Fixed passenger and hand carried baggage inspections system to detect the presence of excess amounts of currency.

Medium-Term S&T Requirements

Develop a non-containerized or break bulk cargo inspection system that automatically detects density anomalies in non-containerized, homogeneous cargoes.

A walk-through drug detection system to rapidly screen passengers who may be carrying concealed narcotics.

Fixed system to detect drugs transported through the mail (all letter and parcel sizes).

Marine Architecture Database to display current production drawings of vessels commonly employed in drug smuggling to help identify voids and sealed spaces suitable for hiding contraband.

Increase the effectiveness of the U.S. Customs Service Automated Commercial System via incorporation of controlled cargo tracking and the expansion of databases.

Portable device to detect drugs dissolved in liquids and packaged in metallic containers larger than 50 gallon drums.

An expansion to the spectral data base for ion mobility spectrometers to include additional precursor chemicals.

Long-Term S&T Requirements

Expand capabilities for additional applications (Tariff Compliance).

WIDE AREA SURVEILLANCE

Priority Operational Needs

Facial Recognition

Target Sorting and Classification

Over-the-Horizon Detection and Targeting

Short-Term S&T Requirements

Improve the capability to correlate multiple sensor inputs into one presentation.

Automatic sorting and tracking (legitimate vs suspect targets).

Develop track recording capability sufficient to reveal patterns and changes to patterns and routes used by drug traffickers on land, sea and in the air.

Integrate this capability with graphical information systems.

Automatic integration of all source databases.

Significantly improve the positional accuracy of OTH and ROTHR to 1-2 nm.

Develop an untethered UAV application with a multi-sensor package (> 1000 nm).

Satisfy airspace control concerns for UAVs.

Develop low cost, high bandwidth satellite communications.

Reduce the size and weight of RF and non-RF Tags.

Increase the durability, covertness, reliability and concealability with SATCOM and GPS capability.

Command and Control workstation that integrates surveillance, tracking, analysis and map image data, and includes communication interface with other computer information systems and voice communication networks.

A track recording device for aircraft, marine and land vehicles that will allow law enforcement agencies to determine and analyze current drug trafficking routes.

Beacon for tagging cargo containers or vessels with remote on/off activation via satellite control from a central monitor.

Miniaturized beacon with world-wide coverage which can be monitored from a regional command center.

Remote site monitor incorporating still video technology, high capacity digital storage and state of the art data transmission techniques for unattended use in hostile areas.

Portable semi-passive tag to attach to suspect aircraft for radar discrimination from nonsuspect aircraft.

Miniature active transponder with low probability of intercept equipped with remote monitoring at ranges up to 100 miles from a central location.

Develop a combined sensor and data transmitter to monitor and report activity at remote airfields.

Regional satellite communications and position location coverage for Central and South America.

Medium-Term S&T Requirements

Worldwide coverage for centralized monitoring of personnel, vehicles, containers, aircraft, watercraft, documents, currency and illegal drugs.

An automated vehicle tracking system capable of simultaneously tracking several hundred beacons.

Develop still video transmission capability for use with emerging digital mobile satellite systems.

World-wide satellite communications and position location coverage.

Long-Term S&T Requirements

Develop target altitude capability for OTH/ROTHR (within 5,000 feet)

APPENDIX F - COUNTERDRUG COMMUNITY R&D PROJECTS FOR FY93 AND FY94

This appendix provides a listing of those projects comprising the national counterdrug R&D program for Fiscal Years 1993 and 1994. The listing is organized according to the agency that is acting as the "lead" for monitoring and reporting on the technical and fiscal aspects of the project. In most cases, CTAC and ARPA use law enforcement agencies to oversee projects so the funding amounts in the listing include amounts funded by CTAC and ARPA, in addition to individual agency funds. The totals are representative since these funds may not have been authorized, released or committed at the time of this document's release. Sensitive and intelligence related R&D projects or their funding are not shown in this appendix.

Thrust	Tech	Lead	Title	Funding
Drug Enforcement Administration (DEA)				
WAS	SUR	DEA	Project Breakthrough	CTAC
TT	SUR	DEA	Drop and Run Video	CTAC
TT	SUR	DEA	Enhanced Real-time Voice Identification System	CTAC
TT	SUR	DEA	Cocaine/Heroin Impurity Profiles	CTAC
TT	ADP	DEA	Intelligence Fusion System	DEA
TT	ADP	DEA	Automated Booking Station	DEA
WAS	SUR	DEA	RF Tags - Worldwide	CIA
				FY 93 ($K) *FY 94 ($K)*
			Total DEA	**2,250** **705**
Department of Defense (DoD)				
DR	DR	DoD	Demand Reduction	DoD
NII	Insp	DoD	PFNA-TOF	DoD
NII	Insp	DoD	PFNA Testbed Operations	DoD
NII	Insp	DoD	Columated Gamma	DoD
NII	Insp	DoD	Mobile Detection System	DoD
NII	Insp	DoD	SW Border Testbed	DoD
NII	Insp	DoD	X-Ray Testbed Operations	DoD
NII	Insp	DoD	Dist Simulation Technical Support	DoD
NII	Insp	DoD	Small Package Inspection System	DoD
NII	Insp	DoD	Quick Screen/NOR	DoD
NII	Insp	DoD	Cargo Search 2 Advanced X-Ray	DoD
NII	Insp	DoD	Otay Mesa Testbed	DoD
NII	Insp	DoD	System Evaluation & Simulation	DoD
NII	Insp	DoD	Low Power Neutron	DoD
NII	Insp	DoD	TNA	DoD
NII	Insp	DoD	Chemical Micro Sensor	DoD
NII	Insp	DoD	Chemical Detector/Neural Net	DoD
NII	Insp	DoD	Enhanced Canines	DoD
NII	Insp	DoD	Solid Cocaine Matrix Detector Study	DoD
NII	Insp	DoD	NII Study Line	DoD
TT	ADP	DoD	Analysis of Digital Computer Media	DoD
TT	ADP	DoD	Bank Security Database	DoD

Thrust	Tech	Lead	Title	Funding
Department of Defense (DoD) (Continued)				
TT	ADP	DoD	Txt/Msg Extraction & Understand	DoD
TT	ADP	DoD	Facial Recognition Algorithms	DoD
TT	COM	DoD	LPI/LPD Radio	DoD
TT	ESM	DoD	Rhubarb, NSA	DoD
TT	ESM	DoD	Project M (Fax Exploit)	DoD
TT	ESM	DoD	Automated Fax	DoD
TT	ESM	DoD	Car Stopper	DoD
TT	SUR	DoD	Ultra Miniature Battery	DoD
TT	SUR	DoD	Micro GPS	DoD
TT	SUR	DoD	GPS Cesium Clock	DoD
TT	SUR	DoD	LOCUSP Phase II	DoD
TT	SUR	DoD	Technology Development	DoD
TT	SUR	DoD	Tunnel Detection	DoD
TT	SUR	DoD	Small Talk	DoD
TT	SUR	DoD	Tags	DoD
TT	SUR	DoD	Tracking & Location Sys/FESTIVE/SLICE	DoD
TT	SUR	DoD	TT Study Line	DoD
TT	SUR	DoD	Meteor Burst	DoD
WAS	SUR	DoD	WAS Study Line	DoD
WAS	SUR	DoD	CD D&M Studies	DoD
WAS	SUR	DoD	D&M OP Analysis	DoD
WAS	SUR	DoD	OTH Technology Development	DoD
WAS	SUR	DoD	Special Techniques	DoD
WAS	SUR	DoD	SEE SNOW	DoD
				FY 93 ($K) *FY 94 ($K)*
			Total DoD	**30,409** **30,299**
Federal Bureau of Investigation (FBI)				
TT	ESM	FBI	Top Water	CTAC
TT	ESM	FBI	Concealed Audio Transceiver Surv System	CTAC
TT	SUR	FBI	Location and Tracking System	CTAC
TT	SUR	FBI	LPI-LPD Body worn Transmitter	CTAC
TT	SUR	FBI	Topographic Maps with Buildings	CTAC
TT	SUR	FBI	Small Look	CTAC
TT	SUR	FBI	3-D Map Vector Presentation	CTAC
TT	SUR	FBI	Airborne System for Info Command and Control	CTAC
NII	Insp	FBI	Trace Narcotics Detection (GC)	FBI
TT	ADP	FBI	Drug Information System	FBI
TT	ADP	FBI	DRUGFIRE Matching Algorithm	CTAC
TT	COM	FBI	LPD Mobile Handheld Radio (Completed)	FBI
TT	COM	FBI	Pager-Sized Surveillance Radio (Completed)	FBI
TT	ESM	FBI	Rapid Prototyping Facility	FBI
TT	ESM	FBI	Improved Speaker/Topic Spotting Signal Proc	FBI
TT	ESM	FBI	Video Camera Compromise (Completed)	FBI

Thrust	Tech	Lead	Title	Funding
Federal Bureau of Investigation (FBI) (Continued)				
TT	ESM	FBI	LPD Mobile Communications/CADENZA	FBI
TT	ESM	FBI	Solid-State Digital Audio Recorders/ANDANTE	FBI
TT	ESM	FBI	Body Worn Video Camera	FBI
TT	ESM	FBI	Digital Plant Recorder	FBI
TT	ESM	FBI	Rebar Clutter HRT/SWAT	FBI
TT	ESM	FBI	Mini Handheld Secure Radio Solid State Recorder Compression Algorithm	FBI
				FY 93 ($K) *FY 94 ($K)*
			Total FBI	**11,347** **4,059**
Financial Crimes Enforcement Network (FinCEN)				
TT	ADP	FinCEN	Research and Development	FinCEN
TT	ADP	FinCEN	Link Analysis / High Performance Computing	FinCEN
TT	ADP	FinCEN	Omni Query	FinCEN
				FY 93 ($K) *FY 94 ($K)*
			Total FinCEN	**340** **1,500**
Immigration and Naturalization Service (INS)				
TT	ESM	INS	Ultra-Wide Band Compression	CTAC
WAS	SUR	INS	Transportable Observation Platform	CTAC
WAS	SUR	INS	Modular Sensor Design	CTAC
WAS	SUR	INS	Hydrophones	INS
WAS	SUR	INS	Modular Sensor Design	INS
				FY 93 ($K) *FY 94 ($K)*
			Total INS	**1,971** **0**
CTAC Demand Reduction Technology				
DR	Treat	HHS	Drug Abuse Brain Scanning Research	CTAC
DR	Treat	HHS	Cocaine Catalytic Antibodies	CTAC
DR	Treat	HHS	Drug Evaluation Network System	CTAC
				FY 93 ($K) *FY 94 ($K)*
			Total CTAC Demand Reduction	**3,181** **1,000**

Thrust	Tech	Lead	Title	Funding
U.S. Coast Guard (USCG)				
TT	SUR	USCG	Underwater Search Methods	ARPA
NII	Insp	USCG	Portable Drug Detector	CTAC
TT	SUR	USCG	Video Communications (VICOM) Helmet	CTAC
NII	Insp	USCG	Drug Detection Using Chemiluminescence	USCG
NII	Insp	USCG	Hidden Compartment Sensor	USCG
NII	Insp	USCG	Ion Mobility Spectrometry Detection	USCG
NII	Insp	USCG	Sensor Technology Research	USCG
NII	Insp	USCG	Phenomenology Research	USCG
TT	SUR	USCG	Forensics and Protocols Research	USCG
WAS	SUR	USCG	Sensor Integration and Displays	USCG
WAS	SUR	USCG	Inverse Synthetic Aperture Radar Shipboard	USCG
WAS	SUR	USCG	Unmanned Aerial Vehicles	USCG
WAS	SUR	USCG	Shipboard Infrared Imaging System (SIRIS)	USCG
				FY 93 ($K) *FY 94 ($K)*
			Total U.S. Coast Guard	**1,405** **1,652**
U.S. Customs Service (USCS)				
NII	Insp	USCS	Gamma-Ray Detector for Empty Containers	CTAC
NII	Insp	USCS	Low Radiation Source Mini-Buster	CTAC
NII	Insp	USCS	Gas Chromotograph	CTAC
NII	Insp	USCS	Narcotics Detection in Mail Packages	CTAC
NII	Insp	USCS	Miniature Gamma Ray Backscatter	CTAC
NII	Insp	USCS	Narcotics Detection Technology Assessment	CTAC
NII	Insp	USCS	Evaluation of Nonintrusive Inspection Tech	CTAC
NII	Insp	USCS	Refinement of Biosensor System for Heroin	CTAC
NII	Insp	USCS	Signature Analysis Study Related to Cargo	CTAC
NII	Insp	USCS	Side Scan Sonar	USCS
NII	Insp	USCS	CTEC POE BETA Test Site	USCS
NII	Insp	USCS	Cargo Search Dual X-Ray Inspection System	USCS
WAS	SUR	USCS	Mission Matrix	USCS
WAS	SUR	USCS	Video Surveillance System	USCS
				FY 93 ($K) *FY 94 ($K)*
			Total U.S. Customs Service	**2,017** **2,153**
U.S. Department of Agriculture (USDA)				
TT	Insp	USDA	Coca Eradication	USDA
TT	Insp	USDA	Cannabis Eradication	USDA
TT	Insp	USDA	Detection/Spectral/Remote Sensing	USDA
TT	Insp	USDA	Crop Yield	USDA
TT	Insp	USDA	Crop Substitution	USDA
TT	Insp	USDA	Rural Drug Use	USDA

Thrust	Tech	Lead	Title	Funding
U.S. Department of Agriculture (USDA) (Continued)				
TT	Insp	USDA	Plant Physiology (Growth Research) Support	USDA
WAS	Insp	USDA	Opium Eradication	USDA
				FY 93 ($K) *FY 94 ($K)*
			Total Dept. of Agriculture	**6,687** **6,489**
Central Intelligence Agency (CIA)				
NII	Insp	CIA	CTEC Instrumentation	CTAC
WAS	SUR	CIA	Special Purpose Radar	DoD
NII	Insp	CIA	Sensor Chemical Design Concept	CIA
TT	ADP	CIA	Narcotics Analysis Data Base System	CIA
TT	ADP	CIA	Information Systems Studies	CIA
TT	SUR	CIA	Optical Recognition Technology Study	CIA
TT	SUR	CIA	Remote Low Light Level TV	CIA
WAS	Insp	CIA	Phenomenology Study	CIA
WAS	SUR	CIA	Over the Horizon Radar Study	CIA
WAS	SUR	CIA	Opium Detector	CIA
				FY 93 ($K) *FY 94 ($K)*
			Total CIA	**3,078** **0**
U.S. Marshals Service (USMS)				
TT	ADP	USMS	Seized Assets Management System (SAMS)	USMS
				FY 93 ($K) *FY 94 ($K)*
			Total U.S. Marshals Service	**0** **0**
U.S. Secret Service (USSS)				
WAS	SUR	USSS	Chemical Taggant Program	CTAC
				FY 93 ($K) *FY 94 ($K)*
			Total U.S. Secret Service	**0** **0**
				FY 93 ($K) *FY 94 ($K)*
			TOTAL COUNTERDRUG R&D	**62,685*** **47,857***

** Totals do not include funding amounts for intelligence related R&D projects*

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Abbreviation Key:

Advanced Research Projects Agency (ARPA)
Central Intelligence Agency (CIA)
U.S. Customs Service (USCS)
U.S. Coast Guard (USCG)
Department of Defense (DoD)
U.S. Department of Agriculture (USDA)
U.S. Department of Health and Human Services (HHS)
Drug Enforcement Administration (DEA)
Federal Bureau of Investigation (FBI)
Financial Crimes Enforcement Network (FinCEN)
Immigration and Naturalization Service (INS)
U.S. Marshals Service (USMS)
U.S. Secret Service (USSS)
Counterdrug Technology Assessment Center (CTAC)
Thrust
- Wide Area Surveillance (WAS)
- Tactical Technology (TT)
- Nonintrusive Inspection (NII)
- Demand Reduction (DR)

Technology (Tech)
- Automated Data Processing (ADP)
- Communications (COM)
- Electronic Suppression Measures (ESM)
- Inspection (Insp)
- Tracking and Surveillance / Radar (SUR)
- Substance Abuse Treatment (Treat)

Lead - Agency providing oversight and reporting functions
Funding - Agency providing funding for project

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