MEETING THE CHALLENGE OF HOMELAND SECURITY:

A Report by the Bay Area Science Infrastructure Consortium (BASIC)

Highlights of the Bay Area's Research and Development Capabilities Related to the Critical Mission Areas of the Department of Homeland Security

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This report was produced through the contribution and support of *BASIC* members and other leaders in the Bay Area corporate research community

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The BASIC mission is to be a catalyst for regional action to advance and support the Bay Area's R&D Infrastructure

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BASIC (Bay Area Science Infrastructure Consortium) is a program of the Bay Area Economic Forum, co-sponsored by the Bay Area Council and the Association of Bay Area Governments (ABAG)

TABLE OF CONTENTS

BASIC Bay Area Science Infrastructure Consortium

Message from the Chairman

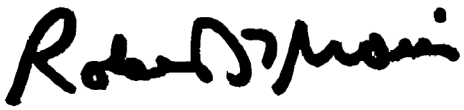
The Bay Area Science Infrastructure Consortium (*BASIC*) strongly supports President Bush's recommendation to create a national program for technology research within the Department of Homeland Security. We applaud the Administration's statement in its *National Strategy for Homeland Security* report: "The Nation's advantage in science and technology is a key to securing the homeland."

The nine-county Bay Area of Northern California is a proven leader in providing that technological advantage to the nation. The region's leadership position is a result of its scientific expertise, its innovative spirit, and a research and development infrastructure that may be unparalleled in the country and the world.

The members of BASIC and I are keenly aware of the critical challenge the security of this country poses. With that challenge in mind, we prepared this report to describe the Bay Area's success in creating current technologies and performing advanced stage research in each of the six critical areas for homeland security identified by the Administration.

As a collaboration among the leaders of the Bay Area's national research laboratories, major research universities, and research-oriented companies and organizations, *BASIC* is pleased to provide this document as a resource for our nation's leaders.

We also are pleased to present this report to the business, government, and community leaders in the region and State to expand awareness of the Bay Area's leadership in science and technology.



Dr. Robert J.T. Morris
Chairman

MEETING THE CHALLENGE OF HOMELAND SECURITY

HIGHLIGHTS OF THE BAY AREA'S RESEARCH AND DEVELOPMENT CAPABILITIES Related to the CRITICAL MISSION AREAS of the DEPARTMENT OF HOMELAND SECURITY

Executive Summary

The Bay Area Science Infrastructure Consortium (BASIC) strongly supports President Bush's recommendation to create a national program for technology research within the new Department of Homeland Security.

The creation of a focused program on homeland security research is a national priority of major importance. To provide protection for its people, the country is looking to its science and technology community. As stated in the executive summary of the Administration's *National Strategy for Homeland Security,* "The Nation's advantage in science and technology is a key to securing the homeland…Just as science has helped us defeat past enemies overseas, so too will it help us defeat the efforts of terrorists to attack our homeland and disrupt our way of life."

President Bush's proposal to establish the national homeland security research program identified six critical mission areas:

- Intelligence and Warning
- Border and Transportation Security
- Domestic Counterterrorism
- Protecting Critical Infrastructure
- Defending Against Catastrophic Terrorism
- Emergency Preparedness and Response

The Bay Area – the nine-county region of Northern California encompassing Silicon Valley and the cities of San Francisco, Oakland, San Jose – already is making vital contributions to the scientific and technological advances required for this nation to respond to the homeland security challenge.

This region of the country offers a unique combination and unequaled concentration of scientific and intellectual leadership, together with a research and development infrastructure that may be unparalleled in its strength and diversity:

- ***Five leading research universities***
  Stanford, UC Berkeley, UC Davis, UC San Francisco, and UC Santa Cruz

- ***Five national research laboratories***
  E. O. Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, NASA Ames Research Center, Sandia National Laboratories, and Stanford Linear Accelerator Center

- ***Four international independent research centers***
  Buck Institute for Age Research, Electric Power Research Institute (EPRI) Monterey Bay Aquarium Research Institute, and SRI International

- ***Corporate leadership in information technology, biotechnology and non-intrusive inspection technology***
  Major companies in ***information technology*** include:
  Advanced Micro Devices, Apple, Applied Materials, ArcSight, Aspect, Cenus Technologies, Cisco, Cylink, Hewlett-Packard, IBM, Intel, IntelliVision, Intevac, iPIX, Lockheed Martin Missiles & Space, National Semiconductor, Network Associates, Oracle, Palo Alto Research Center, Sanctum, Silicon Graphics, Sun Microsystems, Symantec and VeriSign.
  Major ***biotechnology*** companies include:
  Applied Biosystems, Bayer, Chiron, Genentech, Gilead Sciences, Recognition Systems, and Roche.
  Leading companies specializing in ***non-intrusive inspection technology*** include: Ancore, ARACOR, and InVision Technologies.

- ***One of the leading regions in the next wave of innovation – the integration of bio/info/nano technologies, and medical research***
  The Bay Area is a leader in this technology convergence that will play a critical role in national security as well as in improving human health and communications.

Completing the circle of key elements in the Bay Area's technological strength is the nation's largest concentration of venture capitalists and the nation's largest entrepre-neurial community. The close proximity of venture capital to industry enables the Bay Area to rapidly move new technologies from the laboratory to production. With homeland security a high priority and fast deployment critical, the Bay Area's ability to deploy new technologies quickly is extremely important.

The strength of the Bay Area as a center for research and innovation comes not from any single piece of its research and development infrastructure, but from the combination and interaction of these diverse elements in a uniquely creative and entrepreneurial environment.

Prior to September 11, public and private Bay Area laboratories were already focused on many of the challenges now identified under the umbrella of homeland security. Since September 11 these efforts have accelerated, with many technologies developed by national and industry laboratories already deployed or in advanced stages of development.

This report highlights some of the region's important research achievements directly related to the six specific mission areas, and demonstrates that the Bay Area is already in the forefront of the homeland security effort.

Research laboratories in the Bay Area, the State of California and across the country are only at the beginning of what must be a greatly expanded, long-term commitment to protect the nation.

The Bay Area, with its scientific capabilities and technological expertise, is positioned to play a special role in assisting the nation to achieve its goal of providing a secure homeland for its people.

EXAMPLES OF BAY AREA CORPORATE AND NATIONAL LABORATORIES' RESEARCH AND DEVELOPMENT CAPABILITIES
Related to the
CRITICAL MISSION AREAS OF HOMELAND SECURITY

Intelligence and Warning

(We must have an intelligence and warning system that can detect terrorist activity before it manifests itself in an attack so that proper preemptive, preventive, and protective action can be taken. – National Strategy for Homeland Security)

- ***Biometrics***: IBM has nearly 50 scientists dedicated to biometrics research, including speech technologies and voice and fingerprint recognition. ***(IBM)***

- ***Data Protection/Collaboration:*** Oracle's solutions for connected and disconnected wireless access, decision support and multi-channel interaction centers help the public sector coordinate, collaborate and communicate across government agencies and with its constituents. ***(Oracle)***

- ***Data Representation for Rapid Insight:*** SGI's Visual Simulation Lab develops visualization and human-machine interface technologies to rapidly overcome information overload concepts. ***(Silicon Graphics Inc.)***

- ***Information Technology***: Computer scientists at Berkeley Lab are developing: (1) Information processing and retrieval technology for detecting and identifying terrorists from text-based and network-based databases; (2) Computational and informatics techniques for model recovery from observed images and video streams.
  (E. O. Lawrence Berkeley National Laboratory)

- ***Intelligence and Warning:*** Integration of multiple real-time data and analysis channels (e.g. from hyperspectral imaging, remote sensing, biomolecular sensors, medical facilities, etc.) using an interactive web-based platform (Bio-Act) with advanced data mining, pattern recognition, and contextual search and retrieval software to detect threats and provide customized meaningful visualizations and early warnings across agency jurisdictions. ***(NASA Ames Research Center in partnership with California Menay Institute)***

Intelligence and Warning (cont.)

- ***Intelligence and Warning***: SRI has developed technologies for computer network intrusion detection; threat assessment and information sharing; collaborative intelligence analysis; and image and text analysis for intelligence extraction. SRI's discoveries in sensors and sensor systems for detection of chemical and biological agents have been applied to micro-detectors, laboratory-quality instrumentation systems, remote optical and chemical identification systems, and portable and mobile devices.
  (***SRI International***)

- ***Internet Resource/User Access:*** Cenus Technologies' globally scalable Layer 7 networking technology enables the compilation, for analysis, of usage and access data of Internet, World Wide Web, and WAN/LAN based resources and traffic, by individual users, user populations, and by files accessed. This enables the mining of such data to discern patterns of resource usage and communications, and enables identification of users to exacting and discreet levels of locality, and paths of access.
  (Cenus Technologies)

- ***Mission Critical Communication Platform:*** Aspect's technology provides ability to link government and private sector data; monitor and track information and people to identify potential threats; and proactively sends alerts and notifications to appropriate individuals via any communication channel. ***(Aspect)***

- ***Night Vision:*** Intevac's intensified digital video sensors for high performance camera applications offer high sensitivity and high resolution in both the visible and near infrared range of the electromagnetic spectrum. These sensors and cameras provide important military and commercial applications for detecting or imaging objects using infrared radiation, including low light level surveillance to nighttime long-range target detection and identification. (***Intevac)***

- ***Nuclear Threat Assessment***: Lawrence Livermore's Nuclear Assessment Program is the DOE/NNSA lead for technical, operational, and behavioral assessments of nuclear and radiological threats. This program also provides technical support to the law enforcement and intelligence communities, including real-time assessments of nuclear black market transactions, field support for seizures of illicit nuclear materials, participation in FBI-designated special events, and instruction related to nuclear crime at various national and international law enforcement training venues.
  (***Lawrence Livermore National Laboratory)***

Intelligence and Warning (cont.)

- ***Pattern and Trend Discovery***: IBM has several projects among its eight worldwide research labs for the comprehensive intelligent mining of unstructured, semi-structured and structured digital data. ***(IBM)***

- ***Systems Security***: IBM Research's Global Security Analysis Lab creates tools and services for system security needs, including intrusion detection, vulnerability testing, intrusion avoidance, wireless security, and advanced cryptography. ***(IBM)***

- ***Threat Assessment:*** ArcSight's enterprise software utilizes sophisticated real time correlation technology enabling large, geographically-dispersed organizations to better manage their security function by consolidating and analyzing diverse sources of security-relevant information to identify and react to true threats and attacks. (***ArcSight, Inc***.)

- ***Threat Assessment***: Lawrence Livermore's International Assessments Program is among the strongest in the nation for analysis and research related to foreign weapons of mass destruction, including early stage foreign technology development and acquisition, patterns of cooperation and foreign cyber threats. (***Lawrence Livermore National Laboratory***)

- ***Threat Assessment:*** NASA Ames Research Center has extensive experience and a diverse range of world-class researchers in critical information technologies for the detection of threats. Expertise includes data mining and analysis, information sharing, collaborative systems, human factors, high-performance computing and information fusion. Ames has expertise in the development of integrated systems to deploy advanced technologies, including work with the FAA and NASA space missions. Ames is working with the Transportation Security Agency to apply these technologies to the problem of passenger threat assessment. (**NASA Ames Research Center)**

- ***Threat Assessment:*** Enterprise software utilizes the latest hacking techniques and signatures to assess the susceptibility of an organization's Web site to attack and report out to management and security teams on recommended fixes. ***(Sanctum***)

- ***Verified Information Sharing:*** VeriSign offers a range of solutions to authenticated users – intelligence community, law enforcement and first responders – establishing trust and verifying the level of access users have to certain information. ***(VeriSign)***

Intelligence and Warning (cont.)

- ***Video Intelligence and Automated Monitoring:*** IntelliVision's technology analyzes video in real-time and automatically identifies inconsistencies and abnormalities in environment, human behavior and movements of people, vehicles and objects. Automatically detects security threats and breaches and alerts security professionals in timely manner. Vastly enhances reliability of CCTV, access control, intrusion detection, perimeter monitoring, asset protection, and other security systems. ***(IntelliVision)***

- ***Visual Data Collection and Analysis***: iPIX's Rimfire® imaging platform enables collecting, processing, and analyzing photos captured by field personnel and surveillance cameras. Millions of images are handled daily by this robust distributed infrastructure. ***(iPIX)***

- ***Visual Surveillance***: iPIX's 360-degree-by-360-degree video camera solutions provide complete, live and archived visual coverage in real time, using only one camera head with no moving parts and in a package that can be configured to provide situational awareness and tele-operation on unmanned vehicles, robots, and ground sensors in any environment. ***(iPIX)***

Border and Transportation Security

(We must…promote the efficient and reliable flow of people, goods, and services across borders, while preventing terrorists from using transportation conveyances or systems to deliver implements of destruction. – National Strategy for Homeland Security)

- ***Border and Seaport Security:*** ARACOR's Eagle system, a powerful, mobile, relocatable cargo inspection system provides a combination of cargo x-ray inspection capabilities for seaports, border crossings, and facility entry points to detect explosives, weapons, drugs, and, potentially, special nuclear materials. U.S. Customs Service gave the Eagle its highest rating based on x-ray inspection capabilities and selected it as the primary security system for U.S. seaports. ***(ARACOR)***

- ***Border and Transportation Security:*** Ancore has major R&D and D&E programs to develop and test non-intrusive neutron based techniques for the detection of a wide range of threats (explosives, chemical agents, nuclear materials and devices, radiological weapons, drugs, etc.) in all modes of transportation: fully loaded trucks crossing borders, marine cargo containers at seaports of entry, other vehicles, air cargo, air passenger luggage, etc. ***(Ancore Corp.)***

- ***Border and Transportation Security:*** Quantum Magnetics, a wholly-owned subsidiary of InVision Technologies, specializes in developing aviation security products such as the i-Portal (imaging weapons detector) and LiquiScan (sealed bottles) in addition to quadrupole resonance (QR) technology-based Qscan (luggage and smaller parcels), wand (persons) and portal (persons). ***(InVision Technologies and Quantum Magnetics)***

- ***Border and Transportation Security***: Research on system for container tracking for port security. (***NASA Ames Research Center in partnership with California Menay Institute)***

- ***Border and Transportation Security:*** Recognition Systems' biometric verifications systems use the size and shape of a person's hand to help speed them through border crossings. This technology is already at work at Israel's Ben Gurion International Airport with millions of inspections already completed. ***(Recognition Systems, Inc.)***

- ***Border and Transportation Security***: SRI, a leader in natural language speech recognition, has licensed its spoken language recognition system to a commercial firm that has deployed it into a translation device in use in Afghanistan. ***(SRI International***)

Border and Transportation Security (cont.)

- ***Border and Transportation Security/Nuclear Detection***: Advanced radiation detection technology and analysis techniques for application to transportation and border security. ***(E. O. Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Sandia National Laboratories)***

- ***Border Security/Visual Surveillance and Documentation***: iPIX's highly compatible fixed spherical platforms allow live and/or archived capture of 360-degree-by-360-degree as well as 360-degree-by-180-degree views of any area, allowing for single camera surveillance at border crossings, cockpits, and security checkpoints. ***(iPIX)***

- ***Border Surveillance:*** Research on the use of high-definition video technology developed for the entertainment industry has broad application for border surveillance. ***(Silicon Graphics Inc. and AliasWavefront)***

- ***Border Surveillance and Aviation Security:*** InVision Technologies has developed one of only two FAA-certified explosives detection systems (EDS) deployed by the federal government in 90% of the airports nationwide. Its detection system is based on computed tomography technology, which has proven effective in detecting explosives determined by the Federal Aviation Administration (FAA) to be a significant threat to commercial aviation. (***InVision Technologies)***

- ***Border Surveillance and Aviation Security:*** SRI is working in several areas, including identity verification; person and asset identification and tracking; aircraft protection, including fuselage ballistic armor and explosion-containing luggage containers; silent micro-air vehicles; and electronic no-fly zones. SRI's expertise in electromagnetics has resulted in penetrating radar systems; reliable wireless systems; precision navigation; and autonomous command and control systems. ***(SRI International)***

- ***Cargo Container Evaluation and Experimental Facility:*** Unbiased testing of commercially available and prototype technologies for detecting nuclear materials inside cargo containers. Active and passive detection technologies are being tested against real nuclear materials inside real cargo containers filled with goods typical of air, sea, and truck cargo. (***Lawrence Livermore National Laboratory)***

Border and Transportation Security (cont.)

- ***Commercial Airport Facilities Security:*** Research and development of biometric verification systems that protect the nation's airports by positively identifying each worker as they enter the airfield. This work leverages the unique installation at San Francisco International Airport which is the only airport in the world using biometrics throughout the entire airport for access privileges. ***(Recognition Systems, Inc.)***

- ***Commercial Aviation, Cargo and Seaport Security:*** Berkeley Lab is developing reliable, long-lived neutron sources and detectors specially designed for rapidly screening cargo ranging from passenger luggage to containerized cargo. It also is exploring a new technology, ex-situ MRI**,** which could search for specific chemical compounds (such as drugs or explosives) in luggage without the use of ionizing radiation. ***(E. O. Lawrence Berkeley National Laboratory)***

- ***Commercial Aviation, Cargo and Seaport Security***: Search and inspection technologies for screening airport passengers, baggage and cargo, including computed tomography, x-ray scanning, gamma-ray imaging, neutron interrogation and thermal imaging. ***(Lawrence Livermore National Laboratory)***

- ***Commercial Aviation Security:*** InVision Technologies' explosives detection system (EDS) machines currently exclusively screen checked baggage in airports across the nation and airports worldwide. ***(InVision Technologies)***

- ***Commercial Aviation Security***: Research on methods for preventing terrorists from boarding public transportation, particularly commercial aircraft. ***(NASA Ames Research Center)***

- ***Commercial Aviation Security***: Ames Research Center, with other NASA facilities, is developing a comprehensive program addressing the challenges of Commercial Aviation Security, including: passenger threat assessment and monitoring of the airport grounds; protection of the overall Air Transportation Management system; and hardening of the airplane in-flight to ensure its safe operation. Ames monitors and maintains a record of safety violations within the national airspace to track security infractions and detect patterns that reflect a weakness in the overall system. (**NASA Ames Research Center).**

Border and Transportation Security (cont.)

- ***Interconnection of Border and Transportation Security Systems:*** Cenus Technologies' service-agnostic routing enables the networking of existing distributed agency networks and autonomous systems; allowing for real time distribution and information sharing between heterogeneous networks involved in border and transportation security. This provides disparate agencies global coordination and global access to knowledge which is crucial to secure public and private transportation systems and facilities and the nation's borders. ***(Cenus Technologies)***

- ***Long Range and Remote Surveillance:*** Intevac's Laser Illuminated Viewing and Ranging (LIVAR®) imaging system enables the visual detection of targets at ranges extending beyond 20 kilometers. LIVAR® enables remote areas, which cannot be monitored by standard surveillance equipment at night, to be effectively searched for potential threat targets. ***(Intevac)***

- ***Smart Visas:*** To ensure positive ID and control of foreign visitors, VeriSign's two-factor smart visas, with digital certificates and biometrics, will verify the identity of the person with the visa. ***(VeriSign)***

Domestic Counterterrorism

(Our Nation will use all legal means – both traditional and nontraditional – to identify, halt…terrorists in the United States. – National Strategy for Homeland Security.)

- ***Bomb Detection***: Technology to disable suspected explosive devices while preserving forensic information (used to disable the shoe bomb of accused terrorist Richard Reid) has been licensed to industry and is now a primary tool of bomb squads nationwide. ***(Sandia National Laboratories)***

- ***Covert Surveillance:*** Intevac's EBAPS™ cameras, built upon state-of-the-art night vision technology, provides low light level surveillance capability without the need for artificial illumination. ***(Intevac)***

- ***Explosives and Weapons Detection:*** ARACOR is currently developing enhanced Eagle cargo inspection system neutron-based capabilities for detecting explosives. ARACOR also working with the Department of Energy's National Nuclear Security Administration to jointly develop an inspection method to detect weapons of mass destruction and special nuclear materials. ***(ARACOR)***

- ***Explosives and Weapons Detection:*** InVision Technologies provides 90% of the explosive detection systems (EDS) to the Transportation Security Administration (TSA) for checked baggage screening at the nation's airports. Its subsidiary, Quantum Magnetics, concentrates on developing screening devices using quadrupole resonance, which targets explosives' molecules and low-frequency magnetic sensing for detecting weapons and currency. ***(InVision Technologies and Quantum Magnetics)***

- ***Forensics:*** Lawrence Livermore National Laboratory's Forensic Science Center has developed a unique capability to detect and characterize ultratrace levels of virtually any compound in any sample matrix, and is emerging as the nation's second laboratory for the international treaty banning chemical weapons. ***(Lawrence Livermore National Laboratory)***

- ***Forensics and Materials Characterization****:* The Advanced Light Source (ALS) at Berkeley Lab provides a variety of synchrotron based spectral tools useful for analytical and surface chemistry work including forensics and biological research using Fourier-transform infra-red spectroscopy. The National Center for Electron Microscopy has forefront capabilities with potential for forensics, surface science. **(*E. O. Lawrence Berkeley National Laboratory)***

Domestic Counterterrorism (cont.)

- ***Human Identification Technology:*** Applied Biosystems' human identification technology is used for criminal investigations, identification of missing persons, military personnel and victims of mass disasters. Applied Biosystems' identification kits and genetic analysis instrumentation were used in the World Trade Center victim identification process. ***(Applied Biosystems)***

- ***Information Dissemination Control:*** VeriSign's secure communications for public health, disease control and emergency responders enables experts to effectively address threats and prevent unwarranted public alarm. ***(VeriSign)***

- ***Information Security****:* The computer scientists and applied mathematicians in Berkeley Lab's Computational Sciences Division are contributing to information security via study of: (1) Data protection technology – essential for the preservation of the national infrastructure; (2) Secure and reliable multicast development and deployment for monitoring and information sharing. ***(E. O. Lawrence Berkeley National Laboratory)***

- ***Physical Detection***: SRI's research and development of electromagnetic through-the-wall radar, clandestine detection and surveillance and systems to shield and disarm chemical and biological agent dispensers. ***(SRI International)***

- ***Truck and Car Bomb Detection:*** Development of technologies and production of mobile or stationary material specific non-intrusive inspection system to detect presence of bulk explosive concealed in trucks and cars. ***(Ancore Corp.)***

- ***Truck-Stopping Technology***: Lawrence Livermore National Laboratory, responding to a request from the Governor of California, developed an innovative means of stopping tanker trucks, to keep hijacked trucks from becoming motorized missiles. A prototype was demonstrated in Oakland, CA in November 2001 and testing at high speeds was conducted at the Nevada Test Site in March 2002. LLNL is working with the California Highway Patrol and a major trucking company to implement a field trial program. ***(Lawrence Livermore National Laboratory)***

Protecting Critical Infrastructure

(We must…improve protection of the individual pieces and interconnecting systems that make up our critical infrastructure. – National Strategy for Homeland Security.)

- ***Blast and Structural Analysis:*** Computer scientists and applied mathematicians at Berkeley Lab have developed powerful new techniques for simulating explosions and deflagrations in underground chambers. ***(E. O. Lawrence Berkeley National Laboratory)***

- ***Blast and Structural Analysis:*** SGI's research on the use of computer modeling applications developed for crash analysis in automotive industry is being applied for buildings and construction. ***(Silicon Graphics Inc.)***

- ***Controlled Viewing of Secured Locations:*** iPIX's networked video security cameras (NetCams) provide 360 degree-by-180 degree coverage, reducing the number of cameras necessary, yet allowing for a higher level of visual awareness and analysis from multiple locations. iPIX NetCams have no moving parts and provide digital pan tilt and zoom for comprehensive visual capture with targeted information, capturing and recording the entire environment, while panning and zooming to view just a portion of the scene. ***(iPIX)***

- ***Cybersecurity:*** ArcSight provides the software for building the Information Sharing and Analysis Centers recommended by the National Strategy to Secure Cyberspace by allowing independent organizations to share in a controlled manner relevant real time security information with trusted partners. ***(ArcSight)***

- ***Cybersecurity:*** Cylink is the developer and provider of real-time security solutions which ensure confidentiality, integrity and authentication during the critical information-sharing process between federal, state, and local law enforcement agencies. ***(Cylink)***

- ***Cybersecurity***: IBM has a substantial research and development effort for cryptographic coprocessors, secure storage devices, and data recovery for applications and devices. ***(IBM)***

- ***Cybersecurity***: Lawrence Livermore National Laboratory is home to the Computer Incident Advisory Capability (CIAC), the Department of Energy's cyber watch and warning center. CIAC assists any DOE facility experiencing a computer security incident with analysis, response and restoration support. CIAC also develops cyber security and intrusion detection tools and cyber defense solutions to attacks. ***(Lawrence Livermore National Laboratory)***

Protecting Critical Infrastructures (cont.)

- ***Cybersecurity***: Network Associates' suite of McAfee security solutions provide consumers, industry and government manageable virus protection and security against malicious code and content. In addition, Network Associates Laboratories, the technology research division of Network Associates, Inc., is widely recognized as the world leader in information security research and development.
  (Network Associates, Inc.)

- ***Cybersecurity:*** Sanctum's industry leadership in Web Application Security solutions aids industry and government in stopping Web application attacks. AppShield, an automated Web application firewall, provides 24/7 automatic defense to Web applications from threats such as internet worms (e.g. Nimda), identity theft, e-shoplifting, web site defacement and many more. ***(Sanctum Inc.)***

- ***Cybersecurity***: Development of intrusion detection and response systems that prevent or delay intruder access to critical computer networks. These systems include countermeasures that confuse cyber attackers and reduce their effectiveness.
  (Sandia National Laboratories)

- ***Cybersecurity:*** As the operator of a critical infrastructure, the DNS and SS7 networks, VeriSign has developed leading edge cybersecurity practices to address cyber attacks. It engages in R&D for security software for authentication and encryption of networks and provides a system testbed for state-of-the art security hygiene applied to critical infrastructure data centers. ***(VeriSign)***

- ***Cybersecurity and Critical Infrastructure Protection Applications:*** Oracle's solutions prevent destruction, corruption or degradation of information while protecting against a disruption of service. Solutions also provide connected and disconnected wireless access, decision support and interaction centers to help coordinate, collaborate and communicate across government agencies, and with constituents. ***(Oracle)***

- ***Electrical Infrastructure Security***: The Consortium for Electric Reliability Technology Solutions (CERTS), program office located at Berkeley Lab, develops and disseminates new tools and technologies to model, protect and enhance the reliability and security of the nation's electrical power grid. ***(E. O. Lawrence Berkeley National Laboratory)***

Protecting Critical Infrastructures (cont.)

- ***Entry Point Screening:*** ARACOR's Eagle can be used to rapidly inspect cargo at entrances to military bases, government offices, and critical facilities, such as nuclear power plants. The Eagle is the only system capable of inspecting fluid-filled trucks, such as those used to destroy US embassies and barracks overseas. ***(ARACOR)***

- ***Facility Entry Security:*** Ancore's technology is used for detection of bombs and other threats at entrances to sensitive facilities. Non-Intrusive systems, based on neutron interrogation, are being developed; some already installed, ***(Ancore Corp.)***

- ***Food and Agricultural Crop Security***: The USDA's Research Laboratory is a key national facility for research in developing diagnostics for food and agricultural crop contamination. ***(USDA Agricultural Research Service's Western Regional Research Center and Plan Gene Expression Center, East Bay)***

- ***IT Security, High-End Computing and Dependable Software Systems:*** NASA Ames is developing a diverse range of IT Security and High-end Computing technologies necessary to protect the nation's critical IT infrastructure. Ames has led the recent trend toward grid computing which enables a decentralized approach to managing computing resources. NASA, a leader in high-dependability computing, has formed a partnership with Carneige Mellon in this area. ***(NASA Ames Research Center)***

- ***Physical Infrastructure Protection and Cybersecurity:*** Research and development on explosives detection and explosion containment such as permeable blast barriers. To protect critical information systems such as power grids, air traffic control, and financial systems, SRI has developed software for threat analysis, including intrusion detection software, multilevel security software systems, and authentication systems. SRI's Cyber Defense Research Center conducts vulnerability assessments. ***(SRI International)***

- ***Protecting Information Systems:***. Oracle's database technology to protect information systems helps maintain organizational information availability, integrity, authentication, confidentiality and non-repudiation, and enables the public sector to prevent unauthorized disclosure of information. ***(Oracle)***

Protecting Critical Infrastructures (cont.)

- ***Survivable and Secure Infrastructure:*** Cenus Technologies' fully distributed application level routers interconnect servers and server networks in a fully distributed manner allowing for a geographically diverse architecture without any central points to congest or fail. These networks are fully self-healing and self-configuring, able to reconfigure themselves and continue to provide uninterrupted service from attacks and failures. These systems also add security, preventing the unauthorized access to server system resources, and the introduction of illegitimate information into interconnected server systems. ***(Cenus Technologies)***

- ***Water, Air and Food Security***: Research on monitoring and preservation of water quality, air quality, and agriculture and food production in the face of chemical or biological attacks. ***(NASA Ames Research Center in partnership with California Menay Institute)***

Defending Against Catastrophic Terrorism

(…the threat of terrorist attacks using chemical, biological, radiological, and nuclear weapons requires new approaches… – National Strategy for Homeland Security)

- ***Atmospheric Contamination***: The National Atmospheric Release Advisory Center (NARAC), located and operated at Lawrence Livermore National Laboratory, is a national emergency response service for real-time assessment of incidents involving nuclear, chemical, biological or natural hazardous materials. This atmospheric modeling facility is the nation's principal resource for evaluating the spread of atmospheric contaminants, and facilitating decision making on protective action by emergency managers. ***(Lawrence Livermore National Laboratory)***

- ***Bioanalysis***: Two state of the art synchrotron light sources provide forefront capabilities in protein crystallography, a critical tool in biodefense. ***(E. O. Lawrence Berkeley National Laboratory, Stanford Linear Accelerator Center)***

- ***Biocharacterization:*** The Material Sciences Division of Berkeley Lab has developed extremely sensitive techniques in the application of Superconducting Quantum Interference Devices (SQUIDS) to high sensitivity antibody detection. (***E. O. Lawrence Berkeley National Laboratory)***

- ***Biodetction:*** Applied Biosystems is the exclusive licensee of Hoffman-La Roche, owner of the basic PCR process and reagent patents, for research and development, and applied fields such as quality assurance and control, environmental testing, food testing, GMO testing, agricultural testing (including plant disease diagnostics), forensics and identity testing in humans (other than parentage testing), and animal identity testing. The 5' nuclease process using TaqMan® probes is the methodology being used by the Center for Disease Control (CDC) for detection of bioterrorism agents. ***(Applied Biosystems)***

- ***Biodetection***: Technological breakthroughs in biodetection instrumentation, enabling DNA amplification and identification in minutes rather than hours and days as previously required, have been licensed to industry. DNA chips have been developed in partnership with Affymetrix. Sensitive polymerase chain reaction technologies have been transferred to Cepheid Corp. Research on proteomics and pathogen detection is currently being carried out with Ciphergen Corp. ***(Lawrence Livermore National Laboratory)***

Defending Against Catastrophic Terrorism (cont.)

- ***Biodetection***: Lawrence Livermore National laboratory has made significant breakthroughs in biodetection instrumentation (miniaturization and increased ruggedness of DNA identification devices and flow cytometry) that have been at the core of biodefense capabilities deployed since the September 11 terrorist attacks. The Biological Aerosol Sentry and Information System, developed jointly by Livermore and Los Alamos, was deployed for the Salt Lake Winter Olympics. The two labs worked closely with many law enforcement, emergency response and public health agencies that would be involved in dealing with bioterrorism to develop appropriate sample handling, communications and response protocols. ***(Lawrence Livermore National Laboratory, Los Alamos National Laboratory)***

- ***Biodetection.*** Extensive tools have been developed to model and monitor the transport of toxins and pathogens in open areas and in buildings. ***(NASA Ames Research Center)***

- ***Biotechnology:*** The Joint Genome Institute is at the forefront of the nation's capabilities in biotechnology, with specific applicability to defense against bioterrorist attacks. ***(E. O. Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory)***

- ***Biotechnology Cluster/Vaccines, Anti-infectives and Diagnostics***: A major concentration of private sector scientific talent is present in the Bay Area on which to build a viable biodefense effort. The Bay Area, home to more than 575 bioscience companies, is the world's oldest and largest biotech cluster. The region's biotech industry is dominated by health-care firms focused on vaccines, therapeutics, diagnostics research, development and commercialization. Among these companies are nine working on vaccines, 18 developing anti-infectives (anti-viral, anti-bacterial and anti-fungal), and seven are perfecting diagnostics. (***Bay Area's 575 bioscience companies)***

- ***Chemical Agent Detection:*** Development of active neutron based techniques to detect presence of chemicals in cargo carried in trucks and in land and sea cargo containers. ***(Ancore Corp.)***

- ***Chemical and Biological Detection***: Research on a smart suite of physiological and environmental sensors for early detection of chemical and biological attacks. ***(NASA Ames Research Center)***

Defending Against Catastrophic Terrorism (cont.)

- ***Chemical and Biological Detection***. Microsensors for advanced detection of chemical and biological agents, using microchips as miniature chemical analysis laboratories for portable use by first responders, are now under development and testing with commercial partners. ***(Sandia National Laboratories)***

- ***Chemical and Biological Detection***: Remote bioagent detection systems provide advanced warning of a biological weapon threat using ultraviolet laser-induced flourescence to scan for and discriminate clouds of biological agents over a broad area. ***(Sandia National Laboratories)***

- ***Chemical and Biological Detection and Response Systems***: Technologies are currently deployed in the Washington Metro and in prototype form at San Francisco International Airport. ***(Sandia National Laboratories)***

- ***Chemical and Biological Warfare Defense:*** SRI's programs to detect, identify, neutralize and protect against chemical and biological agents in a variety of environments have been ongoing since 1978. Work ranges from basic research, applied science and engineering, database and signal processing, algorithm development, modeling, and concept feasibility demonstrations to hardware integration and field testing of systems. ***(SRI International)***

- ***Contamination of Buildings:*** Berkeley Lab's Environmental Energy Technologies Division investigates indoor and outdoor air fate and transport for the DOE and DTRA. Specifics of their work include modeling of transport of chemical and biological agents in buildings, design of sensor networks for buildings, and self-defending buildings. ***(E. O. Lawrence Berkeley National Laboratory)***

- ***Decontamination*:** Non-toxic foam to decontaminate facilities following an anthrax attack, licensed to two industrial firms and used for clean up of the Dirksen, Hart and Ford Buildings in Washington and contaminated US Postal Service sites. ***(Sandia National Laboratories)***

Defending Against Catastrophic Terrorism (cont.)

- ***DNA Signatures***: Lawrence Livermore's biodetection program is developing "gold standard" DNA signatures for top priority threat pathogens, and is working with the Centers for Disease Control to validate these signatures and distribute them to public health agencies nationwide. Livermore also works with the FBI, Department of Defense, and the intelligence community to develop detailed biological "fingerprints" and data to support forensic analysis for any act of biological terrorism. ***(Lawrence Livermore National laboratory)***

- ***Ensure Business Continuity:*** Oracle's solutions for redundant systems to ensure that organizations are fully prepared to detect, prevent and respond to unforeseen disruptions in system availability, whether the result of natural disasters, internal sabotage or terrorist threats and attacks. These include redundant hardware and software, synchronous and asynchronous off-site back-up, and online systems maintenance. ***(Oracle)***

- ***Environmental Characterization****:* Berkeley Lab's Center for Environmental Biotechnology researches all aspects of bacterial survival and use in the natural environment. Its studies of natural biological background can help distinguish man made attacks from natural outbreaks and studies of the survivability of bacterial and viral agents in the environment under various conditions. A particular research interest is the use of chemotaxis for mapping water-borne biochemical contaminants with bacteria. The Isotopic Geochemistry group can geo-locate materials from variations in isotopic abundances around the world. Berkeley Lab's geophysics and water resources experts can contribute to locating and characterizing underground facilities and to performing threat analysis on domestic water supplies respectively. ***(E. O. Lawrence Berkeley National Laboratory)***

- ***Genetic Analysis:*** Applied Biosystems provides DNA-based analysis kits for identification of microorganisms through sequencing of ribososmal DNA genes, and manufactures genetic analysis systems – the technology that made it possible for the rapid sequencing of the human genome by both the public and private sectors. ***(Applied Biosystems***)

- ***Nuclear Detection:*** Ancore developed active neutron based techniques to detect nuclear materials and device components in fully-loaded trucks and cargo containers. ***(Ancore Corp.)***

Defending Against Catastrophic Terrorism (cont.)

- ***Nuclear Detection***: LLNL's rapidly deployable, reconfigurable network of correlated radiation detectors and cameras can detect, characterize and track vehicle-transported radioactive or nuclear material moving at near-freeway speeds. Upon detecting an unknown source, the system warns security authorities, providing information about the detection, vehicle type, and location. ***(Lawrence Livermore National Laboratory)***

- ***Nuclear Incident Response***: Lawrence Livermore National Laboratory is a key participant in regional and national incident response teams, including a radiological assistance team for state and local agencies, a nuclear accident response group, and a joint technical operations team (which deals with nuclear terrorism and extortion threats). LLNL maintains a deployable response capability called HotSpot which can be transported to any locality needing radiological field support. ***(Lawrence Livermore National Laboratory)***

- ***Protein/Small Molecule Analysis:*** Applied Biosystems manufactures mass spectrometry systems for analysis proteins and small molecule metabolites – important for detecting how a substance is metabolized by the body. These systems can be used toward the identification of microorganisms as well as to measure the level toxins and/or drug quantities present in a sample. ***(Applied Biosystems)***

- ***Real Time Networking for Emergency Information Access/Distribution:*** Cenus Technologies' scalable networking enables agencies responsible for the detection, collection, analysis, and distribution of critical information from distributed sources and computational systems to coordinate and deliver instructions and treatment regimens globally with sufficient speed for a successful response to bioterrorism, and nuclear terrorist attacks. ***(Cenus Technologies)***

- ***Urban Defense***: The Biological Aerosol Sentry Information System (BASIS), used to monitor major events, combined with the Program for Response Options and Technology Enhancements for Chemical/Biological Terrorism (PROTECT) for high-value installations, serves as the basis for the "Defense of Cities" effort to detect and mitigate the consequences of a major chemical or biological attack. ***(Sandia National Laboratories, Lawrence Livermore National Laboratory, Los Alamos National Laboratory)***

Emergency Preparedness and Response

(We must prepare to minimize the damage and recover from any future terrorist attacks…We must plan, equip, train, and exercise many different response units to mobilize without warning for any emergency. – National Strategy for Homeland Security.)

- ***Biological Threat Response:*** Oracle's solution enables emergency department physicians to quickly assess and monitor disease outbreaks through a form indicating symptoms. The solution includes software in the database that analyzes data for aberrations that could indicate an unusual event. The database stores all information, which is easily accessible by designated and trained members of the hospital staff using only a browser in a hosted environment. ***(Oracle)***

- ***Command and Control Based on Geospatial Information Systems:*** SGI's advanced command and control systems is designed to get the right information to the right people at the right time – based on geospatial data processing in support of first responders. ***(Silicon Graphic Inc.)***

- ***Data Automation and Improved Case Management Process:*** Fully integrated Oracle E-Business Suite makes agencies' front-and-back-office systems work together seamlessly. The suite is the only complete set of business applications that enables agencies to cut costs across supply chain, financials, projects, human resources and business intelligence functions. ***(Oracle)***

- ***Emergency Preparedness:*** Research and development on emergency response training, emergency response tools, command and control systems for first responders, and robust, mobile, ad hoc wireless communication systems. ***(SRI International)***

- ***Emergency Preparedness and Response:*** The web-enabled Bio-Act platform provides users with a single, integrated point of access to observe real-time, geographically-based crisis situations, run predictive simulations, communicate instantly across diverse venues and collaborate on decision-making when faced with actual or potential public health and environmental safety disasters, including bio-attacks. ***(NASA Ames Research Center in partnership with California Menay Institute.)***

Emergency Preparedness and Response (cont.)

- ***Emergency Response Control Center:*** NASA Ames Research Center expertise in the development and application of information systems technologies for managing and controlling a complex logistics operations during emergency response includes; planning and scheduling of limited resources; human-centered systems techniques to analyze and help develop the threat response system; anomaly detection techniques to monitor process; and advanced human-computer interaction research to ensure the appropriate information is provided to the human operators. (**NASA Ames Research Center)**

- ***Emergency Response Information***: During an emergency, stress on critical information systems means more servers and resources must be brought into play rapidly. However, these systems must also be able to respond rapidly and be in the appropriate places for optimal response time. Cenus Technologies makes it possible to provision new systems on-the-fly to handle emerging needs for these systems without pre-positioning of hardware. ***(Cenus Technologies)***

- ***Emergency Response Transportation***: NASA Ames is developing advanced-technology for extremely short take-off and landing vehicles, enabling rapid deployment of people and resources to inaccessible or highly dangerous environments. ***(NASA Ames Research Center)***

- ***Facilities Documentation***: iPIX's capture and playback of 360-degree-by-360-degree Immersive Still Image technology, referred to as Virtual Tours, are used at The White House to provide "virtual visits" while protecting secured locations from potential threat. The Winter Olympics in Utah used 3000 iPIX images to provide first response law enforcement and safety personnel with complete views of every venue they were protecting. ***(iPIX)***

- ***Homeland Security Analysis***: Two national laboratory supercomputer centers are collaborating with private industry in database management, terascale computing, modeling and complex simulation software – technologies critical to homeland security analysis. ***(Advanced Micro Devices, Applied Materials, E. O. Lawrence Berkeley National Laboratory, IBM Almaden Research Center, Intel Corporation, Lawrence Livermore National Laboratory, Oracle Corporation, People Soft).***

- ***Homeland Security Analysis***: Supercomputing/computational biology research directed toward the development and use of bioinformatics tools and databases. ***(E. O. Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory).***

Emergency Preparedness and Response (cont.)

- ***IT System Recovery:*** Cenus Technologies' unique ability to provide load-balanced cluster support for high volume systems allows for distributed clusters with virtually local performance characteristics and rapid recovery if critical systems are lost. ***(Cenus Technologies)***

- ***IT System Recovery***: IBM's Business Continuity and Recovery Services leverages the innovative security research from IBM's worldwide research labs to assess and protect data, networks and systems and address intrusion detection, security assessment, incident management, firewall management, data backup and recovery and secure hosting. ***(IBM)***

- ***Meta-Data and Advanced Networking:*** Cenus Technologies' advanced next generation networking technologies enables the interconnection of distributed heterogeneous server networks on either an inter-agency and/or inter-autonomous system basis. This seamless routing platform enables these networks to leverage existing IT infrastructure investments and access, distribute, share and coordinate resources and information in real time, ultimately enabling the efficient distribution and coordination of meta-data. . ***(Cenus Technologies)***

- ***Mission Critical Communication Platform:*** Aspect's technologies enable the deployment, scheduling, and tracking of personnel based on communication, collaboration, and intelligence data. ***(Aspect)***

EXAMPLES OF BAY AREA RESEARCH UNIVERSITIES'
RESEARCH PROGRAMS
BENEFITING THE NATION'S SECURITY

STANFORD UNIVERSITY

Bio-X Program

The Stanford University's Bio-X program brings together engineering, physics, chemistry, and the information sciences with biology and medicine to foster new discoveries and inventions. The Stanford Schools of Engineering, Medicine, Humanities and Sciences, and Earth Sciences teamed up to form the new program. Bio-X will create opportunities for fundamental discoveries that emerge from new intellectual connections between traditionally separate disciplines.

Stanford scientists, including a number of Bio-X affiliates, have been heavily involved in homeland security issues. Bio-X holds great opportunities for discovering new ways to sense and control biological agents, for designing new defenses against pathogens, and for promoting healing with new techniques and new instruments.

The Bio-X program will be headquartered in the new Clark Center, that after its completion next June, will house about 700 people from all of the participating scientific fields and more than twenty university departments. This unprecedented gathering of specialists from different areas of science and technology will form a geographic focus for bringing together the much larger Stanford community of scientists and engineers working on interdisciplinary projects involving biology. Bio-X will also engage collaborators and industrial affiliates from outside Stanford.

Participants in the Bio-X program are expert in biorobotics, biosensors, genetic control systems, cell and tissue imaging, image processing, signal transduction, instrumentation and medical devices, bioengineering, machine-organism interfaces, bioinformatics, high-resolution single-molecule biophysics, genomics and gene regulation, protein-folding biochemistry and modeling, chemical biology, neuroscience, biomechanical simulation, network control modeling, and microbial ecology and systems. Stanford has the great advantage of having people in all these fields working together on one campus.

Other Stanford Programs Related to Homeland Security

Department of Electrical Engineering
Stanford's Department of Electrical Engineering has a research program underway focused on detecting biological agents, particularly the contamination of water. The ultimate research goal is to develop effective remote sensing systems that are portable and fully automatic, enabling the detection of a variety of known and novel biological agents before troops on the battlefield are exposed. The Department has achieved success in developing a prototype of a handheld biotector.

UC BERKELEY

CITRIS – Center for Information Technology Research in the Interest of Society
(CITRIS is a partnership of four UC campuses and the private sector, and is headquartered at UC Berkeley)

Centered at UC Berkeley, the Center for Information Technology Research in the Interest of Society (CITRIS) will sponsor research on problems that have a major impact on the economy and quality of life: conserving energy; education; saving lives, property, and productivity in the wake of disasters; boosting transportation efficiency; advancing diagnosis and treatment of disease; and expanding business growth. More than 100 faculty members in engineering, science, social science, and other disciplines at four UC campuses will collaborate with researchers at more than 20 supporting companies on CITRIS research.

Solutions to many of these problems have a common IT feature: at their core they depend on highly-distributed, reliable, and secure information systems that can evolve and adapt to radical changes in their environment, delivering information services that adapt to the people and organizations that need them. It is this feature that is at the heart of the initial research agenda for CITRIS. These systems,called Societal-scale Information Systems (SISs), must easily and naturally integrate devices, ranging from tiny sensors and actuators to hand-held information appliances, workstations, and room-sized cluster supercomputers.

Many CITRIS research projects have clear relevance to homeland defense. For example, sensor networks can be used to:

- Detect chemical and biological weapons;
- Allow “first responders” to get real-time information about the structural safety of a building and the location of building occupants; and
- Provide for physical security of bridges and other structures that might be subject to terrorist attack.

Other UC Berkeley Programs Related to Homeland Security

Bioengineering – Nano-Microscope

The most advanced scientific tool in development in UC Berkeley's Department of Bioengineering is a nanoscopic micro-CIA (microscale confocal imaging array). The future potential of the nano-microscope includes developing a hand-held biowarfare detection device that can identify the slightest amount of biological warfare agents, or transform a microchip into an entire genomics or proteomics laboratory-on-a-chip to study genes and proteins in the quest for new disease-fighting drugs, or enable physicians to monitor their patients' health (down to a cellular level) from any location.

Center for Infectious Disease and Preparedness

Under the sponsorship of the Centers for Disease Control and Prevention, the UC Berkeley School of Public Health will be establishing the UC Berkeley Center for Infectious Disease and Preparedness to provide training and support to public health and safety systems in California and Nevada as part of a national network of such centers. UC Berkeley will be collaborating with the California Menay Institute at NASA Ames Research Center in this endeavor.

Cyber-security

U. C. Berkeley is home to some of the world's leading researchers in cyber-security, with active research programs in wireless security, encryption, security for sensor networks and other power-constrained environments, intrusion detection, and defense of the Internet against worms, viruses, and distributed denial of service attacks. Berkeley also has significant expertise in the interdependencies between cyber-infrastructure and other elements of the critical infrastructure, such as air traffic control and the electric power grid.

Environmental Surveillance Technology

UC Berkeley's Department of Electrical Engineering and Computer Science has developed miniaturized environmental sensors combined with minature radio transmission technology ("Smart Dust") that can be spread widely over an area for surveillance and environmental monitoring.

The development of "Smart Dust" has exploited UCB programs in very large scale integrated circuits, ultra-small integrated circuits and micro-electromechanical devices.

UC Berkeley Programs (cont.)

Structural Engineering Research on Potential Target Infrastructure
UC Berkeley and other UC Campuses are working on the structural engineering of target buildings, bridges and other infrastructure. Their expertise ranges from retrofitting systems, the use of carbon overlays to resist seismic and blast forces and the design and testing of lightweight, advanced composite materials to improve blast resistance. In addition, UC can provide research on impact and penetration, projective impact and explosions, blasting of steel and reinforced concrete structures, and blast resistant structural design.

UC Berkeley researchers currently are looking at the steel columns from the World Trade Center in an effort to improve structural design and construction and to understand the affects of fire on future steel structures.

UC DAVIS

Multi-Disciplinary Public Health Initiative
With its research strengths in medicine, veterinary medicine, primate biology, agriculture, biotechnology, and other life sciences, UC Davis is pursuing a multi-disciplinary public health initiative that will respond to threats from new and re-emerging infectious diseases, and address the recently developing needs for bio-defense. This initiative will establish new facilities and take advantage of federal funding that is being made available to better protect the public's health and the nation's food supply. Projects include:

> ***Western National Center for Biodefense and Emerging Diseases****:* UC Davis, in collaboration with the Lawrence Livermore National Laboratory, other UC campuses, and the State Department of Health Services is seeking federal funds to construct a biosafety level 4 laboratory to study infectious diseases naturally present in western states, and respond to bioterrorist attacks involving agents such as anthrax or smallpox.
>
> ***Regional Centers of Excellence in Biodefense and Emerging Infectious Diseases****:* UC Davis is developing a proposal for a regional center under the program established by the National Institute of Allergy and Infectious Diseases. The centers will perform basic and clinical research on infectious agents, expand the pool of researchers and technical personnel trained in biodefense, create regional biodefense facilities and aid the region's response to biodefense emergencies.

UC Davis (cont.)

Contained Research Facility*:* This facility, the first of its kind in the U.S., will be a complex of greenhouses and laboratories where research on agricultural pests and plant diseases can be carried out in a highly-secure, biologically-contained environment.

Western Institute for Food Safety and Security*:* UC Davis, in partnership with the California Department of Food and Agriculture and the California Department of Health Services, will establish an institute to develop methods to identify, treat and prevent both natural and intentional food contamination.

National Surveillance Network and California Center for Preparedness*:* UC Davis is a key participant in a national surveillance network to protect crop plants and agricultural ecosystems, and is a participant in the California Center for Preparedness (CCP) with Lawrence Livermore National Laboratory, and the Governor's Office of Emergency Services. The CCP will coordinate operational and communications infrastructures needed to address large-scale medical and public health events; conduct training, education and distance learning programs for first responders; serve as a clearinghouse for basic and applied research into issues concerning biodefense and homeland security; and disseminate research in biodefense and homeland security into mainstream applications in human health, animal health and agriculture.

UC SAN FRANCISCO

QB3–Institute for Bioengineering, Biotechnology and Quantitative Biomedical Research
(Headquartered at UCSF Mission Bay Complex)

The central scientific goal of QB3 is to gain a predictive understanding of the behavior of the biological networks that implement the cellular program and thus determine the functions of cells and organisms. The result will be a modern physiology, obtained from molecular information and from bioinformatics and computational analysis. It will provide unique insights into the control systems that regulate phenotype and with unprecedented abilities to modify the behavior of these systems. These approaches will provide new avenues to address the problems related to homeland security.

The broad institutional goals of QB3 are: (i) to incorporate into biology new quantitative approaches drawn from engineering, physics, and mathematics; (ii) to train a new generation of students who are fluent in physics, math, engineering, chemistry, and the biology; (iii) to develop new technologies and bioinformatics tools appropriate to this collaborative enterprise; and (iv) in this new multidisciplinary atmosphere and with these new tools, to address some of the "grand challenges" of biology.

The Institute for Quantitative Biomedical Research is one of four California Institutes for Science and Innovation for promoting research and innovation. QB3 currently comprises about 90 faculty scientists, together with the research staffs of their laboratories, totaling perhaps 1000 scientists. It is anticipated that about 30 additional faculty will be added, with further expansion planned when the new facilities are completed in 2004–05.

UC SANTA CRUZ

UC Santa Cruz, noted for creating the software that assembled the first public working draft of the human genome, is now focusing on comparative genomics, a field critical to managing data regarding genes of pathogenic organisms.

Center for Biomolecular Science and Engineering (CBSE)

UC Santa Cruz' CBSE fosters research and education intended to meet the challenges of the post-genomic era resulting from completion of the Human Genome Project and the sequencing of model organisms. The revolutionary technologies that have recently been developed to gather and analyze genomic information will help to forge a new understanding of biology, with widespread applications to medicine, agriculture, ecology and emerging infectious diseases (of paramount importance to homeland security).

Other UC Programs Related to Homeland Security

Cybersecurity and Security of Airports and Public Places

Among the research areas being explored at the University of California are computer security, encryption, online secrecy, and monitoring of Internet communications, including pioneering work on "denial-of-service" attacks on the Web. UC Davis' Center for Digital Security uses physical and mathematical modeling to investigate threats to communications networks that might develop in the next five to ten years, and countermeasures to defend or "harden" networks.

UC researchers are involved in research and development related to technologies with the potential to improve security at airports and other public places. These include vision-based systems that range from face recognition systems and networks of omni-directional cameras running activity analysis algorithms that could be adapted for monitoring high-risk areas, to "augmented" reality systems for remote observation.

Appendices

APPENDIX A

BAY AREA CORPORATIONS WITH EXPERTISE RELATED TO HOMELAND SECURITY

(Companies Contributing to Paper)

Ancore Corporation (Santa Clara)
The TNA™ (Thermal Neutron Analysis) and PFNA (Pulsed Fast Neutron Analysis) non intrusive inspection technologies for detecting explosives, drugs, chemical warfare agents and nuclear and radiological weapons were pioneered and patented by Ancore Corporation. Based on identifying material specific signatures, rather than shapes or configuration of objects, these technologies automatically pinpoint the contraband in carry-on items, luggage, trucks and air and sea cargo containers.

Applied Biosystems (Foster City)
Applied Biosystems develops and markets instrument-based systems, reagents, software, and contract related services to the life science industry and research community. These technologies enable biological discoveries in life science research, pharmaceutical research and development, diagnostics, and agriculture. Applied Biosystems' broad portfolio of technologies, which include DNA sequencing, PCR, organic synthesis, chemiluminescence, mass spectrometry, and information management systems, enable genomics, proteomics, high throughput screening, and other molecular analyses.

ARACOR (Sunnyvale)
ARACOR's Eagle is the world's most powerful mobile and relocatable cargo inspection system. (Eagle's 6 MV x-ray source can penetrate at least 300 mm of steel.) ARACOR is developing enhanced Eagle capabilities for detecting explosives, nuclear materials and weapons of mass destruction. Department of Defense is sponsoring development of Inspection AIDE (Analyzer for Identification of Drugs and Explosives) – AIDE has been successfully tested, and ARACOR is awaiting funding to develop a prototype deployed on an Eagle. ARACOR also working with the Department of Energy's National Nuclear Security Administration to develop and deploy an inspection method for detecting weapons of mass destruction and special nuclear materials in cargo.

Bay Area Corporations (cont.)

ArcSight (Sunnyvale)
ArcSight is a leading provider of enterprise software solutions that enable large organizations to better manage their security function by integrating and optimizing the management of diverse sources of security-relevant information. By delivering complete aggregation, correlation, investigation, resolution and reporting – all within a single solution – ArcSight provides a coordinated infrastructure that maximizes security results while decreasing overall costs. ArcSight's 360° Intelligence utilizes asset-based correlation technology that allows enterprises to combine vulnerability assessment data and asset value with real time event data, improving their ability to detect true threats and attacks and react to them in real time.

Aspect (San Jose)
Aspect Communications Corporation is the leading provider of business communications solutions. Its Homeland Security solution is a mission critical communication platform that enables the gathering, analysis and dissemination of information that empowers people and systems to communicate with each other and share information. Aspect is the only company that provides the mission-critical software platform, development environment and applications that seamlessly integrate voice over IP (VoIP), traditional telephony, e-mail, voicemail, Web, fax and wireless business communications, while guaranteeing investment protection in a company's front-office, back office, Internet and telephony infrastructures.

Cenus Technologies (Scotts Valley)
Cenus Technologies is the leader in advanced, next generation Application Protocol (AP) routing, and is the first company to provide route optimization based on true Layer 7 (Application) based information. Cenus' core technology enables government agencies, enterprises, carriers and service providers to optimize their networks without the need to re-architect and in a manner that is non-disruptive to existing network routers, servers and other equipment and technologies. Cenus' application level routing layer is a platform for the interconnection of heterogeneous server networks either inter-agency, or inter-autonomous system, which enables the virtualization and resource aggregation of Internet-wide server networks. Cenus Technologies' platform provides breakthrough levels of performance, scalability, reliability, security, extensibility and redundancy.

Bay Area Corporations (cont.)

Cylink Corporation (Santa Clara)
Cylink develops, markets and supports a comprehensive portfolio of hardware and software security products for mission-critical private and public networks. Cylink's PrivaCy Manager provides advanced, policy-based, network security management. As a security solutions provider, Cylink partners with other network equipment vendors to provide and implement comprehensive network solutions. Cylink's key business solution focus areas are Homeland Security, including Critical Infrastructure Protection for Airports and First Responders, and Secure Storage Area Networks for Business Continuity and Disaster Recovery.

Hewlett-Packard (Palo Alto)
Hewlett-Packard, a leading global provider of computing Internet and Intranet solutions, offers complete end-to-end solutions covering critical infrastructure, security, disaster recovery, data warehousing, and server consolidation.

IBM Almaden Research Center (San Jose)
The Almaden Research Center is one of eight IBM Research facilities worldwide and a premier industrial research laboratory. At Almaden, some of the finest minds in the industry focus on basic and applied research in computer science, magnetic and optical storage technology, physical and materials science and technology, and scientific and technical application software. Several of the 500+ scientists and engineers focus directly on security related projects, and much of the more general work at the lab can be applied to IT security improvements.

IntelliVision (San Jose)
IntelliVision has powerful leading-edge technologies that provide video intelligence and automated monitoring solutions. Its patented and unique "self-learning" technologies analyze video in real-time, and automatically identify inconsistencies and abnormalities in an environment. The product modules (or Intelligent Vision Agents): (a) analyze and track abnormal or suspicious behavior; (b) track people or objects in a scene; (c) identify unattended baggage; (d) detect weapons; (e) identify people based on federal databases; (f) eliminate piggybacking/tailgating – a prime cause of failure of access control systems; (g) automate video based monitoring, perimeter, and night-time monitoring; and (h) custom detection based on conditions unique to situation.

Bay Area Corporations (cont.)

Intevac, Inc. (Santa Clara)
Intevac is developing revolutionary photonics products that address potentially large commercial and military markets. The Company also produces sophisticated manufacturing equipment used in the manufacture of high technology products and is leveraging its equipment expertise to enable cost-effective production of new photonics products. Intevac's photonics products are high-speed electro-optical devices that detect light with extraordinary sensitivity. The Company's proprietary technology makes possible products such as long-range target identification systems and video cameras with night vision capability. Intevac's equipment products are designed to deposit or modify highly engineered thin-films of material on a variety of substrates. These systems are designed for continuous high volume manufacturing of precision thin-film products such as flat panel displays, magnetic media for hard drives and low-light-level cameras.

InVision Technologies (Newark)
InVision Technologies develops, manufactures, markets and supports explosive detection systems based on advanced Computed Tomography (CT) technology for civil aviation security. InVision's wholly-owned subsidiary, Quantum Magnetics, develops weapons, narcotics, explosives and other detection systems based on quadrupole resonance and other proprietary magnetic sensing technologies.

iPIX (Internet Picture Corporation) (San Ramon)
iPIX patented technology delivers the most comprehensive imaging solutions on the market for use in safety planning, first response, detection, and deterrence. iPIX® holds 17 patents in its two main product lines: Immersive Imaging and Rimfire Imaging. Together, these industry-leading product lines provide an end-to-end infrastructure that captures, processes, hosts, and distributes rich media. iPIX mission-critical Immersive Imaging solutions provide the quickest and easiest way to capture the most data in a single, 360-degree-by-360-degree high-quality image. The 360-degree video solution provides high-quality immersive movies and enables viewers to independently determine their perspectives, while the NetCam solution provides digitally navigable 180-degree-by-360-degree images ideal for surveillance.

Bay Area Corporations (cont.)

Network Associates, Inc. (Santa Clara)
With headquarters in Santa Clara, Calif., Network Associates, Inc. is a leading supplier of network security and availability solutions. Network Associates is comprised of three product groups: McAfee Security, delivering world-class anti-virus and security products; Sniffer Technologies, a leader in network availability and system security; and Magic Solutions, a leader in innovative service management solutions.

Oracle Corporation (Redwood City)
For more than 25 years, Oracle Corporation has been a partner to the most important organizations, such as the U.S. Department of Defense, that rely on the company's technologies in protecting the most vital data assets. Oracle has already proved it delivers the necessary solutions to address any organization's homeland security needs through functional and technical expertise; infrastructure technology for information assurance, business continuity and collaboration; specific solutions tailored for the unique needs of the public sector; leadership in national initiatives; and industry-standardized technologies.

Recognition Systems, Inc – An Ingersoll Rand Business (Campbell)
Recognition Systems, Inc., (RSI) a division of Ingersoll-Rand, is the world's leading supplier of Biometric access control, time and attendance, and personal identification products. The Recognition Systems HandReaders verify a person's identity in less than one second, based on the unique size and shape of the hand. Installations include San Francisco International Airport, where since 1991, their 18,000 employees have used Hand Readers to gain access to the entire airfield. At Ben Gurion International Airport in Israel over two million passengers have used RSI technology to speed through immigration.

Sanctum, Inc. (Santa Clara)
Founded in 1997, Sanctum, Inc. is the recognized leader for Web application security solutions. Sanctum software solutions provide automatic enforcement of intended business processes, ensuring the protection of core information and data. By detecting and defending against any unauthorized behavior, Sanctum protects customers against malicious cybercriminal activity—from theft of intellectual property and customer data, to e-commerce fraud and Web site defacement—even if a site has unknown security holes or flaws. Sanctum's solutions complete an organization's security infrastructure, assure regulatory compliance and create sustainable ROI. Sanctum's customers include industry leaders in finance, retailing, healthcare, government and telecommunications.

Bay Area Corporations (cont.)

Silicon Graphics Inc.(SGI) (Mountain View)
Immersive Visualization and Visual Area Networking. Silicon Graphics, the world leader in computer graphics systems technologies, has developed a variety of visualization technologies ideally suited to allow officials to rapidly assimilate the growing and diverse amounts of data being collected regarding security threats and turn this data into information in support of rapid decision making. With Visual Area Networking, the right visual information can be sent to the right person at the right time.

VeriSign, Inc. (Mountain View)
VeriSign is the leading provider of digital trust services enabling commerce and communication with confidence. VeriSign's digital trust services create a trusted environment through four core offerings – Web presence services, security services, payment services, and telecommunications services – powered by a global infrastructure that manages more than five billion network connections and transactions a day. VeriSign provides exceptional cybersecurity services through its Managed Security Services, Managed DNS and Managed PKI services.

APPENDIX B

BAY AREA'S LEADING RESEARCH UNIVERSITIES

Stanford University
Stanford is a premier research university, with programs exploring the frontiers of knowledge in physics, chemistry, biology, medicine, engineering, earth sciences, math, computational sciences and other fields. Founded more than 100 years ago, Stanford has 14,000 undergraduate and graduate students and 10,000 faculty and staff members, all of whom help the university fulfill its mission of teaching, learning and research.

University of California, Berkeley
The University of California, Berkeley, founded in 1868, enjoys an international reputation for excellence in research. Its achievements are reflected in its extraordinary impact on the Bay Area, the State of California, the nation and the world in a broad range of areas from biotechnology to computer technologies. Its five colleges and nine professional schools enroll over 33,000 students in more than 100 academic departments and interdepartmental groups. According to the National Research Council, Berkeley ranks first nationally in the number of graduate programs in the top 10 in their fields.

University of California, Davis
The University of California, Davis, contains three Colleges, five Schools and one Division, including the California Regional Primate Research Center. UC Davis is particularly noted for its strengths in agricultural, biological, biotechnological, environmental, human health and veterinary sciences. Its School of Veterinary Medicine is the largest in the nation and is ranked first in receiving NIH funds to support basic biomedical research.

University of California, San Francisco
The University of California, San Francisco (UCSF), is one of the world's premier institutions in the health sciences – distinguished for biomedical research, education of health care professionals, and advancement of new techniques to diagnose and treat disease. UCSF is the only campus in the 10-campus UC system devoted exclusively to the health sciences. Based on the importance of its research achievements, UCSF continues to be one of the prime recipients of national research funding.

University of California, Santa Cruz
Enrolling students since 1965, UC Santa Cruz emphasizes undergraduate and graduate education enhanced by leading-edge research. Particularly distinguished are programs related to the Jack Baskin School of Engineering, the Center for Ocean Health, the National Center for Adaptive Optics, and the Santa Cruz Institute for Particle Physics. UC Santa Cruz is ranked No. 1 for research impact in astrophysics among the top 100 federally funded U.S. universities, and No. 2 worldwide for research impact in the physical sciences.

APPENDIX C

BAY AREA'S NATIONAL RESEARCH LABORATORIES AND INDEPENDENT RESEARCH INSTITUTIONS

NATIONAL RESEARCH LABORATORIES

NASA Ames Research Center

Ames Research Center, one of ten field installations of the National Aeronautics and Space Administration (NASA), plays a critical role in virtually all NASA missions in support of America's space and aeronautics program. As a NASA and world leader in information technology research, Ames conducts the critical R&D and develops the enabling technologies that makes those missions possible. Currently, Ames employs over 800 people performing basic and applied research in a diverse range of information technology areas and has one of the most diverse research environments for information technology in the country. The development in working with the FAA and the development of integrated systems that have been deployed will enable NASA Ames to play a critical role in facilitating the integration of technology providers into a larger, integrated vision. Ames also is a NASA leader in astrobiology, nanotechnology, fundamental space biology, supercomputing, biotechnology, aerospace and thermal systems, air traffic management and human factors research.

Ernest Orlando Lawrence Berkeley National Laboratory (Berkeley Lab)

Berkeley Lab, an unclassified Department of Energy facility managed by the University of California, has the core mission to provide national scientific leadership and technological innovation, including performing leading multi-disciplinary research in the energy sciences, high performance computing, environment, advanced materials, nanotechnology, physics, and biosciences.

Lawrence Livermore National Laboratory (LLNL)

LLNL is a Department of Energy national laboratory managed by the University of California. Its mission is to apply science and technology in the national interest, with a focus on stockpile stewardship, nonproliferation and counterterrorism, energy and environment, and bioscience.

National Laboratories (cont.)

Sandia National Laboratories
Sandia National Laboratories is the largest federal research and development laboratory in the U.S. With major facilities in Albuquerque, NM, Livermore, CA, Tonopah, NV and Kauai, HI, Sandia's principal missions are in national defense, homeland security, energy technologies, and support to the Department of Defense and the intelligence community. Sandia pursues "science with the mission in mind" and has strong capabilities in the physical, engineering, and computational sciences and most recently in biotechnology. Sandia is a National Nuclear Security Administration lab managed by Lockheed Martin Corp.

Stanford Linear Accelerator Center (SLAC)
The Stanford Linear Accelerator Center (SLAC) is a national laboratory operated by Stanford University on behalf of the U.S. Department of Energy. Its mission is to design, construct and operate state-of-the-art electron accelerators and related experimental facilities for use in high energy physics and synchrotron radiation research.

INDEPENDENT RESEARCH INSTITUTIONS

Buck Institute for Age Research
The Buck Institute for Age Research, a nonprofit, independent research institute completed phase one of construction and opened its research facility and first laboratory in 1999. When completed, the Institute, located on a 488-acre site in Novato, Marin County, and designed by the renowned architect, I. M. Pei, will consist of four laboratories and a support and educational facility covering 355,000 square feet. The primary scientific focus of the Institute will be the major neurodegenerative diseases which most affect persons of advanced age.

Electric Power Research Institute (EPRI)
The Electric Power Research Institute (EPRI), headquartered in Palo Alto, California, was established in 1973 as a non-profit center for public interest energy and environmental research. EPRI's collaborative science and technology development program now spans nearly every area of power generation, delivery and use. More than 1,000 energy organizations and public institutions in 40 countries draw on EPRI's global network of technical and business expertise.

Monterey Bay Aquarium Research Institute (MBARI)
The Monterey Bay Aquarium Research Institute (MBARI) was founded in 1987 by David Packard. The mission of MBARI is to achieve and maintain a position as a world center for advanced research and education in ocean science and technology, and to do so through the development of better instruments, systems, and methods for scientific research in the deep waters of the ocean.

SRI International
SRI International is one of the world's leading independent, non-profit research and technology development organizations. Founded as the Stanford Research Institute in 1946, SRI is known for its innovations in information technology, communications, engineering, pharmaceuticals, biotechnology, chemistry, physics, and for research in the public policy areas of education, health, and economic development. For decades SRI has conducted basic research and development in a range of areas that support the nation's defense and intelligence needs, including new energy sources, advanced materials, signal processing, and innovative tactical training systems. SRI has pioneered network security, intrusion detection, information extraction, planning and reasoning systems, image processing, the next generation of computer science, artificial intelligence, systems design, speech recognition, and other forms of human-computer interaction.

APPENDIX D

BAY AREA'S NEW RESEARCH COMPLEXES

Mission Bay and UCSF Mission Bay (San Francisco)
UC San Francisco's new 43-acre life sciences campus will be a premier center of scientific discovery and for teaching and research into improving human health. UCSF Mission Bay, located near downtown San Francisco is the focal point of the 303-acre Mission Bay biotechnology development by the Catellus Development Corporation.

The new campus is an addition to a network of UCSF locations. The Mission Bay campus will allow UCSF to double its research space, speed the pace of biomedical discovery, and help prepare a new generation of students.

The first building at UCSF Mission Bay will open in January 2003 when 900 faculty and staff move into Genentech Hall. It will house programs in structural and chemical biology, as well as the Molecular Design Institute and the Center for Advanced Technology. Another research facility is scheduled for occupancy in fall of 2003 for programs in neuroscience, developmental biology, and genetics. In 2004, a Community Center and headquarters building for the California Institute for Quantitative Biomedical Research (QB3) are expected to be completed. The campus will continue to be built in phases over the next 15 years, leading to 20 structures and a population of 9,100 at full build-out projected for 2020.

UCSF Mission Bay is the anchor of the greater Mission Bay project. The overall project is expected to include a technology zone of biotechnology, applied life science, and pharmaceutical businesses surrounding the UCSF campus.

New Research Complexes (cont.)

NASA Research Park (Moffett Field, CA)
The 213-acre NASA Research Park (NRP) will be a dynamic world-class shared-use campus developed by NASA Ames Research Center in collaboration with academia, industry and nonprofit organizations with shared goals in support of NASA's mission. Within the NRP, new laboratories, offices, classrooms, auditoriums, museums, a training and conference center, open space, a burrowing owl preserve and limited retail facilities are being planned.

Major partners currently involved in the NRP endeavor include: The University of California, Santa Cruz; Carnegie Mellon University; San Jose State University; Foothill-De Anza Community College District; California Air and Space; National Association for Equal Opportunity in Higher Education (NAFEO); Women In Science, Technology, Engineering, and Mathematics (WiSTEM); Girvan Institute of Technology and the Space Technology Center.

By pursuing strategic collaborative research partnerships within the disciplines of astrobiology, biotechnology, information technology and nanotechnology, NASA Ames Research Center will be even better positioned to provide research leadership well into the 21st century.

UCSC Silicon Valley Center
Located in the NASA Research Park, the Silicon Valley Center is operated on behalf of the UC System by its Santa Cruz Campus. Its mission is to develop collaborative programs with NASA Ames, serve as a portal into the research capabilities of the UC System for NASA's research programs and become, over time, a major Ames' source of outside research expertise. In addition, the Silicon Valley Center serves as a planing center for the development of a proposed 2,000 student educational and research center in the NASA Research Park directly focused on the needs of Silicon Valley.

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