



We want to tell you about an extraordinary company:

- One with exceptionally talented people and core competencies critical to meeting 21st century requirements for America's defense and homeland security.
- One that over the last decade has repositioned itself as the nation's 2nd largest defense enterprise, with approximately 120,000 employees and anticipated 2003 revenues of \$25 billion – \$26 billion.
- One that has transformed itself from an aircraft manufacturer into a leading provider of information-age warfighting systems used in all environments from beneath the sea to outer space.

We want to tell you about Northrop Grumman Corporation.

Northrop Grumman's strategy since the early 1990s has been guided by our vision of future wars and conflicts. Following the end of the Cold War, we began to consider what technological advances might alter the ways militaries would fight in the twenty-first century. We anticipated that innovations in surveillance, computerized battle management and precision strike would bring a revolution in military affairs.

We repositioned our company to support these changes and embarked on a program of acquisitions and internal growth that has created the new Northrop Grumman Corporation.

Today, as the following overview of our operating sectors makes clear, Northrop Grumman delivers the products and services most prized by our military customers. Northrop Grumman is the premier provider of sensors and electronic warfare systems. We're a major producer of manned and unmanned aircraft and other platforms and systems for surveillance, targeting and precision strike, as well as a leading systems integrator. Northrop Grumman is the world's largest shipbuilder, with expertise in submarines and surface ships, both nuclear and non-nuclear. And with TRW, we are now the federal government's largest provider of information technology and a leading contractor for military space and missile defense programs that are of the highest priority for our nation's security.

At Northrop Grumman, we are committed to the highest standards of business conduct, and we have proud traditions of innovation, technical excellence and responsiveness to the needs of our customers.

We hope you will see our company come alive in the pages that follow -- and sense some of the excitement we feel about our competitive strengths and bright prospects.

Kent Kresa, *Chairman and CEO*

Ronald Sugar, *President and COO*

Northrop Grumman is a leading defense enterprise. From its headquarters in Los Angeles, Calif., Northrop Grumman operates in all 50 states and 25 countries. Northrop Grumman operates as seven sectors: Electronic Systems, headquartered in Baltimore, Md.; Information Technology, headquartered in Herndon, Va.; Mission Systems, headquartered in Reston, Va.; Integrated Systems, headquartered in El Segundo, Calif.; Newport News, headquartered in Newport News, Va.; Ship Systems, headquartered in Pascagoula, Miss. and Space Technology, headquartered in Redondo Beach, Calif.

Electronic Systems

Northrop Grumman's Electronic Systems sector, headquartered in Baltimore, is a world leader in the design, development and manufacture of advanced electronics and systems for military, civil, and commercial use. Electronic Systems provides airborne radar systems, secondary surveillance systems, inertial navigation systems and sensors, electronic warfare systems, precision weapons, air traffic control systems, air defense systems, communications systems, space systems, marine systems, oceanic and naval systems, integrated avionics systems, rugged display systems and computers, logistics systems, and automation and information systems. Electronic Systems has 51 major operations worldwide, 19 international offices and approximately 25,000 employees.

Fire Control Radars

Providing fire control radars for fighter aircraft of the U.S. and allied nations has been one of the company's most successful business areas. Northrop Grumman has produced more than 6,000 AN/APG-66 and AN/APG-68 fire control radars for F-16 aircraft since 1976 and continues to upgrade these radars. The AN/APG-66 is presently on 16 airborne platforms and is deployed in 21 countries. Through the F-16A/B midlife update, the AN/APG-66 now offers a newly developed signal data processor, higher power, faster data throughput, greater sensitivity and wider dynamic range, plus 250-hour reliability.

The AN/APG-66 is also baseline equipment on the British Aerospace Hawk 200 light attack aircraft. The AN/APG-68 radar on the F-16C/D is the first – and to date the only – multimode, high-performance fighter radar to demonstrate triple-digit reliability, with more than 300 hours mean time between maintenance actions. The radar is operated by the air forces of seven countries. A midlife update version, called the APG-68(V)9, has recently entered development and will provide greater air-to-air detection ranges and synthetic aperture radar ground-imaging capability for precision targeting.

The company will provide the advanced agile beam fire control radar and the internal forward-looking infrared and targeting system for 80 Lockheed Martin F-16 Block 60 aircraft for the United Arab Emirates (UAE). In addition, Northrop Grumman's Integrated Electronic Warfare System has been selected by the UAE as the EW suite for the F-16 Desert Falcon fleet. Included in the EW contract is the Combined Intermediate Automatic Test

Equipment program. The value of the company's participation on the F-16 Block 60 program is expected to exceed \$1 billion, depending on customer requirements and options.

A Northrop Grumman-led joint venture with the Raytheon Company has been developing the F-22 radar system for more than 10 years. In addition to sharing hardware fabrication and assembly with Raytheon, Northrop Grumman is responsible for the overall design of the AN/APG-77 radar system, including the control and signal processing software. Northrop Grumman also has responsibility for radar systems integration and test activities. The main component of the radar sensor is a highly reliable Active Electronically Scanned Array (AESA), which provides the rapid beam agility, low radar cross section and target detection capability that enables the air dominance fighter to achieve its first look, first shoot, first kill capability.



In addition, Northrop Grumman is providing the advanced AESA radar for the Lockheed Martin Joint Strike Fighter aircraft. In a joint venture with Lockheed Martin Missiles and Fire Control of Orlando, Fla., the company is also supplying the JSF with both an electro-optical distributed aperture system, which will provide the pilot with a full sphere of situational awareness, and an electro-optical targeting system.



In another joint venture with Lockheed Martin, Northrop Grumman has developed and produced the Longbow AN/APG-78 multimode radar and the AGM-114L Hellfire fire-and-forget missile for the AH-64D Longbow Apache helicopter. The Longbow system provides a fast-reaction, low-exposure, extremely accurate weapon system for diverse surveillance and attack missions during the day, night, adverse weather and low-visibility conditions. The U.S. Army successfully fielded the Longbow system in May 1998. The United Kingdom and Singapore have also selected the Longbow Apache to fulfill their reconnaissance/attack helicopter requirement. A smaller, lightweight Longbow radar variant is being developed for the

RAH-66 Comanche helicopter, for which Northrop Grumman is also providing the mission computer cluster.

AWACS Radar System

The AN/APY-1/-2 Surveillance Radar System provides the downlook surveillance capability for the E-3 Airborne Warning and Control System (AWACS). AWACS is designed to detect and track both enemy and friendly aircraft throughout a large volume of airspace. The radar provides full, long-range surveillance of high- or low-flying

aircraft during all kinds of weather and above all kinds of terrain. The AN/APY-1/-2 can look down from an altitude of 30,000 feet to scan as far ahead as 245 miles (400 kilometers), assessing both enemy and friendly resources.

Electronic Systems is presently under contract to produce the Radar System Improvement Program (RSIP) for the Air Force. In 2000, the sector completed the delivery and retrofit of the RSIP modification to NATO and the United Kingdom.

This RSIP contract includes the production of the associated RSIP kit hardware/software as well as installation and checkout activities. With the RSIP modification, the AWACS radar system will maintain its operational capability against the growing threat from smaller radar cross section targets, cruise missiles and electronic countermeasures. Reliability, maintainability and the man-machine interface are also being improved. RSIP will permit the AWACS radar system, developed during the early 1970s, to continue as a vital deterrent well into the 21st century.

MESA Radar



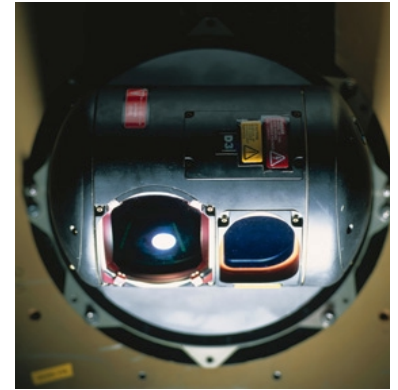
Advances in technology have caused a revolution in the capabilities and flexibility of airborne surveillance systems and sensors used in Airborne Early Warning & Control (AEW&C) systems. Developments in distributed transmitters, commercial off-the-shelf processing and high-performance antenna arrays have enabled the Electronic Systems' Multirole Electronically Scanned Array (MESA) radar to be cost-effectively applied to an increased gross weight variant of the Boeing 737-700 series aircraft. The MESA radar provides air—to-air coverage, air-to-surface coverage, integrated identification friend or foe, special track beams and focused sector operation.

The Northrop Grumman MESA system leverages the experience gained from AWACS in an all-new radar design. As part of a team led by The Boeing Company, Northrop Grumman will supply its MESA radar for Australia's AEW&C Project Wedgetail program. The contract is valued at more than \$1 billion (US). The team will develop and provide four 737 AEW&C aircraft to the Royal Australian Air Force. More recently, Turkey has signed a \$1 billion contract, also for four of the aircraft.

Electronic Countermeasures

Electronic defense systems, including warning and countermeasures, protect pilots and their aircraft by warning crews of threats or disrupting enemy radar/infrared and hostile weapons systems. Northrop Grumman is a leading supplier of radar warning receivers and airborne electronic warning and countermeasures systems.

The AN/AAR-54(V) Passive Missile Approach Warning System is an affordable, highly advanced, compact and lightweight missile warning system that can be integrated into many types of airborne or ground-based platforms including the Northrop Grumman NEMESIS AN/AAQ-24(V) Directional Infrared Countermeasures (DIRCM) system. The NEMESIS is the only IR countermeasures system in production that protects large, fixed-wing transports and small, rotary-wing aircraft from the infrared missile threat.



The company was recently awarded a contract by the U.S. Air Force for the Large Aircraft Infrared Countermeasures (LAIRCM) system. The Air Force plans to install the LAIRCM equipment on a total of 20 Air Force C-130 and C-17 transport aircraft. The system consists of the various elements of the NEMESIS plus an additional laser.

The AN/APR-39A(V)2 is a lightweight, low-cost radar warning receiver and electronic warfare management system for combat helicopters and large-body aircraft. The system is currently installed on the AH-1, UH-1, CH-47, NH-53, AH-64, Cougar, BH-3, HH-60, C-130 and MV-22 aircraft. Over 500 systems have been delivered to date.

Northrop Grumman has delivered more than 1,750 internal countermeasures sets, designated AN/ALQ-135, for the Air Force F-15 fighter. The system is also used by Saudi Arabia on its F-15s. Production continues with an ongoing reliability and capability enhancement program that will keep the AN/ALQ-135 protecting the F-15 well into this century.

Northrop Grumman also manufactures the internal AN/ALQ-162 systems for the U.S. Navy, Air Force, Army, and Marine Corps and the air forces of Canada, Denmark, Kuwait, Italy and Spain.



The company has delivered more than 1,350 AN/ALQ-131 self-protection countermeasures pods to the Air Force and nine allied nations. The AN/ALQ-131 is certified for use on the F-16 and six other aircraft and was undefeated in 8,000 sorties during Operation Desert Storm.

The internal AN/ALQ-165 Airborne Self-Protection Jammer (ASPJ) is now in production for the F/A-18 Hornet aircraft for Finland and Switzerland and is in use on Marine Corps and Navy F/A-18C/D aircraft for Balkan operations. Additionally, ASPJ is carried by Korean F-16s and is also available for use on other platforms.

Air Traffic Management

A world leader in air traffic management systems, Northrop Grumman has produced more than 475 civilian air traffic control systems for surveillance of airborne and airport surface traffic in 23 countries. Northrop Grumman offers complete turnkey airspace management systems that integrate primary and secondary radars with data processing and display systems and communications equipment.



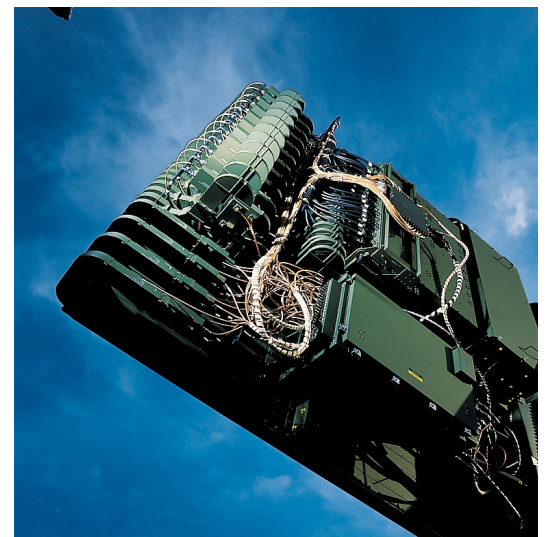
Under contract with the U.S. Federal Aviation Administration (FAA), Northrop Grumman delivered 134 ASR-9 airport surveillance radars. The company's newest solid-state primary surveillance radar system is the ASR-12, which evolved from the ASR-9 and is now operational in Mexico, Peru and El Salvador. Nine additional systems are scheduled for delivery to three other countries.

The joint-use ARSR-4 air route surveillance radar monitors en route air traffic and is operational at 44 sites in the United States to support FAA and continental U.S. air defense requirements.

Forty Airport Surface Detection Equipment surface radar systems track aircraft moving along the ground at U.S. airports with high traffic density and are currently being upgraded with an Airport Movement Area Safety System. A variant of this system has been installed in Singapore. One hundred forty-eight FAA Mode S secondary surveillance radars provide U.S. controllers with an integral data-link capability in addition to long-range surveillance. The Monopulse Secondary Surveillance Radar offers Mode S upgradeability for international air traffic control customers. Thirty-one systems have been produced for 15 international customers.

Air Defense

The company is a leading provider of tactical military radars and countrywide air defense systems. More than 420 systems have been delivered to 35 countries worldwide. The AN/TPS-75 is the Air Force's standard long-range, three-dimensional tactical surveillance radar. Fifty-seven are operational in U.S. inventory. The AN/TPS-70 is the primary sensor in the Air Force Caribbean Basin Radar Network and is in service in 17 countries worldwide. Recent improvements to the AN/TPS-70 include a solid-state transmitter and commercial off-the-shelf (COTS) processing to improve reliability. More than 120 AN/TPS-63 L-band gapfiller radars are operational in 11 countries in both ground-based and aerostat platforms. The AN/FPS-130 is the latest addition to the family of long-range, 3-D surveillance radars. Three of these all-solid-state radars have been



delivered to Thailand as part of the countrywide Royal Thai Air Defense System contract awarded to Northrop Grumman. Similar air defense systems have been installed in Egypt, Morocco, Mexico, Jordan and other Middle Eastern and North African countries.

The company is now expanding its product line to include command, control, communications, computers, intelligence, surveillance and reconnaissance (C⁴ISR) systems that integrate a broad range of airborne and ground-based sensors with command, control, intelligence and reconnaissance capability.

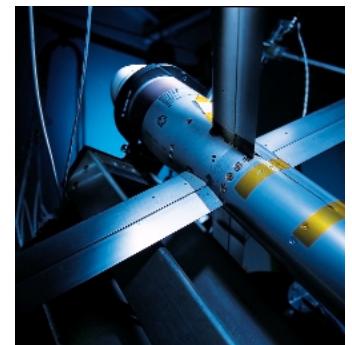
California Microwave Systems

Northrop Grumman enhanced its existing strengths in airborne surveillance systems and ground-based communications when it completed the acquisition in 1999 of the Information Systems Division of California Microwave Inc.

California Microwave Systems specializes in airborne reconnaissance and surveillance systems, government ground-based satellite communications and mission-planning systems. Customers include the U.S. military services, other U.S. government agencies and international defense organizations.

Bat Anti-armor Submunition

Northrop Grumman recently began low-rate initial production of the Army's Bat, a brilliant self-guided submunition that uses a combination of acoustic and infrared sensors to autonomously find, attack and destroy moving missile launchers and other armored vehicles deep in enemy territory, day or night. Compatible with multiple missile and aircraft delivery vehicles, including UAVs, Bat is dispensed over a target to selectively attack and destroy it.



Marine and Naval Systems

Northrop Grumman's Navy-related businesses provide systems and sensors that enhance the capabilities of submarines, surface ships, and naval aircraft platforms.

Oceanic and Naval Systems (O&NS), based in Annapolis, Md., is a world leader in sophisticated undersea systems. It develops, builds, tests, and supports systems in seven areas: mine warfare, unmanned undersea vehicles/weapons/targets, undersea sensors, manned submersibles, ASW sonar and surface ship radars.

A leader in towed and autonomous undersea vehicles, O&NS has delivered over 30 AN/AQS-14 helicopter-towed, acoustic mine detection systems. These systems are now being upgraded with increased resolution, side-looking sonar and laser-line scanning for optical identification of targets.

Unmanned undersea vehicles capable of launch and recovery from multiple platforms are being equipped with reconfigurable payloads. These payloads support multiple missions such as maritime surveillance, undersea mine detection and surface data collection for Intelligence, Surveillance and Reconnaissance (ISR).



Northrop Grumman designed, developed and built the Advanced SEAL Delivery System, the first in a new class of dry submersibles that provide greater range, speed and comfort for special operations forces on missions in high-threat environments. Boat no. 1 began open ocean testing by the Navy in August 2001.

The Marine Systems business in Sunnyvale, Calif., has been a leader in producing marine machinery for more than 80 years. Today, Northrop Grumman is the sole provider of propulsion systems and turbine generator sets to the Navy submarine fleet, where reliability and quiet operation are essential. Northrop Grumman Marine Systems was recently selected to develop and supply the Main Turbine Generators (MTG) for the next generation aircraft carriers (CVNX). These are the largest MTGs in the world.

In addition, Northrop Grumman Marine Systems produces a full line of naval propulsion, power generation and power distribution equipment for naval surface combatants and submarines. The business unit offers a complete line of power line conditioners, solid state automatic bus transfer modules, static frequency converters, machinery control systems and advanced motor drives.

The prime power product line includes the fuel-efficient intercooled recuperated gas turbine, the WR-21, which is completing development in time for the DD(X) program. A team led by Northrop Grumman and Rolls-Royce has been selected to supply WR-21 gas turbines for the UK's Type 45 class destroyer.

The Sunnyvale, Calif.-based unit is also a leader in the development and production of missile launching and handling equipment for submarine and land-based weapon systems. This includes four generations of the Fleet Ballistic Missile Launching System, the Tomahawk Capsule Launching System, and Ground Missile Defense launchers. Northrop Grumman recently announced the addition of the Navy's Electromagnetic Aircraft Launching System to its product line, which is the next-generation catapult currently under development for the CVNX-1, the Navy's advanced carrier program.

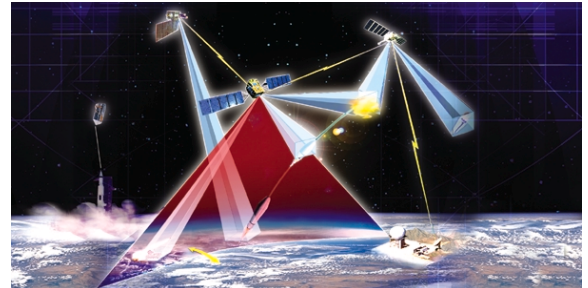
The Sperry Marine business unit, with headquarters in Charlottesville, Va., provides smart navigation and ship control solutions for the commercial marine industry and international navies. Sperry Marine is the leading supplier of advanced integrated bridge systems and ring-laser gyro inertial navigation systems for the Navy surface and submarine fleet, Sperry Marine manufactures and markets products under the Sperry Marine, Decca and C.

Plath brand names and provides customer service and support through offices in 19 countries and authorized service depots in 250 locations worldwide.

Space Systems

For more than 30 years, the Northrop Grumman Space Systems business unit has supplied the sensors for scores of space-based missions, including the Gemini rendezvous radar, the cloud imager for the Defense Meteorological Satellite Program, the infrared sensor for the Defense Support Program, and the multispectral/hyperspectral cameras for Orb View-3 and Orb View-4 commercial remote sensing program.

Northrop Grumman supplies the infrared payload, electronics and ground processing for the mission data processor to the Lockheed Martin-led SBIRS High team. SBIRS High is a series of high earth-orbiting satellites whose sensitive infrared sensors can detect the launch of strategic and theater ballistic missiles from space and pass the time and location of launch to battlefield commanders.



SBIRS High works in conjunction with SBIRS Low now known as the Space Tracking & Surveillance System (ST&SS), a constellation of missile tracking satellites capable of performing missile defense, missile tracking, technical intelligence and battlespace characterization. The company's Space Technology sector is leading the ST&SS industry team. The sector will also contribute to the systems engineering, ground segment and algorithms. In addition, Northrop Grumman will be one of two competitors for the sensor payload and ground station data processing program.

In October 2001, Northrop Grumman completed the acquisition of the Electronics and Information Systems Group of Aerojet-General. The EIS business unit provides space-borne sensing for early warning systems, weather and ground systems that process C⁴ISR data from space-based platforms for high-priority U.S. government national security programs.

Electro-Optical/Infrared Programs

Northrop Grumman produces high-performance, second-generation, forward-looking infrared systems, lasers and laser-based electro-optical systems for military applications. These systems are currently being used for precision strike targeting, reconnaissance and maritime patrol missions and electronic warfare.

The company is producing the RISTA II reconnaissance camera for Danish F-16A/B and Army UAV aircraft. Deliveries have also begun for the Night Hunter electro-optical surveillance and detection system for British Nimrod maritime patrol aircraft. Northrop Grumman is nearing completion of a highly successful, 15-year

production run for the mast-mounted site surveillance and laser designator system for the Army OH-58D Kiowa Warrior Scout helicopters.

LITENING II, a laser target designator and navigation pod, combines night or day targeting and navigation capabilities in a single, low-cost, high-performance pod. It enables fighter aircraft to detect and identify ground targets for highly accurate delivery of both conventional and precision-guided weapons. The LITENING system is currently installed on the F-16 Block 30 and the AV-8-B Harrier.

Other Land Combat Systems

Northrop Grumman produces the Army's Vehicular Intercommunication System, which will be installed on every tank, Bradley fighting vehicle, tracked howitzer and mobile command unit. The Army has installed more than 9,000 systems to date, with another 1,200 on order. Saudi Arabia and Kuwait have installed more than 1,000 systems, and the two nations have an additional 1,100 systems on order. The Integrated Family of Test Equipment (IFTE), produced for the Army, can be reconfigured to check out almost any weapon in the Army's inventory. IFTE also is in use with the Marine Corps and the National Guard as well as the armed forces of South Korea and Germany.

Northrop Grumman supplies night vision products – primarily goggles, image intensifier tubes, weapon sights, and aviation systems – to the U.S. armed forces and their allies around the world. These products played a key role in the Persian Gulf War, where they demonstrated dramatically the tactical advantage of night warfare. More recently, the company has been awarded substantial contracts from the U.S. Special Operations Command and Marine Corps for its AN/PVS-17 Miniature Night Vision System with enhanced image intensifier, a product that substantially increases the combat soldier's lethality in low-light conditions while setting a new standard for weight reduction.

Automation & Information Systems (A&IS)



Northrop Grumman A&IS provides advanced integrated systems solutions for package and parcel sorting and delivery and material handling applications to U.S. governmental and industrial customers.

A&IS has been providing the U.S. Postal Service with products and services for more than 11 years, leveraging its engineering and program management strengths to provide innovative technical solutions that improve productivity, lower operating costs and help achieve the highest levels of customer satisfaction. Northrop Grumman's customer base also includes several of the world's top overnight couriers.

Since its acquisition in 2000 of Solystic S.A., a French-based designer and integrator of high-speed sorting systems, Northrop Grumman has broadened its position as a leading worldwide supplier of advanced, automated postal and material handling equipment.

Navigation Systems

Northrop Grumman's Navigation Systems Division (NSD) provides situational awareness utilizing a wide range of products and related technologies. NSD's inertial navigation systems provide location and direction information for numerous military and commercial aircraft, helicopters, tactical missiles, ICBMs and satellites. They are also used for shipboard navigation, mobile surveying, land navigation and fire control systems. NSD builds a range of secondary surveillance radars that provide identification of cooperative platforms. Undersea, it applies its unique fiber optic lightweight, wide-aperture sensor array technology to the *Virginia*-class submarine for acoustic sensing.

Integrated avionics system programs include development of the mission computer for the AH-1Z and UH-1Y U.S. Marine Corps helicopters that integrates communications, navigation, sensors, digital maps and mission planning.

Navigation Systems' rugged displays offer daylight-visible and night-capable standard or smart displays, which are standard for future U.S. Army and Navy all-glass cockpits. NSD also supplies land combat forces with rugged computers and displays including the Next Generation Handheld, a computer with a sunlight-readable display and a dual-channel tactical modem that interfaces with U.S. and NATO communications devices.

Other rugged products include integrated systems for the tactical Tomahawk weapons control system, and the Programmable Integrated Communications Terminal. The MobileVu system is the first truly sunlight-readable system designed specifically for law enforcement, fire and other civil applications. It provides a rugged, wide-viewing-angle display that is the brightest in the industry and an open-architecture, upgradeable Pentium III that provides critical data when needed.

Information Technology

Northrop Grumman's Information Technology (IT) sector is a leading provider of advanced information technology-based systems, services and solutions to diverse government and commercial customer bases. For more than four decades, Northrop Grumman has been a trusted partner of the Department of Defense (DoD); the intelligence community; civil, federal and state and local agencies; commercial and international clients. The sector employs more than 22,000 professionals located in 500 sites worldwide.

The sector delivers solutions across seven areas of technology and operational needs: information systems; C⁴ISR and weapons systems; enterprise IT systems; training and simulation; science and technology; base and range support; and homeland security.

Information Systems

Northrop Grumman delivers information systems addressing the entire spectrum of organizational information systems needs - mission systems, enterprise applications and IT/communications infrastructure. The sector provides modernization, planning, implementation, and operational services for the advanced information systems of federal, state, municipal and commercial customers.

Northrop Grumman IT is a partner in the Eagle Alliance joint venture that was selected by the National Security Agency (NSA) for the Groundbreaker contract, the agency's largest IT outsourcing program. The NSA estimates that the 10-year IT outsourcing program has a value in excess of \$2 billion. The Eagle Alliance will provide telephony and network services, distributed computing services and enterprise management of the non-mission IT infrastructure at NSA headquarters in Fort Meade, Md., and surrounding offices.

In 2001, the Postal Service selected Northrop Grumman for the \$200 million Information Technology Support Services contract to provide day-to-day production operations support for the Postal Service's computing environment.



For the U.S. Department of the Treasury, Northrop Grumman is the prime contractor on HR Connect, an enterprise resources planning system for human resources and payroll processes. The \$110 million contract covers all 14 bureaus within Treasury. The new system will replace over 100 legacy systems for personnel and payroll functions throughout the department and its bureaus.

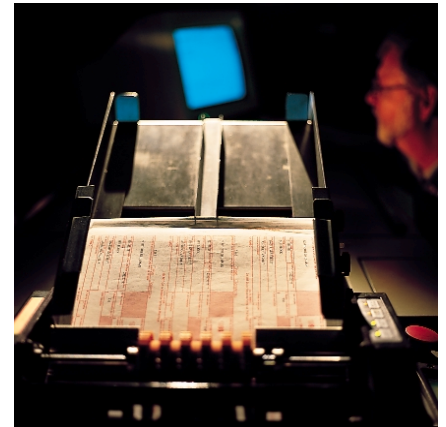
Northrop Grumman is the program integrator for the Total Army Personnel System (TAPSYS)-3 by the Defense Supply Service-Washington. The \$70 million contract calls for the IT sector to develop, enhance and maintain systems, subsystems and databases in support of the Army Personnel Command.

Northrop Grumman provides complete information technology services to Vought Aircraft Industries Inc. under an outsourcing agreement estimated at \$67.5 million. Services under this wide-ranging agreement include support of all hardware, from desktops to mainframes; network services, including WANs and LANs; systems engineering support; application support; programming; consulting; disaster recovery and help desk services.

The Naval Sea Systems Command uses Northrop Grumman to conduct combat systems engineering for digital computer-based shipboard combat systems. Under a \$57 million contract, the sector provides design and integration support for shipboard command and control, communications and intelligence systems. The work is performed on new construction ships as well as the modernization and overhaul of the current fleet.

The Defense Information Systems Agency receives Northrop Grumman IT support for the current and future versions of the Defense Information Infrastructure (DII) Common Operating Environment (COE) under a \$47.5 million contract. DII COE is part of the backbone software infrastructure providing interoperable computer software systems and applications for the DoD.

The Internal Revenue Service (IRS) uses Northrop Grumman's Service Center Recognition/Imaging Processing System (SCRIPS) program to provide data capture, management and storage services that processes three families of forms for the IRS—1040EZ tax returns, Information Return Processing Form 1099s and federal tax deposits. The system was deployed in April 1994 and has processed over 600 million tax returns.



The Information Directorate, Air Force Research Laboratory, Rome, N.Y., awarded the sector a \$25 million contract in 2000 to develop, implement, operate and manage the Joint Battlespace Infosphere Distributed Testbed (JBI-DT). A pivotal program for the Air Force, the JBI-DT is designed to improve the performance and reduce the lifecycle costs of command and control, intelligence, surveillance and reconnaissance systems.

The Department of Transportation Volpe Center located in Cambridge, Mass., awarded Northrop Grumman IT a \$25 million contract in 1999 to support a broad range of transportation systems research and development activities. The sector's services are aimed at improving operational performance, examining technological advances, managing maintenance and distribution, operational and regulatory analysis, strategic planning and implementing geographical information systems.

In 2000, Congress directed the Justice Department to develop a plan to integrate the Immigration and Naturalization Service's (INS) Automated Biometric Identification System (IDENT) and the FBI Integrated Automated Fingerprint Identification System (IAFIS). When completed, the new system will allow federal officials to conduct background checks on illegal immigrants more quickly, efficiently and accurately. To support the IDENT/IAFIS integration program, Northrop Grumman provides systems engineering and program planning support on the project.

Northrop Grumman IT helps provide a full range of health information technology services throughout DoD Health Affairs through the Defense Medical Information System / Systems Integration, Design, Development, Operations & Maintenance Services Follow-On (D/SIDDOMS II).

A system developed by Northrop Grumman IT increases weather forecasters' efficiency and productivity, leading to more accurate and timely warnings to the emergency management community, the media, the general public and other users. The sector continues to provide support for the Advanced Weather Interactive Processing System (AWIPS) operated by the National Weather Service and the National Oceanic and Atmospheric Administration's Forecast Systems Laboratory. AWIPS allows meteorologists and hydrologists to display and analyze high-volume, high-resolution satellite imagery, radar data, automated surface observing systems and computer-generated numerical forecasts—all from one workstation.

C⁴ISR and Weapons Systems

Northrop Grumman's C⁴ISR services support the development, testing and deployment of systems that deliver information superiority for the nation's defense. The sector works with the DoD, the intelligence community and other related organizations to ensure the timely acquisition and delivery of information critical to the network-centric battlespace of the future.

The sector also performs systems integration and provides technical engineering services to support the development and maintenance of major DoD weapon systems. These services range from nuclear safety cross-check analysis to performance acceptance test and evaluation for strategic and theatre missile programs. Northrop Grumman is a leading provider of advanced support for numerous weapons systems based in space, in the air, on land and on the sea.

Northrop Grumman supports the Army's Communications-Electronics Command (CECOM), Fort Monmouth, N.J., developing software for satellite communications planning and management. The Common Network Planning Software will replace the current network planning software for the Defense Satellite Communications System. Northrop Grumman works with CECOM's Software Engineering Center under a \$702 million contract to provide software and systems engineering support for assigned mission-critical defense systems and associated programs throughout their life cycle.

Northrop Grumman is a leading supplier to the Space and Naval Warfare Systems (SPAWAR) Command, including engineering and technical services to fielded C⁴ISR systems, for the SPAWAR Systems Center in Charleston, S.C., under an \$81 million contract awarded in 2000. The sector supports the operations, maintenance, upgrades and modernization of C⁴ISR systems. In addition, the sector supports the development of advanced concepts and technologies for future C⁴ISR systems for the SPAWAR Command in San Diego, Calif.

The U.S. Strategic Command (USSTRATCOM) uses Northrop Grumman for B-2 Mission Planning Program (MPP) support, providing the tools for B-2 low-observable end-to-end mission planning. The work includes developing, testing, and integrating the B-2 low observable autorouter and associated mission planning production tools into SWPS; providing on-site engineering support; conducting user training; and modifying the force-level product to maintain currency with evolving SWPS and USSTRATCOM operational requirements.

Enterprise IT Solutions (Computing Systems)

Northrop Grumman IT is the premier federal government provider of comprehensive Internet and infrastructure solutions for multiservice networking, storage management, IT service management, application solutions, network security and high-end computing systems. The sector delivers complete IT solutions through partnerships with IT manufacturers and superior professional services.

In the area of multiservice networking, Northrop Grumman IT combines solid infrastructure design with the best in networking and multiservice products to integrate voice, video and data into an efficient, innovative, total enterprise solution. The sector's storage management expertise encompasses an array of storage functions and topologies that ensure that data is available, reliable and secure through any situation without compromising the performance of the total enterprise. In IT service management, the company enables its customers to monitor the health of their enterprise, and create more informed management of IT business services as a part of an agency's complete mission.

As the market leader in application solutions, Northrop Grumman IT has unparalleled expertise negotiating comprehensive licensing arrangements and the best possible terms and support to maximize the IT budget. Armed with the most cutting-edge hardware and software technologies, the sector's network security experts secure enterprises from malicious attacks without compromising network availability for their most trusted partners.

In 2001, Northrop Grumman IT was selected for NASA's Scientific and Engineering Workstation Procurement III (SEWP III) for two classes of the contract. The program enables the sector to provide networking and storage solutions in an open and distributed computer environment to all federal government agencies and their associated contractors for the next five years. The value of SEWP III to the sector is estimated to be \$160 million in the first year and \$800 to \$900 million over the five-year term of the contract.



Training and Simulation



The DoD and commercial markets today require mission-needs analysis before weapons or systems development because without value-added justification, even the most sophisticated project will not go forward. This results-oriented environment leads to new trends to integrate test and evaluation with training and simulation.

An eight-year, \$1.2 billion contract from the Army's Simulation, Training and Instrumentation Command (STRICOM) supports the command's major mission areas of live domain, training instrumentation and test, constructive simulation and virtual simulation.

The sector team helps STRICOM modernize training facilities to meet the needs of the digital army of the future.

The Training and Simulation Division of the Naval Air Warfare Center in Orlando, Fla., awarded Northrop Grumman the General Aviation Instructional Systems Development program. Tasks required by the \$150 million contract include training course maintenance, instructional systems development and modification enhancement of training devices across the broad spectrum of the aviation community.

Science and Technology

Northrop Grumman IT's science and technology expertise is well positioned for addressing the government's growing emphasis on missile defense, space control missions and homeland security. The sector is a leading provider in the areas of contracted research, development, application and demonstration of advanced technologies as well as scientific and engineering technical assistance, and high-performance technical computer system acquisition and integration.

NASA's 20-year partnership with Northrop Grumman has helped the agency expand the frontiers of science and space. Sector engineers and scientists provide reliability and space environment analysis to the Jet Propulsion Laboratory, the lead NASA organization for the unmanned exploration of our solar system. For example, sector staff helped define the thermal-vacuum test requirements for Topex, a mission to conduct precise measurements of ocean surface topography. The team also developed photograph-enhancing algorithms to correct for aberrations in the Hubble Space Telescope and provided support for design of a replacement to the Hubble's Wide-Field Planetary Camera.

As the principal contractor for the Air Force Research Laboratory's Directed Energy Directorate for the Advanced Laser Imaging Analysis Support program, Northrop Grumman provides technical support in developing and testing high-energy lasers and imaging technology. Work includes developing and conducting advanced imaging experiments as well as supporting advanced lasers systems development, integration, and test and data reduction.

Northrop Grumman is installing and supporting a Cray MTA-2 multithreaded supercomputer at the Naval Research Laboratory in Washington, D.C. Under the Millennia contract, the General Services Administration (GSA) awarded the 10-year program to the sector. The all-CMOS MTA-2 will be the first system of its type installed, representing a breakthrough design that will significantly expand computational capabilities, especially for memory-intensive applications.

Base and Range Support

Northrop Grumman IT is a preferred provider of services for large facilities of the U.S. government, particularly base and range operations support for the Army, Navy, Air Force and NASA.

Making sure Florida's Kennedy Space Center (KSC) or Cape Canaveral Air Station (CCAS) are ready to handle all mission requirements is the primary responsibility of the sector's Space Gateway Support team at KSC and CCAS, part of the \$2.2 billion Joint Base Operations and Support Contract (J-BOSC). These functions include project management; logistics, medical services, engineering, protective services such as fire and security, safety and mission assurance, environmental management and information management.



The Army relies on Northrop Grumman to provide operations and maintenance services for the Range Complex at Fort Hood, Texas. Under this \$30 million contract, the sector operates and maintains 10 major multi-use ranges, 60 smaller ranges, and training facilities such as the two Military Operations in Urban Terrain facilities. The facilities operate 24 hours a day, seven days a week.

Homeland Security

Northrop Grumman IT's proven expertise positions the sector to provide a broad range of services in support of homeland security. From physical plant security to sophisticated data sharing and information exploitation systems, the sector's capabilities address the full continuum of homeland security needs—detection, preparation, prevention, response and recovery.

Northrop Grumman holds a contract to offer common, interoperable multi-application smart card systems and services to all federal agencies. This potential \$1.5 billion contract will initially focus on providing employee identification and building access, as well as computer network access.

A Network Early Warning System prototype being developed by this sector will be capable of providing advance warning of impending Internet-based coordinated attacks on DoD computer networks. This program develops capabilities successfully demonstrated in an earlier program at the Air Force Information Warfare Battlelab into a prototype system.

The sector is one of the teams awarded the GSA's Safeguard Program, a high-profile project that provides services and products in areas including: information systems security and information assurance; vulnerability assessment and threat identification; physical infrastructure protection; and emergency preparedness training, exercises and simulation.

For the Air Force Research Laboratory/Rome Research Site, Northrop Grumman holds the Defensive Information Warfare Technology Applications contract that researches, prototypes, develops, integrates and tests individual technologies and integrated solutions to various challenges in defensive information warfare relating to the protect-detect-react portion of information operations. Northrop Grumman conducts vulnerability assessments of Army Reserve facilities worldwide. The \$10 million task is performed under the GSA's Safeguard Program. Vulnerability assessments help determine the type and level of protection needed to secure resources adequately and economically.

Mission Systems

With headquarters in Reston, Va., Northrop Grumman Mission Systems is a leading global integrator of complex, mission-enabling systems and services for federal agencies engaged in defense and intelligence activities, as well as federal civilian organizations, state and local governments and commercial clients. Leveraging 50 years of expertise, the sector's technology leadership spans five business areas: strategic systems; missile defense; intelligence, surveillance and reconnaissance; homeland security; command and control and technical services and training. Mission Systems has 15,000 employees in more than 300 locations around the world.

Strategic Systems

Since 1953, Northrop Grumman Mission Systems has provided systems engineering and technical assistance to every Air Force Intercontinental Ballistic Missile (ICBM) program. In 1997 the company was awarded a 15-year contract to be the ICBM Prime Integration Contractor (IPIC), responsible for every aspect of sustaining and modernizing this critical national defense asset, including propulsion, guidance, re-entry, operational ground equipment and command and control systems.

Missile Defense

Northrop Grumman Mission Systems is among the top contractors in the missile defense arena. One of the most significant advancements in U.S. missile defense capability is attributed to the sector's complex battle management system. The Battle Management Command Control and Communication (BMC3) system integrates all components and guides the interceptors until their onboard sensors acquire the targets. The BMC3 software coordinates sensor and interceptor operations during flight, providing vital information such as battle management displays and situation awareness data to commanders.

As the prime contractor at the Joint National Integration Center (JNIC), Northrop Grumman Mission Systems provides realistic simulation and training tools for warfighters, supports the integration and system-level testing of missile defense architectures, and supplies a proving ground for new missile defense technologies.

The organization also provides systems engineering and technical assistance to the Rocket Systems Launch Program office, responsible for providing modified Minuteman boosters for both the target and the interceptor. Additionally, Mission Systems manages the design and development of a new, liquid rocket booster that will enhance the testing of current and future missile defense systems.

Intelligence, Surveillance and Reconnaissance

In the realm of intelligence, surveillance and reconnaissance, Northrop Grumman Mission Systems provides a broad spectrum of advanced capabilities. The sector's emphasis is on signal, measurement and signature and imagery intelligence. Additional areas of expertise include automated high-speed sensor data processing, analysis and reporting and comprehensive solutions for mission analysis, system engineering and development integration and operation of tasking, collection, processing exploitation and dissemination systems. The sector's domain portfolio also includes information operations and assurance and space-control for a wide range of missions and cutting-edge visualization technologies.

As the prime contractor to the Air Force Weather Agency, Mission Systems provides systems engineering, management and sustainment services. The sector integrates high-resolution weather analyses, forecast models and space weather applications in support of battlefield theaters worldwide. Also for the Air Force, the company is the prime contractor the Deep Space Surveillance Technology Advancement and Replacement for Ebsicons program. Deep STARE is part of the U.S. Space Surveillance Network and Mission Systems is responsible for installation of new hardware and software, including cameras and electronics, and integration and test.

The company also offers expertise in anti-submarine surveillance and performs—as it has for the last 30 years—system requirements analyses, planning and test and evaluation, with special emphasis on underwater electronics, components, sensors and data handling for the Navy.

Northrop Grumman Mission Systems has a rich history in tactical reconnaissance. One heritage program is Guardrail, considered the signal intelligence workhorse of Army airborne reconnaissance today. Another is Mission Systems' Hunter unmanned aerial vehicle. Hunter has flown numerous successful missions in Kosovo, delivering real-time video surveillance to peacekeeping troops in the Balkans.



Homeland Security

As a premier supplier of public safety, health and intelligent transportation management and communications infrastructure systems, Northrop Grumman Mission Systems supports the complete spectrum of national homeland security initiatives.

Notable public safety programs include E-911 emergency response and operations centers around the country such as the Los Angeles, Calif., Police Department's Emergency Command Control and Communications Center.



In addition, Northrop Grumman Mission Systems is spearheading the development of intelligent transportation systems across the nation. In the tri-state Ohio-Kentucky-Indiana region, the sector delivered and operates the first intelligent traffic management system to include the new national 511 Traveler Information Hotline.

For the U.S. Department of Treasury, Mission Systems manages and operates the Treasury Communications Systems, the largest secure wide area communications network in civil government. The program showcases the sector's network expertise and provides high-value economies of scale to bureau operations worldwide.

Mission Systems is also advancing wireless technologies to enhance global and domestic communications between law enforcement and emergency services. The Multi-Agency Radio Communications System, being developed for the State of Ohio, will provide public safety, law enforcement and emergency management systems with a backbone network linking as many as 12 state agencies over one communications system. The sector also is a key member of the team that will deliver a new digital public safety communications system for combined emergency services in England, Wales and Scotland.

In the area of law enforcement and identity, Northrop Grumman Mission Systems developed and continues to enhance the National Automated Fingerprint Identification System (NAFIS) for the Government of the United

Kingdom. Since the system became fully operational in 1999, more than 31,000 identifications have been made from scene-of-crime marks, utilizing NAFIS.

In public health, the sector is the systems integrator for the Centers for Disease Control and Prevention, providing information systems, support and services that aid in public health research, epidemiological surveillance, response, intervention and emergency notification.



At the same time, Mission Systems is working to secure the nation's most critical seaports for the Coast Guard. This includes developing model port security guidelines, conducting assessments of more than 50 U.S. ports and developing a self-assessment methodology. Other national transportation initiatives include supporting modernization of the Federal Aviation Administration's (FAA) National Airspace System and air traffic control infrastructures, advanced airport security systems and an accelerated counter terrorism program.

Advanced security services help businesses and governments safeguard employees, network and operational assets from cyber and physical threats. The sector also has fielded unique approaches for identity verification. Other significant projects include operation of the U.S. Immigration and Naturalization Service's 128 application support centers and the sector's Public Key Infrastructure (PKI) technology program.



Secure e-government solutions include the development and ongoing enhancement of the Security and Exchange Commission's Electronic Data Gathering, Analysis and Retrieval System. EDGAR enables electronic delivery of required financial filing data for 90,000 corporations and reviewers and speeds delivery of services to citizens and businesses.

Command and Control

For decades, Northrop Grumman Mission Systems has supported the Defense Department's command and control requirements with leading edge, mission-enabling technologies. The sector's Force XXI Battle Command Brigade and Below (FBCB2) is the key system bringing situational awareness to the soldier. FBCB2, on board of every platform in the digitized force, ties forces together at the brigade level. Another system, the Air and Missile Defense Workstation, also developed by the sector, accomplishes air defense command and control at the division level.



Tactical Operations Centers are mobile command posts—highly sophisticated interoperating suites of computers and display technologies. Northrop Grumman Mission Systems designs, develops and sustains these centers for a variety of military and public sector uses.

Mission Systems also is providing system integration and radio network management software for the Joint Tactical Radio System, the first radio communications network designed for use by all U.S. forces. The single radio system will be able to communicate with virtually any U.S. military radio.

For the Air Force, Mission Systems is developing a system for providing warfighters with strategic missile attack data and a network modernization effort for upgrading remote satellite tracking stations worldwide. Mission Systems also developed the Command and Control Interoperable Collaborative Enterprise, which is able to integrate existing systems and databases making them available through a single workstation.

Technical Services and Training

Northrop Grumman Mission Systems offers a wide range of technical support and training products and services that help Defense Department and other federal agencies accomplish their missions.

Training exercises and simulations are Mission Systems hallmark services, particularly in the arena of joint training. For the Joint Forces Command, Northrop Grumman Mission Systems is the prime contractor for the Joint Warfighting Center, the technical and services support hub for the joint training, exercise and rehearsal programs for the U.S. military.

Northrop Grumman Mission Systems also supports peacekeeping operations with linguistics services. For example, within the Balkans Linguist Support Program, Mission Systems provides and manages approximately 1,000 linguists, speaking 10 languages and operating in 10 countries in Europe.

Through its Vinnell subsidiary, Mission Systems is a recognized leader in the field of advanced military training services, logistics, and facilities operations and maintenance. From O&M at Air Force bases in Turkey, logistical and equipment support in Egypt and Ft. Irwin and military training in Saudi Arabia, logistics and base operations at Ft. Monmouth and Dugway Proving Ground, Mission Systems' Vinnell delivers on-the-ground support wherever needed.

Integrated Systems

Northrop Grumman's Integrated Systems sector is a premier aerospace systems integration enterprise. Integrated Systems has the capabilities to design, develop, integrate, produce and support complete systems, as well as

airframe subsystems, for airborne surveillance and battle management, early warning, airborne electronic warfare and air combat aircraft. With approximately 12,000 people, the sector is also integrating these capabilities for emerging network-centric warfare concepts.

Joint STARS

The Joint Surveillance Target Attack Radar System (Joint STARS) is the most advanced targeting and battle management system in the world. Using an advanced radar sensor group provided by the Norden Systems unit of the company's Electronic Systems sector, Joint STARS detects, locates, classifies, tracks and targets hostile ground movements, communicating real-time information through secure data links with Air Force and Army command posts. The system also can be used in peacekeeping and crisis management scenarios.

The system's initial operating capability was declared in December 1997 after Joint STARS had already responded three times to support real-world peacekeeping and combat missions - in 1991 in the Middle East during Desert Storm, and in 1995 and 1996 to support NATO peacekeeping forces in Bosnia-Herzegovina. In February 1999, the 93rd Air Control Wing deployed with two Joint STARS E-8C aircraft to support NATO operations in Kosovo. In 1998, the Air Force awarded Northrop Grumman a preplanned product improvement (P³I) contract to develop the next generation advances to Joint STARS. The P³I contract was the first element of the Radar Technology Insertion Program (RTIP). The Air Force has expanded the potential application of this advanced radar system by awarding a \$303 million prime contract for the first phase of the newly named Multi-Platform Radar Technology Insertion Program (MP-RTIP).

For work on the current E-8C Joint STARS system, the company received a separate indefinite delivery/indefinite quantity (ID/IQ) contract with a potential value of \$1.2 billion for upgrade work on Joint STARS. The contract extends until March 2005. The first project under this ID/IQ contract was the development of an integrated satellite communications system for Joint STARS, valued at approximately \$40 million.

Another major program, one that represents a paradigm shift in the way the U.S. supports its military aircraft, is the Total System Support Responsibility. Awarded in 2000, the TSSR has a six-year initial period of performance valued at more than \$500 million with options that could extend Northrop Grumman's participation on this program for more than two decades. Through this future support contract, the Air Force expects to reduce the cost of supporting the E-8C fleet by having the prime contractor, Northrop Grumman's Integrated Systems, partner with the Warner Robins Air Logistics Center.

B-2 Stealth Bomber

Northrop Grumman is prime contractor for the Air Force's B-2 stealth bomber. The Air Force/Northrop Grumman B-2 Spirit is a strategic, long-range, multirole bomber. The B-2s low observable characteristics make it

the most survivable aircraft in the world, able to penetrate hostile air space without being detected. The B-2 repeatedly demonstrated this and its all-weather capability during NATO combat missions over Yugoslavia in 1999. The B-2 program combines revolutionary aerospace technologies and equally unprecedented design, development and manufacturing systems and processes to create the world's most advanced aircraft.



The B-2 can fly more than 6,000 nautical miles unrefueled and more than 10,000 nautical miles with just one refueling, giving it the ability to fly to any point on the globe within hours. During the NATO air strikes in Operation Allied Force, B-2s made 30-hour round-trip missions regularly between Whiteman AFB, Mo., and Yugoslavia.

For the first time in military aviation history, the Air Force has a war-fighting capability that combines long-range, large payload, stealth and near-precision in one aircraft. The B-2 used the Joint Direct Attack Munition for its Yugoslav deployments.

All 21 B-2s have been delivered to the Air Force. There are 20 B-2s in the operational fleet at Whiteman AFB. One aircraft is in flight test at Edwards AFB, Calif., to validate software and weapons systems upgrades.

E-2C Hawkeye

The E-2C Hawkeye airborne early-warning command and control (AEWC&C) aircraft has served as the “eyes and ears” of Navy carriers for more than 30 years. Continuous modifications and upgrades have kept the E-2C ahead of the threat. The current production version, the Group II Hawkeye, is the most automated AEWC&C system in operation today. The E-2C Hawkeye can monitor six million cubic miles of airspace and more than 150,000 square miles of ocean surface for the presence of enemy aircraft, missiles, ships and fixed targets. The aircraft also is operated by the air forces of Israel, Japan, Egypt, Singapore, Taiwan and France.



The next-generation E-2C, known as Hawkeye 2000, successfully completed its first flight in 1998 and operational evaluation by the Navy in 2001. Production of the Hawkeye 2000 began in 1999 under a five-year, \$1.3 billion contract. Northrop

Grumman will produce 21 of the next-generation aircraft for the Navy and two will be sold to Taiwan. Another E-2C will be built for France under the multi-year contract. The Navy took delivery of the first Hawkeye 2000 E-2C under this contract in October 2001. France is expected to receive its aircraft in 2003. Japan and Egypt are upgrading their fleets to the Hawkeye 2000 configuration. In addition, the company has begun work on the generation beyond Hawkeye 2000. In November 2001, a billion-dollar development program was begun with the award of the Radar Modernization Program pre-System Design and Development contract.

EA-6B Prowler

The EA-6B Prowler, the Navy's electronic warfare aircraft, went into operation in 1971 and has undergone four major upgrades. The Prowler accompanies a wide variety of other aircraft on missions into hostile airspace and provides them with electronic countermeasures and air defense suppression. In 1994, the Secretary of Defense selected the Prowler to become the sole radar support jammer for all the services. Consequently, the Navy's role was expanded to operate from both aircraft carriers and land bases. Eight expeditionary squadrons were created—four Navy squadrons with Air Force aircrews, and four Marine.



The company is under contract for an upgrade to the next-generation Prowler, known as Increased Capability III (ICAP III). Initial Operation Capability is slated for 2005. The first ICAP III EA-6B Prowler logged a successful 1-hour, 45-minute first flight on Nov. 16, 2001. The aircraft is one of two prototypes being modified by the Integrated Systems sector under an approximately \$200 million development program for the Navy.

F/A-18E/F Super Hornet

The F/A-18E/F Super Hornet is the newest version of the combat-proven F/A-18 Hornet that first entered service with the Navy in 1983. The single-seat 'E' and two-seat 'F' Super Hornets have greater range and payload, more powerful engines and provisions than previous versions for advanced avionics and weapons systems.

Northrop Grumman Integrated Systems, as principal subcontractor to The Boeing Company, produces the F/A-18's aft and center fuselage sections and vertical tails and integrates all associated subsystems at its Air Combat Systems facility in El Segundo, Calif.



In 2000, the F/A-18E/F received the National Aeronautic Association's prestigious Collier Trophy recognizing the Super Hornet as the top aeronautical achievement in the United States for 1999.

The Super Hornet entered service in November 1999 with Navy squadron VFA-122 at Naval Air Station Lemoore, Calif. The first Super Hornet fleet deployment is scheduled for 2002.

F/A-18C/D Hornet Strike Fighter

In July 1999, Northrop Grumman completed its final "C/D" Hornet shipset, the 1,479th in the long F/A-18 series of aircraft. The company will continue support of the earlier versions of the F/A-18 being flown by the Navy and Marine Corps and the air forces of Australia, Canada, Finland, Kuwait, Malaysia, Spain and Switzerland.

Joint Strike Fighter

Lockheed Martin, in partnership with Northrop Grumman Integrated Systems and BAE SYSTEMS, has been awarded a \$19 billion System Development and Demonstration contract to continue work on the Joint Strike Fighter (JSF) for the United States and United Kingdom. The U.S. government announcement of the contract award in October 2001 ended a competition between the Lockheed Martin team and The Boeing Company team.



The JSF is the next-generation fighter for three U.S military services (Air Force, Navy, Marine Corps) and the British Royal Navy. Each JSF variant will be tailored to the mission needs of the military branches to maximize commonality and individual service utility and for export to other allied nations.

Lockheed Martin, Northrop Grumman and BAE SYSTEMS form a unique team, each with more than 50 years of experience designing and producing fighter and attack aircraft. The team has the total program solution to multi-service requirements and leads the world in the experience the JSF demands: affordability, stealth, mission systems, carrier suitability, short takeoff and vertical landing (STOVL) capability, single-engine design, accurate weapons delivery systems and international program development.

F-14 Tomcat

Northrop Grumman's F-14 Tomcat fighter is expected to be in operation from Navy carriers at least until the year 2010. The current model, the F-14D, combines the speed and maneuverability of a dogfighter with the unique detection and tracking capability of the APG-71 radar system, and adds to that the range and precision weapons capability of an attack aircraft. The track-while-scan radar gives the pilot and radar intercept officer the ability to

track 24 enemy targets and guide six AIM-54 Phoenix missiles to six targets simultaneously at ranges of more than 100 miles. Northrop Grumman manufactured a total of 632 F-14s for the Navy.

F-5/T-38 Fighters and Trainers

In total, 3,806 aircraft in Northrop Grumman's F-5/T-38 series were produced. The F-5 fighter is the most widely used American supersonic aircraft in the world, with 31 countries having chosen it. Northrop Grumman has put together a premier team of avionics and structural manufacturers to offer a complete upgrade program to modernize these aircraft into a Tiger IV configuration.

Northrop Grumman was awarded a \$31.2 million contract for delivery of 55 replacement wings for the Air Force's T-38 Talon supersonic trainer aircraft. Northrop Grumman began production of the replacement wings in January 2001 and the first wing was delivered in October 2001. Deliveries are continuing at a minimum of one per month for 54 months. More than 500 T-38s are currently operational with the Air Force, Navy and NASA. The improved wing is expected to keep the Talon in service for another 40 years.

Unmanned Vehicle Systems

Northrop Grumman is a world leader in the high-end unmanned aerial vehicle (UAV) systems market with demonstrated systems such as Global Hawk, the Fire Scout vertical takeoff and landing tactical UAV, and the BQM-34 Firebee and BQM-74/Chukar aerial targets.

The Global Hawk unmanned system, in development for the Air Force, will provide battlefield commanders near real-time, high-resolution, reconnaissance imagery. Flying at altitudes up to 65,000 feet, Global Hawk can survey large geographic areas with pinpoint accuracy to give military decision-makers the most current information about enemy resources and personnel.

Once mission parameters are programmed into Global Hawk, the UAV can autonomously taxi, take off, fly and remain on station capturing imagery, return and land. Ground-based operators monitor the UAV's health and status, with the ability to change navigation and sensor plans during flight as necessary.

Global Hawk was awarded the Robert J. Collier Trophy for the top aeronautical achievement for 2000.



The company is also prime contractor for the Navy's Fire Scout vertical takeoff and landing tactical unmanned aerial vehicle system. Northrop Grumman won a competitively awarded \$93.7 million engineering and manufacturing development contract for Fire Scout in February 2000. In May 2001, Fire Scout moved into low-rate initial

production (LRIP) with a \$14.2 million contract award from the Naval Air Systems Command. The company took delivery of the first Engineering and Manufacturing Development RQ-8A Fire Scout in September 2001.



The Fire Scout will be able to fly from any “air capable” combat ship for real-time reconnaissance and targeting missions. The system will provide unprecedented situation awareness and precision targeting support for the Navy and Marine Corps of the future.

Northrop Grumman completed production in July 2001 of the X-47A Pegasus, a company-funded, unmanned air vehicle that will be used to demonstrate aerodynamic qualities suitable for autonomous operation from an aircraft carrier.

The results of the Pegasus demonstration effort will be used in Northrop Grumman’s continuing work on a naval unmanned combat air vehicle (UCAV-N). Under its UCAV-N contract with the Defense Advanced Research



Projects Agency (DARPA) and the Navy, Northrop Grumman is performing trade studies, analysis and preliminary design. The goal of the joint DARPA/Navy project is to demonstrate the technical feasibility for a UCAV-N system to effectively and affordably conduct sea-based 21st century suppression of enemy air defenses, strike and surveillance missions within the emerging global command and control architecture.

Designed to replicate the threat of enemy aircraft, the BQM-34 Firebee has been used to test and evaluate many types of air defense systems. The target system simulates the threat of hostile aircraft for combat training and weapons system development. More than 7,200 have been built.

Northrop Grumman is producing the turbojet-powered BQM-74E, the fourth generation of its successful BQM-74 family of aerial targets, for the Navy. The company has produced more than 7,200 in the series. The Navy uses the targets to train aviators as well as anti-aircraft and gunnery crews, and to evaluate various weapons systems by simulating enemy aircraft and anti-ship and land-attack cruise missiles. The international version of the BQM-74 is the Chukar, which is operated by France, India, Spain, Taiwan and the United Kingdom.

Agreements with EADS

Northrop Grumman and the European Aeronautic Defence and Space Company (EADS), Europe's premiere aerospace and defense company, have signed memoranda of understandings to evaluate potential alliances in key advanced technology areas. These include a variety of surveillance and reconnaissance opportunities, including ground surveillance systems; high altitude, long-endurance unmanned aerial vehicle technology; and naval radars.

Newport News

For more than a century, Newport News has designed, built, overhauled and repaired a wide variety of ships for the Navy and commercial customers. Today, Newport News is the nation's sole designer, builder and refueler of nuclear-powered aircraft carriers and one of only two companies capable of designing and building nuclear-powered submarines. The company also provides after-market services for a wide array of naval and commercial vessels. With vast facilities located on more than 550 acres along two miles of waterfront in Newport News, Va., the sector has the capability to design, build and maintain every class of ship in the Navy's fleet.

Aircraft Carrier Construction



The ninth *Nimitz*-class nuclear-powered aircraft carrier *Ronald Reagan* (CVN 76) is currently under construction at Newport News. The ship was christened on March 4, 2001, and will be delivered to the Navy in 2003. When the President's namesake ship joins the fleet, it will be the most modern and sophisticated aircraft carrier in the world. *Reagan* is 1,092 feet long, and once completed, will be home to 6,000 sailors, carry more than 80 aircraft and cruise at speeds in excess of 30 knots.

Newport News was awarded a \$3.8 billion design and construction contract for the 10th and latest *Nimitz*-class aircraft carrier, CVN 77. Construction of the as-yet unnamed CVN 77 will take place over the next seven years and it will serve as the first ship in the transition to a new class of carriers.

Submarine Construction

Construction on the first four ships in the *Virginia*-class program is currently under way. The *Virginia*-class is the most advanced submarine in the world, and is being constructed under an innovative teaming relationship with Electric Boat. The team is currently under contract to build the first four submarines, with the potential for a class of 30.



Fleet Services

Newport News is the only shipyard to perform overhaul and refueling work on both Navy submarines and *Nimitz*-class aircraft carriers. The sector recently completed a three-year overhaul and refueling of USS *Nimitz* and successfully redelivered the ship to the Navy. USS *Eisenhower* arrived at the shipyard in May 2001 and is undergoing its once-in-a-lifetime overhaul and refueling. The scope of work on *Eisenhower* is valued at approximately \$1.5 billion and includes the refueling of both the ship's reactors, as well as significant modernization work.

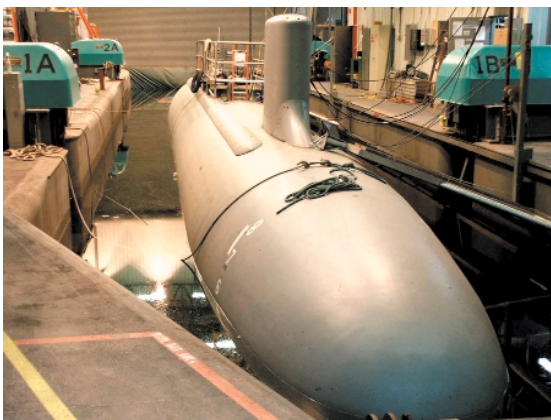
Newport News also performs overhauls and repairs on naval surface ships, and in late 1997 acquired Continental Maritime Inc., a naval ship repair yard located in San Diego, Calif.

Technology Insertion

Newport News incorporates the most advanced technologies and designs into its vessels. With more than 4,000 engineers, designers and technicians, Newport News is at the forefront of new ship technologies.

Advanced design work on the next carrier class is underway at Newport News, beginning with the first ship, CVN 78. In 2000, Newport News was awarded a \$161 million development contract for CVN 78. Many technological improvements will be introduced on the ship, including the development of a new propulsion plant and improved combat capabilities.

The Virginia Advanced Shipbuilding and Carrier Integration Center was developed in support of future ships. This new research facility provides added capability for the development and testing of advanced carrier and submarine systems by leveraging Newport News' expertise with that of the Navy, other defense contractors and Virginia's universities.



Also in the advanced submarine technology arena, the sector served as the lead designer and builder on Cutthroat (LSV 2), a quarter-scale autonomous submarine used to test new technologies for potential insertion in future *Virginia*-class submarines.

Naval Engineering

Newport News provides with a variety of engineering services to the Navy. It has modified and improved existing ship designs, and designed new classes of submarines and surface ships. Newport News is the submarine hull planning yard for the *Los Angeles*-class attack submarine and the lead design yard and hull planning yard for the *Seawolf*-class attack submarine.

Ship Repair

Since the early 1990's, Newport News has completed more than 200 ship repair projects for U.S. government, U.S.-flag commercial and foreign-flag commercial ships, ranging from paint repair to complete hull and machinery renovation.

Ship Systems

Northrop Grumman's Ship Systems sector is a world leader in the design, production and fleet support of surface combatant ships. From design to decommissioning, the sector is a pioneer in providing comprehensive and integrated support services for the life cycle of ships. With more than 17,000 shipbuilding professionals, primarily in Mississippi and Louisiana, the Ship Systems organization has built virtually every type of non-nuclear ship for the Navy, U.S. Coast Guard, international navies and a range of maritime customers.

The sector's two primary shipyards, the Ingalls Operations in Pascagoula, Miss., and Avondale Operations in New Orleans, La., augment the sector with Ship Systems Full Service Operations. This business extends Ship Systems' maritime business further with the capability to design, engineer, construct and provide full life-cycle support services to naval and commercial vessels of all types.

The company's composite construction facility, located in Gulfport, Miss., continues to be the Navy's "Center of Excellence" for research, development and production of high-tech composites for use on naval ships. The Gulfport facility covers 120 acres and is dedicated exclusively to composites manufacturing and modular assembly.

DDG 51 *Arleigh Burke*-Class Aegis Guided Missile Destroyers

For the Navy, the Ship Systems sector is one of two prime contractors designing and producing the DDG 51



Arleigh Burke-class Aegis guided missile destroyers, which provide primary anti-aircraft protection for the fleet. Under this program, 28 ships have been awarded to the sector's Ingalls Operations, with 17 ships delivered so far.

Ingalls Operations currently is building six DDG 51-class Aegis guided missile destroyers. The DDG 51's combat systems are composed of the Aegis combat system and the Spy-ID multifunction phased array radar. The *Arleigh Burke*-class comprises some of the most powerful surface combatants ever put to sea through the combination of Aegis, the vertical launching system, a leading-edge antisubmarine warfare system, advanced anti-aircraft missiles and

Tomahawk ASM/LAM. The sector made repairs and restored the USS *Cole* (DDG 67), which was damaged in 2000 in a terrorist attack in Yemen. This ship was redelivered in the spring of 2002.

DD(X)

A team led by Northrop Grumman has been selected by the Navy to complete the system design for the Navy's advanced, 21st century surface combatant, DD(X). Northrop Grumman's Ship Systems sector will lead the system



design, engineering prototype development and testing of the DD(X) System under a \$265 million contract. The team includes Raytheon Company as mission systems integrator and more than 30 of the nation's top engineering and maritime industrial companies. The initial design contract has a total value of approximately \$2.9 billion over four years.

The DD(X) is the centerpiece of the Navy's 21st century transformation and is the cornerstone program for a family of surface combatants to be designed and built over the next 25 years. This family of ships includes destroyers, cruisers and littoral combat ships, as well as technology to be backfitted into today's existing fleet of Aegis-equipped cruisers and destroyers.

Wasp (LHD)-Class of Large-Deck, Multipurpose Amphibious Assault Ships

The sector is the exclusive provider of the *Wasp* LHD-class of large-deck, multipurpose amphibious assault ships, which operate as the centerpiece of an amphibious ready group. This is an eight-ship program with seven vessels already delivered.

Ingalls Operations has been awarded \$1.369 billion for the construction of an eighth ship. This contract includes \$360 million previously awarded for advance work on the ship, including design, equipment procurement and fabricating selected ship assemblies. Part of this contract includes the development and the detailed engineering design for the ship's all-new gas turbine propulsion and electrical power generation systems. The first seven Ingalls-built LHDs were powered by steam propulsion systems.

LHDs embark, transport, deploy, command and fully support a Marine expeditionary unit of 2,000 Marines. These ships can accommodate three landing craft air cushion (LCAC) and a squadron of AV-8B Harrier II aircraft, as well as a full range of Navy/Marine Corps helicopters and amphibious vehicles, to perform sea control and limited power projection missions. The 844-foot-long ships have living areas for nearly 3,200 crewmembers and embarked troops.

LPD 17 *San Antonio*-Class Amphibious Transport Dock Ships



Northrop Grumman Ship Systems is the prime contractor for the *San Antonio* LPD 17-class of amphibious transport dock ships. The first two ships in this class are currently being constructed at the sector's Avondale Operations, with the third ship, LPD 19, to be built at Ingalls Operations. These versatile ships perform the mission of amphibious transports, amphibious cargo ships and the older dock landing ships by incorporating both a flight deck and a well deck that can be ballasted and de-ballasted to support landing craft. Their increased vehicle and

substantial cargo carrying capacity will make them a key element of 21st century amphibious ready groups. These ships integrate the latest in shipbuilding and warfighting technologies to support current and future Marine Corps aircraft, the advanced amphibious assault vehicles and LCAC or conventional landing craft.

Northrop Grumman has signed a Memorandum of Understanding with the Navy and General Dynamics' Bath Iron Works reallocating construction responsibilities for the *San Antonio*-class and certain *Arleigh Burke*-class destroyers. As a result of this agreement, Northrop Grumman Ship Systems will assume responsibility for the construction of all *San Antonio*-class LPDs and LPD 19 has begun construction at the Ingalls Operations. Northrop Grumman will also assume responsibility for the program's life cycle support.

Deepwater

The Coast Guard has awarded a team consisting of Northrop Grumman and Lockheed Martin a contract to carry out a far-reaching modernization program for the agency's Deepwater forces - the ships, aircraft, command and control, and logistics systems that protect the United States and support the Coast Guard's many missions.

Northrop Grumman and Lockheed Martin are equal partners in Integrated Coast Guard Systems, which received the contract.

The contract is valued at \$11 billion to modernize the service's Deepwater assets over a 20-year period. The program's total potential value over three decades is estimated at approximately \$17 billion. Deepwater is the largest recapitalization effort in the history of the Coast Guard and will involve the acquisition of up to 91 ships, 35 fixed-wing aircraft, 34 helicopters, 76 unmanned surveillance aircraft, and upgrade of 49 existing cutters and 93 helicopters, in addition to systems for communications, surveillance and command and control.



T-AKR Roll-On/Roll-Off Sealift Ships

The sector's Avondale Operations is building a series of T-AKR roll-on/roll-off Strategic Sealift ships for the Navy, with six delivered and one currently under construction. In early 2002, USNS *Brittin* (T-AKR 305), the sixth of seven *Bob Hope*-class Sealift ships being built by Avondale, was delivered to the Navy ahead of schedule. The Sealift ships are 950 feet long and have more than 380,000 square-feet of cargo capacity, making them second in size only to aircraft carriers in the Navy's fleet. They are used for the immediate transportation of heavy military equipment that ground forces need to meet warfighting requirements. These ships can load/offload in 96 hours, with a total lift capacity of five million square feet.

Commercial Vessels

On the commercial side, Ship Systems is building a series of five double-hulled oil tankers for Polar Tankers, Inc., a subsidiary of Phillips Petroleum Company, under a \$500 million contract. These are the first "crude oil tankers" to be built in the United States, promoted by the Oil Pollution Act of 1990. These giant ships, which are nearly 900 feet long, are among the world's most environmentally safe product tankers. Ship Systems has delivered the first two tankers in the program, *Polar Endeavour* and *Polar Resolution*, and has three remaining under construction at its Avondale Operations.

Space Technology

The Northrop Grumman Space Technology sector develops a broad range of systems at the leading edge of space, defense and electronics technology. Based in Redondo Beach, Calif., the sector creates products for U.S. government, commercial and international customers that contribute significantly to the nation's security and leadership in science and technology. More than 8,600 employees work at 30 sites worldwide.



Space Technology's systems link far-flung military forces with space-based communications networks, keep a global eye on hostile threats with 24/7 early warning satellites, explore the universe with high-performance space telescopes and science spacecraft, and probe closer to home with earth science and remote sensing platforms. The sector is revolutionizing the battlefield with laser systems, giving warfighters instant access to high-volume information with broadband satellite systems and integrated avionics, and boosting the speed of telecommunications with ever more capable microelectronics.

Technology

Central to the Space Technology sector's industry leadership is its commitment to defining and developing leading edge technologies. The sector's research and development activities span avionics, sensors, optics, microelectronic processes, lasers, spacecraft structures, power, propulsion and deployable antennas and reflectors. The sector's expertise in digital technologies has allowed it to simplify the design, lower the cost and improve the operating performance of next-generation broadband satellite payloads.

The sector excels at producing microwave and millimeter wave monolithic integrated circuits (MMICs) based on gallium arsenide and indium phosphide semiconductor technologies. These tiny, low-cost microelectronic chips significantly reduce the size, weight and power consumption of the radio frequency (RF) sensors, transmitters and receivers—"the eyes and ears"—of space communications and military systems. Space Technology holds many world records for InP device performance, including digital circuits that operate at a blazing 80 GHz.

Space Technology is a supplier of high-volume, solid-state laser products, including extreme ultraviolet (EUV) light sources, an emerging laser-based photolithography technology for the semiconductor equipment manufacturing segment. The sector also designs high-power, diode-pumped solid-state lasers and laser diodes and arrays for scientific, industrial and medical applications.

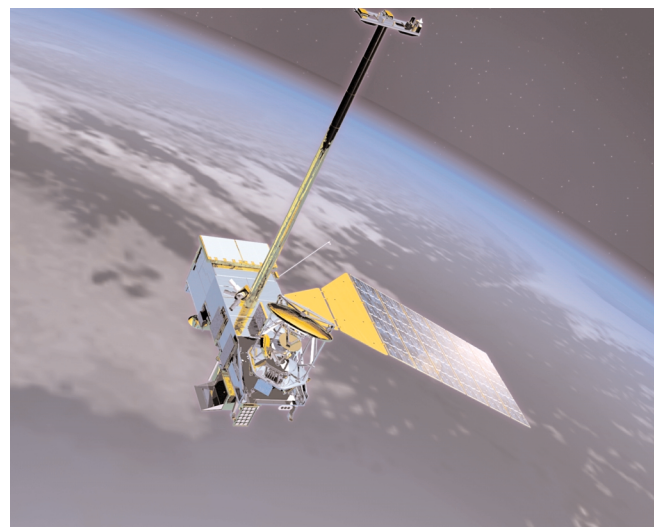
Civil Space

Northrop Grumman puts good ideas into orbit. From system architectures to systems engineering to spacecraft manufacturing to ground station design, the Space Technology sector manages the development and advances the technology for the full range of space communications, defense, earth-observing and scientific missions. The sector's systems range from multi-satellite networks to one-of-a-kind satellites for unique applications, operating in low earth orbits, geosynchronous orbits, and deep in interplanetary space. The sector has built and launched more than 195 spacecraft since delivering the first contractor-built satellite, Pioneer 1, to NASA in 1958.

Earth Observing Systems

Northrop Grumman's space-based remote sensing systems are central to forecasting tomorrow's weather and measuring long-term variations in the planet's environment.

Space Technology received a \$2.9 billion dollar prime contract in 2002 to build the National Polar-orbiting Operational Environmental Satellite System (NPOESS), the nation's next-generation environmental satellite system. Serving civil, military and scientific communities, NPOESS will provide timely



and accurate data for long-range weather and climatic forecasts. The system merges the nation's current weather polar-orbiting programs into a single, national program for the NPOESS Integrated Program Office, a joint effort of the Department of Commerce, Department of Defense and NASA.

As prime contractor for two of NASA's Earth Observing System satellites, Northrop Grumman built the Aqua space platform and integrated six unique instruments onto a standard modular bus. Launched in 2002, Aqua is providing a wealth of environmental data that is helping scientists understand the global water cycle. Aqua was honored in November 2002 by Popular Science magazine as one of the year's best innovations in aviation and space. The Space Technology sector is also building Aqua's sister craft, Aura, which will comprehensively measure the trace gases in the earth's atmosphere.

Space Science

Northrop Grumman-built spacecraft have supported NASA's quest for knowledge for more than four decades. The Space Technology sector has helped map the skies, investigate the space environment and discover deep space phenomena. The sector is now developing systems for next-generation missions, including the exploration of Mars.

NASA awarded Space Technology an \$825 million dollar contract in 2002 to build the James Webb Space Telescope, the successor to the Hubble Space Telescope. The Webb telescope will peer into the infrared band at great distances to see the first stars and galaxies formed in the universe billions of years ago. The data it returns will help astronomers study the birth and evolution of galaxies, the size and shape of the universe, and the life cycle of matter. As prime contractor, Northrop Grumman will lead the development of the observatory and build and integrate the spacecraft.

The Space Technology sector designed and developed NASA's Chandra X-ray Observatory. Since its launch in 1999, Chandra has returned a steady stream of breakthrough X-ray science. From its highly eccentric orbit, the satellite is giving scientists unprecedented access to the distant corners of the universe, providing a detailed look at the structure and evolution of the cosmos.

Northrop Grumman is also developing the Space Interferometry Mission (SIM) in partnership with NASA's Jet Propulsion Laboratory. This revolutionary spacecraft will house a high-precision optical interferometer that will give astronomers the ability to precisely map the location and motion of stellar objects, and search for signs of earth-sized planets around stars close to the sun.

Space Instruments

Northrop Grumman's orbiting space sensors are helping extend the boundaries of science. More than 200 of Space Technology's instruments have studied the planets, delved deep into space and looked back at Earth to monitor atmospheric and environmental change.

The sector's Hyperion hyperspectral imager collects data in more than 220 spectral bands where typical imagers operate across fewer than 10. Launched in 2000, Hyperion is producing enhanced remote sensing data for applications in mining, geology, forestry and agriculture.

The CERES instrument, now orbiting aboard several NASA satellites, has been operational since 1997. This powerful spaceborne tool is helping researchers pinpoint the relationship between clouds and Earth's climate. Northrop Grumman is now developing advanced technologies for follow-on instruments.

Intelligence, Surveillance, Reconnaissance

Northrop Grumman builds systems that keep America alert. The Space Technology sector supplies the technologies that give the nation's monitoring capabilities a global reach and enhance national security. Today, the sector continues to make significant contributions to the nation's defense posture, developing technologies and systems that stand watch over an uncertain world.

Northrop Grumman's Defense Support Program (DSP) satellites, the cornerstone of the nation's early warning system, have monitored the globe for ballistic missile launches since 1970. Designed for the Air Force to detect, characterize and report ballistic missile launches, the satellites also see nuclear detonations. As prime contractor for this critical system, the Space Technology sector successfully engineered and inserted five major technology upgrades over 30 years with no interruption in service. The satellites evolved in size and weight, while sensor sensitivity and capability increased, and ground system and data processing expanded. All of these upgrades were transparent to users and the system has increased in value as a national asset since the original contract award in 1967.

The sector's advanced remote sensing instruments operate across hundreds of spectral bands to set a new standard for imaging. Suitable for a wide variety of surveillance and reconnaissance missions, Northrop Grumman's hyperspectral imagers reveal much more than today's multispectral devices. These versatile instruments have been proven on space-based, fixed wing and helicopter platforms.

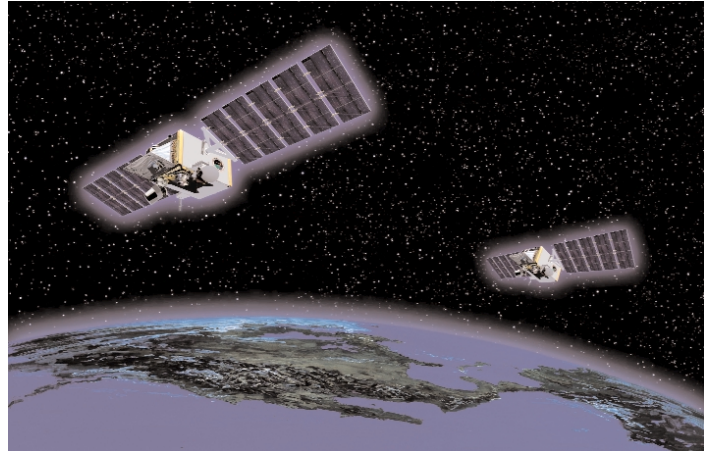
Missile Defense

From space-based systems that detect and track missiles to the laser systems that knock them from the sky, Northrop Grumman's systems defend the homeland. The Space Technology sector's capabilities are well suited to

counter today's widely proliferating strategic and tactical ballistic threats. The sector has developed space-based infrared sensing capabilities since the 1960s, and three decades of nurturing laser technology has transformed what was once a laboratory curiosity into high-power systems for defense at the speed of light.

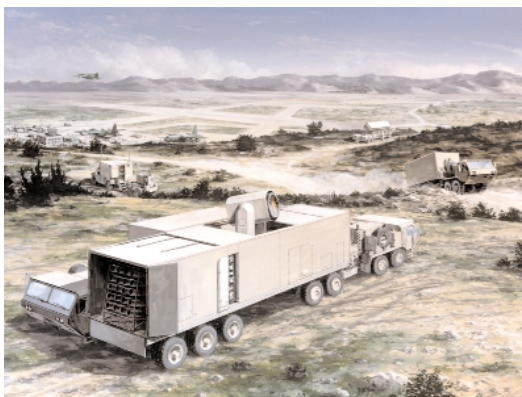
Space-Based Surveillance

The Department of Defense Missile Defense Agency (MDA) awarded Space Technology an \$868 million contract in 2002 to begin the development of the ST&SS. Operating in low-earth orbit, ST&SS satellites will use onboard infrared sensors to detect, track and discriminate ballistic missiles throughout their trajectories. As the MDA's only global tracking system, ST&SS will work with other assets to improve the performance of the overall missile defense system. Northrop Grumman will lead an industry team using an evolutionary, capabilities-based approach. Today's hardware and software technologies will be demonstrated quickly and cost-effectively; on-orbit evaluation will identify opportunities to insert advanced technologies downstream.



Laser Systems

The Space Technology sector has made lasers a vital component of America's defense capabilities. As the premier developer and supplier of high-energy laser systems, the sector has demonstrated the transformational capabilities of this versatile technology and placed it in the hands of the warfighter. From tactical to strategic missions, from threat degradation to destruction, lasers deliver defense at the speed of light and are well suited for use aboard tomorrow's land-, sea-, air-, and space-based platforms.



In November 2002, the Northrop Grumman-built Mobile Tactical High Energy Laser (MTHEL) achieved a significant technological breakthrough, intercepting an artillery projectile in flight, causing it to explode harmlessly in the air. Under contract to the Army and the Israel Ministry of Defense, the MTHEL test bed demonstrated this revolutionary capability in live-fire testing at the White Sands Missile Range. In earlier tests during 2000 and 2001, the test bed – then called the THEL/Advanced Concept Technology Demonstrator – shot down 25 Katyusha rockets, fired singly and in salvos.

A Northrop Grumman-built high-energy laser, flying aboard a 747 aircraft, is the heart of the Airborne Laser (ABL), which will destroy hostile ballistic missiles during the highly vulnerable boost phase of flight, before separation of the missile's warheads. Built of advanced, lightweight materials, the laser will deliver a megawatt-class beam to its targets, and is scheduled for testing in 2004.

Space Communications

The Northrop Grumman Space Technology sector has transformed the communications demands of users into successful satellite networks for 40 years. Space Technology engineered the world's first global communications systems, developed payloads for secure and reliable satellites and is designing tomorrow's broadband architectures. The sector's expertise spans the full range of broadband systems, from system architecture development to system engineering, from space segment to ground systems, from satellite constellations to component-level technologies.

Space Technology is now defining the architectures that will assure that tomorrow's warfighters have the network-centric, data intensive, worldwide communications systems needed to maintain superiority across all levels of conflict. Called Transformational Communications, this multi-agency effort is investigating the capabilities needed to seamlessly network forces and deliver vital information where it's needed, when it's needed. The Space Technology sector is developing the architectures to support this vision and advancing the technologies necessary to make it a reality, including onboard digital processing systems, laser communications and advanced antennas.

Space Technology is building and integrating the payload for the Advanced EHF, the nation's next-generation space-based strategic and tactical relay system. AEHF will deliver survivable, protected communications to U.S. forces worldwide and provide assured connectivity for warfighters operating at all levels of conflict. Built for the Air Force, the payload will deliver the on-orbit digital processing capability needed to rapidly establish and reconfigure networks to meet dynamic command and control requirements. Satellite crosslinks enable flexible global communications without the need for fixed ground sites.



The communications payloads for Milstar, the precursor to AEHF, were also developed by Northrop Grumman. The Space Technology sector designed, built and integrated the low data rate payloads that serve core command and control activities, and supplied the antenna and digital subsystems for the satellites' medium data rate payloads that provide voice, data, imagery and targeting intelligence to fixed sites or small, mobile terminals. Four Milstar satellites are now on orbit; the fifth is scheduled for launch in early 2003.

Radio Systems

Since pioneering software-defined radio technology with the concept of integrated avionics, Northrop Grumman's Space Technology sector has set the industry standard for communications, navigation and identification (CNI) systems for next-generation military aircraft. The sector's integrated CNI avionics feature modular, software-programmable radios that simultaneously carry out numerous tasks and dynamically reconfigure functionalities. Advanced capabilities include friend-or-foe identification of approaching aircraft, automatic acquisition of fly-to points, and secure multiwave, multiband, multimode wireless communications.



Today, Northrop Grumman is charged with providing the integrated CNI avionics for some of the most important cutting-edge defense projects, including the F-35 Joint Strike Fighter (JSF), the F/A-22 Raptor fighter, and the RAH-66 Comanche reconnaissance/attack helicopter. The integrated CNI requirements for the F-35 will be worth \$4 billion to \$5 billion, excluding foreign market sales, over the anticipated life of the program. The selection of the Space Technology sector for these programs under-

scores the value of its extensive experience in the design, development and integration of complex aircraft communications systems.

Space Technology is also the developer of a revolutionary software technology that solves the global problem of upgrading slow, aging processors without incurring the huge expense for rewriting legacy software. Targeted for upgrading military embedded avionics systems, the sector's RePLACE (Reconfigurable Processor for Legacy Applications Code Execution) technology has the potential to save multiple millions of dollars in legacy software rewrite costs for the Department of Defense. In 2001, RePLACE was validated through a series of F-117 flight demonstrations that used ruggedized commercial off-the-shelf hardware to execute the existing F-117 operational flight program.

12/02

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