2008 Space Almanac

The US military space operation in facts and figures.

Compiled by Tamar A. Mehuron, Associate Editor, and the staff of Air Force Magazine
Medium Earth Orbit begins 300 miles

Hard vacuum 1,000 miles

Low Earth Orbit begins 60 miles

Astronaut wings awarded 50 miles

Limit for ramjet engines 28 miles

Limit for turbojet engines 20 miles

Stratosphere begins 10 miles

0.95g 100 miles

0.05g 60,000 miles

Geosynchronous Earth Orbit 22,300 miles

Illustration not to scale
US Military Missions in Space

- **Space Support**: Launch of satellites and other high-value payloads into space and operation of those satellites through a worldwide network of ground stations.
- **Space Force Enhancement**: Provide satellite communications, navigation, weather information, missile warning, command and control, and intelligence to the warfighter.
- **Space Control**: Ensure freedom of action in space for the US and its allies and, when directed, deny an adversary freedom of action in space.
- **Space Force Application**: Provide capabilities for the application of combat operations in, through, and from space to influence the course and outcome of conflict.

### US Space Funding

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**Total**: $823,629 $757,816 $51,066 $1,632,512
**The Year in Space**

**July 30, 2007**
Officials from DOD, NASA, and NOAA announce completion of a $4.2 billion restructuring contract for the National Polar-orbiting Operational Environmental Satellite System (NPOESS).

**July 30**
Space and Missile Systems Center, NOAA, and Lockheed Martin successfully show that a Defense Meteorological Satellite Program satellite, well past its design life, could still function without a gyro-enabled attitude control capability.

**Sept. 14**
The 50th Space Wing completes transfer from the 1970s-era Global Positioning System ground control segment to a modern ground control system, dubbed the Architecture Evolution Plan, with no loss of data.

**Sept. 20**
The Re-entry Structures Experiment, a hypersonic vehicle bearing five innovative experiments, marks its inaugural flight by achieving an altitude of 95,000 feet at Mach 5 and safely landing at White Sands Missile Range, N.M.

**Oct. 3**

**Oct. 10**
Cape Canaveral AFS, Fla., space operators oversee launch of the first Wideband Global SATCOM, via a United Launch Alliance Atlas V.

**Oct. 23**
Retired Air Force Col. Pamela A. Melroy commands the shuttle Discovery, launched into space from Kennedy Space Center, Fla., for a construction mission aboard the International Space Station.

**Nov. 10**
The 23rd and final Defense Support Program satellite enters orbit aboard a United Launch Alliance Delta IV heavy lift expendable launch vehicle, launched from Cape Canaveral AFS, Fla.

**Dec. 3**
Air Force Space Command’s 460th Space Wing at Buckley AFB, Colo., reactivates the 11th Space Warning Squadron, establishing it at Schriever AFB, Colo.

**Dec. 20**
A United Launch Alliance Delta II rocket boosts a new Global Positioning System IIR-M satellite into orbit from Cape Canaveral AFS, Fla.

**Dec. 28**
The 1st Space Operations Squadron, Schriever AFB, Colo., ends operation of the legacy Command and Control Segment satellite control system, which the Air Force has used since 1989.

**Feb. 20, 2008**
Air Force Space Command personnel and assets support Operation Burnt Frost, the successful intercept and shootdown of a decaying US intelligence satellite that could have reached Earth with a full load of fuel.

**March 7**
Air Force Reserve Command stands up its first wing dedicated to space operations, redesignating the 310th Space Group as the 310th Space Wing at Schriever AFB, Colo.

**March 13**
Air Force Space Command personnel at Vandenberg AFB, Calif., team with industry to conduct the first launch of an Atlas V evolved expendable launch vehicle from the West Coast launch facility.

**March 15**
Cape Canaveral AFB, Fla., hosts launch of the sixth of eight modernized GPS IIR-M satellites built by Lockheed Martin.

**March 25**
The Defense Department and the Intelligence Community officially cancel the current Space Radar program, citing affordability and feasibility concerns.

**May 15**
The Air Force selects Lockheed Martin to develop GPS III satellites in an initial $4.6 billion contract award. Teamed with ITT and General Dynamics, Lockheed will build the first two satellites.

**May 19**
At the request of Beijing, the US provides to China National Geospatial-Intelligence Agency satellite images of earthquake-ravaged Sichuan Province.

**June 2**
AFSPC’s 1st Space Operations Squadron at Schriever AFB, Colo., terminates operations of the Midcourse Space Experiment Satellite/Space Based Visible (MSX/SBV), the first US on-orbit asset to conduct surveillance of objects in space.

**Space and Missile Badges**
Air Force Space Command, Peterson AFB, Colo.

(As of July 1, 2008)

14th Air Force
Vandenberg AFB, Calif.
Commander
Lt. Gen. William L. Shelton

21st Space Wing
Peterson AFB, Colo.

30th Space Wing
Vandenberg AFB, Calif.

38th Space Wing
Patrick AFB, Fla.

45th Space Wing
Schriever AFB, Colo.

46th Space Wing
Buckley AFB, Colo.

14th Air Force
Vandenberg AFB, Calif.
Commander
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21st Space Wing
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30th Space Wing
Vandenberg AFB, Calif.

38th Space Wing
Patrick AFB, Fla.

45th Space Wing
Schriever AFB, Colo.

46th Space Wing
Buckley AFB, Colo.

Space Leaders

US Space Command

US Strategic Command

US Space Command

Army Space & Missile Systems Center
Los Angeles AFB, Calif.
Commander

Program Office
DMSP Systems Group
GPS Wing
Launch and Range Systems Wing (EELV, Delta II)
MILSATCOM Systems Wing
Satellite Control & Network Group
Space Based Infrared Systems Group
Space Development & Test Wing (Kirtland AFB, N.M.)
Space Superiority Systems Wing

Army Space & Missile Defense Command
Los Angeles AFB, Calif.
Commander

Space Innovation & Development Center
Schriever AFB, Colo.
Commander
Lt. Col. Robert F. Wright Jr.

National Reconnaissance Office


Gen. Martin C. Faga Sept. 26, 1989 March 5, 1993


Army Space & Missile Defense Command was the Army Strategic Defense Command until August 1992 and the Army Space and Strategic Defense Command until October 1997.

20th Air Force
F.E. Warren AFB, Wyo.
Commander
Maj. Gen. Roger W. Burg

90th Missile Wing
F.E. Warren AFB, Wyo.

91st Missile Wing
Minot AFB, N.D.

341st Missile Wing
Malmstrom AFB, Mont.
Major Military Commands With Space Functions

The Unified Command

US Strategic Command

Headquarters: Offutt AFB, Neb.
Established: June 1, 1992
Cmdr.: Gen. Kevin P. Chilton, USAF

MISSIONS

Deter attacks on US vital interests
Ensure US freedom of action in space and cyberspace
Deliver kinetic and nonkinetic effects to include nuclear and information operations for the joint warfighter

Provide global missile defense plans and operations and regional combating of weapons of mass destruction plans

Provide integrated surveillance and reconnaissance allocation recommendations

The Service Components

Air Force Space Command

Headquarters: Peterson AFB, Colo.
Established: Sept. 1, 1982
Cmdr.: Gen. C. Robert Kehler

MISSIONS

Defend the US through control and exploitation of space
Provide strategic deterrence by operating, testing, and maintaining ICBM forces for STRATCOM
Operate and employ space forces for strategic and tactical missile warning, battlespace characterization, environmental monitoring, satellite communications, precision navigation and timing, spacelift, and space control

Acquire, launch, and sustain space systems for USAF and DOD

Develop tactics, techniques, and procedures to integrate space capabilities with air, land, and sea forces

Develop space professionals

Naval Network Warfare Command

Headquarters: Norfolk, Va.
Established: July 11, 2002
Cmdr.: Vice Adm. H. Denby Starling II

MISSIONS

Operate and maintain the Navy’s space, network, and information operations systems and services
Support warfighting operations and command and control of naval forces
Promote innovative technological solutions to warfighting requirements
Advocate for maritime space, network, and information operations needs

Army Space & Missile Defense Command

Headquarters: Redstone Arsenal, Ala.
Established: Oct. 1, 1997
Cmdr.: Lt. Gen. Kevin T. Campbell

MISSIONS

Conduct space and missile defense operations and provide planning, integration, control, and coordination of Army forces and capabilities in support of US Strategic Command missions

Serve as Army’s specified proponent for space, high-altitude, and ground-based midcourse missile defense

Serve as Army’s operational integrator for global missile defense

Conduct space- and missile-related R&D for Army Title 10 responsibilities

The Service Components

National Reconnaissance Office

Headquarters: Chantilly, Va.
Established: September 1961
Director: Scott F. Large

MISSIONS

Engage in the research and development, acquisition, launch, and operation of overhead reconnaissance systems necessary to meet the needs of the Intelligence Community and DOD

National Geospatial-Intelligence Agency

Headquarters: Bethesda, Md.
Established: Nov. 24, 2003
Director: Vice Adm. Robert B. Murrett

MISSIONS

Provide geospatial intelligence (analysis and depiction of Earth’s physical features and geographic references) to aid national security operations

Formerly National Imagery and Mapping Agency (NIMA).

Major US Agencies With Roles in Space

Central Intelligence Agency

Established: 1947
Director: Michael V. Hayden

MISSIONS

Provide national security intelligence to senior US policy-makers

Direct Space Role

Support the National Reconnaissance Office in designing, building, and operating satellite reconnaissance systems

National Reconnaissance Office

Headquarters: Chantilly, Va.
Established: September 1961
Director: Scott F. Large

MISSIONS

Engage in the research and development, acquisition, launch, and operation of overhead reconnaissance systems necessary to meet the needs of the Intelligence Community and DOD

National Security Agency

Headquarters: Ft. Meade, Md.
Established: November 1952
Director: Lt. Gen. Keith B. Alexander, USA

MISSIONS

Protect US communications

Produce foreign signals intelligence
(Orbital only)

Applications 406
Communications 127
Weather 48
Navigation 99
Launch vehicle/spacecraft tests 6
Other military 126

Weapons-Related Activities 46
SDI tests 11
Anti-satellite targets 2
Anti-satellite interceptors 33

Reconnaissance 444
Photographic/radar imaging 256
Electronic intelligence 55
Ocean surveillance 48
Nuclear detection 12
Radar calibration 37
Early warning 36
Total 896

AFSPC Personnel Deployed by Unified Command

USCENTCOM 1,032
USEUCOM 27
USJFCOM 0
USNORTHCOM 44
USOUTHCOM 17
USSOCOM 0
USPACOM 2
USTRANSCOM 0

Total deployed 1,122

By Region

Western and Southern Europe
Germany 15
UK 0
Italy 5
Turkey 1
Spain 1
Other countries 8

East Asia and Pacific
Japan/Okinawa 0
South Korea 0
Other countries 1

Africa, Near East, South Asia
Saudi Arabia 17
Egypt 0
Other countries 990

Western hemisphere
Canada 0
Other countries 84

Orbits
Orbits result from the mutual attraction of any two bodies with a force proportional to the product of their individual masses and inversely proportional to the square of the distance between them. The curvature of the Earth, on average, drops 16 feet below the horizontal over a distance of about five miles. A spacecraft circling above would “fall” that same amount over the same distance. It travels five miles in one second if gravitational pull equals one G. Therefore, spacecraft velocity of five miles per second (18,000 mph) produces perpetual orbit at sea level, unless the spacecraft’s flight is upset by perturbations, such as solar wind or mechanical anomalies.

Orbital Altitude
- LEO Low Earth orbit
- MEO Medium Earth orbit
- GEO Geosynchronous Earth orbit
- HEO High Earth orbit

Orbital Inclinations
- 1 Equatorial
- 2 Sun synchronous
- 3 Polar

Geosynchronous Transfer Orbit
It is common procedure to pick an initial “parking” orbit, usually at LEO, then boost payloads to higher altitude. Engines are fired first (at perigee) to reach the apo- ge of an elliptical transfer orbit and then are fired again to put the spacecraft into a circular orbit at that higher altitude.

Illustrations are not drawn to scale.
### US Military/Civil Launches
(As of Dec. 31, 2007)

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Data changes in prior years reflect recategorization from civil to military launches.

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(As of Dec. 31, 2007)

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### What’s Up There
(As of Dec. 31, 2007)

#### Payloads in Orbit

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<td>Other**</td>
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</table>

* Russia includes Commonwealth of Independent States (CIS) and former Soviet Union.
** Other refers to countries or organizations that have placed fewer than five objects in space.
Inclination is the angle between the Earth’s equatorial plane and a satellite’s orbital plane. A satellite at the wrong inclination—passing over the wrong spot on Earth—may hinder its ability to perform its mission.

US Satellites Placed in Orbit or Deep Space

(As of Dec. 31, 2007)

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<td>1983</td>
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*Includes some military payloads.

Air Force Personnel in Space Organizations

As of Sept. 30, 2007

<table>
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<tr>
<th>FY98</th>
<th>FY99</th>
<th>FY00</th>
<th>FY01</th>
<th>FY02</th>
<th>FY03</th>
<th>FY04</th>
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Satellite Inclination

Inclination is the angle between the Earth’s equatorial plane and a satellite’s orbital plane. A satellite at the wrong inclination—passing over the wrong spot on Earth—may hinder its ability to perform its mission.
AFSPC Squadrons by Mission Type
(As of Sept. 30, 2007)

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<th>FY00</th>
<th>FY01</th>
<th>FY02</th>
<th>FY03</th>
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</table>

The Constellations

Multiple satellites working in groups to perform a single mission can provide greater coverage than a single satellite, enabling global coverage or increasing timeliness of coverage.

**Navigation** constellations provide simultaneous signals from multiple satellites to a location on the ground.

**Communications** constellations ensure at least one satellite is in line of sight of both ends of the communications link.

**Weather and reconnaissance** constellations generally contain both high and low altitude systems.

Some **surveillance** systems need continuous access to areas of interest, calling for high altitude, long dwell time orbits.
AD SPACE
Athena I
Function: lift low to medium weights.
Launch site: Cape Canaveral AFS, Fla., Vandenberg AFB, Calif.
Contractor: Lockheed Martin.
Stages: two.
Propulsion: stage 1 (Thiokol Castor 120 Solid Rocket Motor), 435,000 lb thrust; stage 2 (Pratt & Whitney Orbus 21D SRM), 43,723 lb thrust.
Dimensions: length 62 ft, max body diameter 7.75 ft.
Weight: 146,264 lb.
Payload: 1,750 lb to LEO.

Athena II
Function: lift low to medium weights.
First launch: Jan. 6, 1998.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: three.
Propulsion: stages 1-2 (Castor 120 SRMs), 435,000 lb thrust; stage 3 (Orbus 21D SRM), 43,723 lb thrust.
Dimensions: length 93 ft, max body diameter 7.75 ft.
Weight: 266,000 lb.
Payload: 4,350 lb to LEO.

Atlas V
Function: lift medium to heavy weights.
Variants: 400 and 500 series.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: two.
Propulsion: (400 and 500 series) stage 1: one RD AMROSS LLC RD-180 engine with two chambers, 860,200 lb thrust; stage 2: Centaur, one or two Pratt & Whitney RL10A-4-2 engines, 16,500-22,300 lb thrust. Strap-on solid rocket boosters, up to three (400), up to five (500).
Dimensions: (stage 1) length 106.2 ft, max body diameter 12.5 ft; (stage 2) length 41.6 ft, max body diameter 10 ft.
Weight: 741,061-1.2 million lb.
Payload: (400 series) 27,558 lb to LEO, 10,913-17,196 to GTO; (500 series) 22,707-45,238 lb to LEO, 8,752-19,180 lb to GTO. (500 series supports 16.5 ft diameter payload fairing.)

Delta II
Function: lift medium weights.
Launch site: CCAFS, VAFB.
Contractor: Boeing.
Stages: up to three.
Propulsion: stage 1 (Rocketdyne RS-27A), 237,000 lb thrust; stage 2 (Aerojet AJ10-118K), 9,753 lb thrust; stage 3 (Thiokol STAR 48B SRM), 14,920 lb thrust; nine strap-on SRMs (Alliant Techsystems), 100,270 lb thrust.
Dimensions: length 125 ft, max body diameter 16.7 ft.
Weight: 511,190 lb.
Payload: 5,960-13,440 lb to LEO.

Delta IV
Function: lift medium to heavy weights.
Variants: Medium, Medium-Plus, and Heavy.
First launch: Nov. 20, 2002.
Launch site: CCAFS; VAFB.
Contractor: Boeing.
Stages: two.
Propulsion: stage 1, Rocketdyne RS-68 (Heavy, two additional core engines), 650,000 lb thrust; stage 2 (Medium), P&W RL10B-2, 24,750 lb thrust.
Dimensions: (core booster, all versions) length 125 ft, max body diameter 16.7 ft.
Weight: (Medium) 64,719 lb; (heavy) 196,688 lb.
Payload: 20,170-49,740 lb to LEO; 9,480-28,620 lb to GTO. (Heavy supports 16.6 ft diameter payload fairing.)

EELV
Function: lift medium to heavy weights.
Note: Atlas V and Delta IV (see individual entries) are participating in USAF's evolved expendable launch vehicle (EELV) modernization program. These systems replaced Atlas II, Titan II, and Titan IV launch vehicles.
**Pegasus**  
Function: lift low weights.  
Variants: Standard and XL.  
Launch site: dropped from L-1011 aircraft.  
Contractor: Orbital Sciences, Alliant.  
Stages: three.  
Propulsion: (XL) (all Alliant Techsystems) stage 1, 109,400 lb thrust; stage 2, 27,600 lb thrust; stage 3, 7,800 lb thrust.  
Dimensions: length 49 ft, wingspan 22 ft, diameter 4.17 ft.  
Weight: 42,000 lb.  
Payload max: (Standard) 850 lb to LEO; (XL) 1,050 lb to GEO.

**Space Shuttle**  
Function: lift heavy weights.  
First launch: April 12, 1981.  
Launch site: John F. Kennedy Space Center, Fla.  
Contractor: Boeing (launch).  
Stages: delta-winged orbiter.  
Propulsion: three main engines, 394,000 lb thrust; two SRMs, 3.3 million lb thrust.  
Dimensions: system length 184 ft; span 78 ft.  
Weight: 4.5 million lb (gross).  
Payload max: 55,000 lb to LEO.

**Taurus**  
Function: lift low weights.  
Variants: Standard and XL.  
Launch site: CCAFS, Kodiak Launch Complex, Alaska; VAFB; Wallops Island, Va.  
Contractor: Orbital Sciences.  
Stages: four.  
Propulsion: Castor 120 SRM, 495,400 lb thrust; stage 1, 109,140 lb thrust; stage 2, 26,900 lb thrust; stage 3, 7,200 lb thrust.  
(Stages 1-3, Alliant Techsystems) Dimensions: length 89 ft, max body diameter 7.6 ft.  
Weight: 170,000 lb max.  
Payload max: 3,000 lb to LEO.

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**Major Military Satellite Systems**

**Advanced Extremely High Frequency Satellite Communications System**  
Common name: AEHF  
In brief: successor to Milstar, AEHF will provide assured strategic/tactical, worldwide C2 communications with at least 10 times the capacity of Milstar II but in a smaller package.  
Function: EHF communications.  
Operator: MILSATCOM JPO (acquisition); AFSPC.  
First launch: 2009, planned.  
On orbit: three, planned.  
Orbit altitude: 22,000+ miles.

**Defense Meteorological Satellite Program**  
Common name: DMS  
In brief: satellites that collect air, land, sea, and space environmental data to support worldwide strategic and tactical military operations. Operational control transferred to NOAA in 1998; backup operation center at Schriever AFB, Colo., manned by Air Force Reserve Command personnel.  
Function: environmental monitoring.  
Operator: NPOESS Integrated Program Office.  
On orbit: two (primary).  
Orbit altitude: approx 527 miles.

**Defense Satellite Communications System III**  
Common name: DSCS  
In brief: nuclear-hardened and jam-resistant spacecraft used to transmit high-priority C2 messages to battlefield commanders.  
Function: SHF communications.  
Operator: AFSPC.  
First launch: October 1982.  
On orbit: five (primary).  
Orbit altitude: 22,000+ miles.

**Defense Support Program**  
Common name: DSP  
In brief: early warning spacecraft whose infrared sensors detect heat generated by
a missile or booster plume.  
Function: strategic and tactical missile launch detection.  
Operator: AFSPC.  
First launch: November 1970.  
On orbit: classified.  
Orbit altitude: 22,000+ miles.

Enhanced Polar System  
Common name: EPS  
In brief: next generation polar communications to replace interim polar system (see Interim Polar System, below), which provides polar communications capability required by aircraft, submarines, and other forces operating in the high northern latitudes. Pre-acquisition, system definition, and risk reduction efforts started in Fiscal 2006.  
Function: EHF polar communications.  
Operator: MILSATCOM JPO (acquisition); AFSPC.  
First launch: availability 2013.  
On orbit: two, planned.  
Orbit altitude: 22,300+ miles.

Global Broadcast System  
Common name: GBS  
In brief: wideband communications program, initially using leased commercial satellites, then military systems, to provide digital multimedia data directly to theater warfighters.  
Function: high-bandwidth data imagery and video.  
Operator: Navy.  
On orbit: two.  
Orbit altitude: 23,230 miles.

Global Positioning System  
Common name: GPS  
In brief: constellation of satellites used by military and civilians to determine a precise location and time anywhere on Earth. Block IIR began replacing older GPS spacecraft in mid-1997; first modified Block IIR-M with military signal (M-code) on two channels launched in 2005. Next generation Block IIF with extended design life, faster processors, and new civil signal on third frequency launches in 2008. Generation after next GPS III with advanced anti-jam and higher quality data is slated for initial launch in 2014.  
Function: worldwide positioning, navigation, and precise time transfer.  
Operator: AFSPC.  
First launch: Feb. 22, 1978 (Block I).  
On orbit: 30.  
Orbit altitude: 10,988 miles.

Interim Polar System  
Common name: IPS  
In brief: USAF deployed a modified EHF payload on a host polar-orbiting satellite to provide an interim solution to ensure warfighters have protected polar communications capability. Polar 3 slated for launch in 2007.  
Function: EHF polar communications.  
Operator: Navy.  
First launch: 1997.  
On orbit: two.  
Orbit altitude: 25,300 miles (apogee).

Milstar Satellite Communications System  
Common Name: Milstar  
In brief: joint communications satellite that provides secure, jam-resistant communications for essential wartime needs.  
Function: EHF communications.  
Operator: AFSPC.  
On orbit: five.  
Orbit altitude: 22,300 miles.

Mobile User Objective System  
(also known as Advanced Narrowband System)  
Common name: MUOS  
In brief: next generation narrowband UHF tactical communications satellite to replace the UHF Follow-On Satellite (see below). Concept study contracts awarded in 1999; production award to Lockheed Martin in September 2004; initial launch in 2010.  
Function: UHF tactical communications.  
Operator: Navy.  
First launch: 2010, planned.  
On orbit: none.  
Orbit altitude: 22,300 miles.

Space Based Infrared System High  
Common name: SBIRS High  
In brief: advanced surveillance system for missile warning, missile defense, battlespace characterization, and technical intelligence. System initially will complement, then replace, Defense Support Program spacecraft (see p. 47).  
Function: infrared space surveillance.  
Operator: AFSPC.  
First launch: 2009, planned.  
On orbit: none.  
Orbit altitude: 22,300 miles.

Space Based Surveillance  
Common name: SBSS  
In brief: Will replace the Midcourse Space Experiment/Space Based Visible (MSX/SBV) satellite that performs tracking and optical signature collection on Earth-orbiting objects.  
Function: space surveillance.  
Operator: AFSPC.  
First launch: Early 2009, planned.  
On orbit: one Pathfinder satellite to be launched in 2008 and four operational satellites are planned for the 2014 timeframe.  
Orbit altitude: 528 miles.

Space Tracking and Surveillance System  
(formerly SBIRS Low).  
Common name: STSS  
In brief: infrared surveillance and tracking satellites to detect and track ballistic missiles from launch to impact. System is sensor component of layered ballistic missile defense system and will work with SBIRS High (see above).  
Function: infrared surveillance.  
Operator: MDA (acquisition); AFSPC.  
First launch: 2008 or later for R&D, planned.  
On orbit: none.

Transformational Satellite Communications System  
Common name: TSAT  
In brief: protected strategic and tactical survivable SATCOM and unprotected wideband SATCOM connectivity for authorized users. Protected TSAT SATCOM uses anti-jam and low probability of intercept capabilities coupled with defensive information warfare, nuclear survivability, resistance to physical destruction, and US control of SATCOM access for assured communications. TSAT represents part of the space backbone of the global information grid supporting Internet-like connectivity, net-centric operations, and warfare (NCOW). It will feature laser crosslink and greatly reduced transmission time to users on the ground. Intended to replace Advanced Extremely High Frequency system (see p. 47), it is slated for launch around 2016. Currently in design and risk-reduction phase.
**Major Military Satellite Systems, Continued**

**Function:** EHF, Ka-band and laser communications.
**Operator:** MILSATCOM Systems Wing (acquisition); AFSPC (operations).
**First launch:** 2016, planned.
**On orbit:** five and one spare, planned.
**Orbit altitude:** 22,300 miles.

**UHF Follow-On Satellite**
**Common name:** UFO
**In brief:** new generation satellites providing secure, anti-jam communications; replaced FLTSATCOM satellites.
**Function:** UHF and EHF communications.
**Operator:** Navy.
**First launch:** March 25, 1993.
**Constellation:** four primary, four redundant.
**On orbit:** nine.
**Orbit altitude:** 22,300 miles.

**Wideband Global SATCOM**
**Common name:** WGS
**In brief:** multiservice program leveraging commercial methods to rapidly design, build, launch, and support a constellation that will augment X-band satellite communications (DSCS) and one-way Ka-band (Global Broadcast Service) while providing a new two-way Ka-band service (see p. 47 and 48).
**Function:** wideband communications and point-to-point service (Ka-band and X-band frequencies).
**Operator:** AFSPC (bus); SMDC/AR-STRAT (payload).
**First launch:** Oct. 10, 2007.
**On orbit:** six, planned.
**Orbit altitude:** 22,000+ miles.

**Dark and Spooky**
**A number of intelligence satellites are operated by US agencies in cooperation with the military. The missions and, especially, the capabilities are closely guarded secrets.**
- Most of the names of satellites, such as White Cloud (ocean reconnaissance), Aquacade (electronic ferret), and Trumpet (Sigint), are essentially open secrets but cannot be confirmed by the Intelligence Community.

**Major Civilian Satellites in US Military Use**

**Geostationary Operational Environmental Satellite**
**Common name:** GOES
**In brief:** in equatorial orbit to collect weather data for short-term forecasting.
**Function:** storm monitoring and tracking, meteorological research.
**Operator:** NOAA.
**First launch:** Oct. 16, 1975 (GOES-1).
**Constellation:** two, with on-orbit spare.
**Orbit altitude:** 22,300 miles.

**Globalstar**
**Common name:** Globalstar
**In brief:** mobile communications with provision for security controls.
**Function:** communications.
**Operator:** Globalstar L.P.
**First launch:** February 1998.
**Constellation:** 48.
**Orbit altitude:** 878 miles.

**Ikonos**
**Common name:** Ikonos
**In brief:** one-meter resolution Earth imaging.
**Function:** remote sensing.
**Operator:** Space Imaging, Inc.
**First launch:** Sept. 24, 1999.
**Constellation:** one.
**Orbit altitude:** 423 miles.

**Inmarsat**
**Common name:** Inmarsat
**In brief:** peacetime mobile communications services, primarily by US Navy.
**Function:** communications.

**Intelsat**
**Common name:** Intelsat
**In brief:** routine communications and distribution of Armed Forces Radio and TV Services network.
**Function:** communications.
**Operator:** International Telecommunications Satellite Organization.
**First launch:** April 6, 1965 (Early Bird).
**Constellation:** 51.
**Orbit altitude:** 22,300 miles.

**Iridium**
**Common name:** Iridium
**In brief:** voice, fax, data transmission.
**Function:** handheld, mobile communications.
**Operator:** Iridium L.L.C.
**First Launch:** May 5, 1997.
**Constellation:** 66 (six on-orbit spares).
**Orbit:** 485 miles.

**Landsat**
**Common name:** Landsat
**In brief:** imagery use includes mapping and planning for tactical operations.
**Function:** remote sensing.
**Operator:** US Geological Survey.
**First launch:** July 23, 1972.
**Constellation:** one.
**Orbit altitude:** 438 miles (polar).

**National Polar-orbiting Operational Environmental Satellite System**
**Common name:** NPOESS
**In brief:** advanced joint civil-military polar environmental satellite that provides weather, atmosphere, ocean, land, and near-space data. Managed by tri-agency (DOD, Department of Commerce, and NASA) integrated program office. Designed to replace USAF’s DMSP and NOAA’s Polar-orbiting Operational Environmental Satellite (POES) (see p. 50).
**Function:** worldwide environmental forecasting.
**Operator:** IPO (AFSPC for acquisition and launch; NOAA for operations).
**First launch:** 2010, planned.
**Constellation:** three.
**On orbit:** none.
**Orbit altitude:** 550 (LEO) miles.

**Orbcomm**
**Common name:** Orbcomm
**In brief:** potential military use under study in Joint Interoperability Warfighter Program.
**Function:** mobile communications.
**Operator:** Orbcomm Global L.P.
**First launch:** April 1995.
**Constellation:** 30.
**Orbit altitude:** 500-1,200 miles.

**Pan Am Sat**
**Common name:** Pan Am Sat
**In brief:** routine communications providing telephone, TV, radio, and data.
**Function:** communications.
**Operator:** Pan Am Sat.*

**Reading About Space**

Major Civilian Satellites in US Military Use, Continued

- Constellation: two.
- Operator: NOAA (on-orbit); NASA (launch).
- Function: extended weather forecasting.
- Prime: To be replaced by NPOESS.
- As of 1998, there were NOAA-N (launched in 2005) and N Prime. To be replaced by NPOESS.
- In brief: two advanced third generation environmental satellites (one morning orbit and one afternoon orbit) provide longer-term weather updates for all areas of the world. Final two spacecraft in this series are NOAA-N (launched in 2005) and N Prime. To be replaced by NPOESS.
- Orbit altitude: 279 miles.

Satellite Pour l’Observation de la Terre

- Constellation: one.
- Constellation: one.
- Orbit altitude: 509 miles.

Telstar

- Constellation: two.
- Orbit altitude: 517 miles.

Major US Military Ground-Based Space Surveillance Systems

Air Force Space Surveillance System

- Common name: Air Force Fence
- In brief: continuous wave radars located across the southern US to track man-made objects in Earth orbit.
- Function: space surveillance.
- Operator: AFSPC.
- Operational: March 31, 1959 (US Navy).
- Unit location: Dahlgren, Va. (command & control); receivers in Arkansas, California, Georgia, Mississippi, and New Mexico; transmitters in Alabama, Arizona, and Texas.
- Components: One command & control center, six receiver sites, and three transmitters.

AN/FPS-85 Phased-Array Radar

- Common name: Eglin radar
- In brief: active phased-array radar used in all weather to track man-made objects in Earth orbit.
- Function: space surveillance.
- Operator: AFSPC.
- Unit location: Eglin AFB, Fla.

Ballistic Missile Early Warning System

- Common name: BMEWS
- In brief: phased-array radar used for tactical warning and attack assessment and tracking Earth-orbiting satellites.
- Function: ballistic missile attack and space surveillance.
- Operator: AFSPC.
- Operational: 1959 (Trinidad, British West Indies); July 1, 1961 (Clear AFS, Alaska).
- Unit location: Clear AFS, Alaska; RAF Fylingdales, Britain; Thule AB, Greenland.
- Components: (Clear AFS) AN/FPS-120 solid-state phased-array radar (SSPAR) with two faces; computers for radar control and data processing.

Ground-based Electro-optical Deep Space Surveillance

- Common name: GESOPT
- In brief: optical system that tracks objects such as Earth-orbiting satellites in deep space.
- Function: space surveillance.
- Operator: AFSPC.
- Operational: June 30, 1982.
- Unit location: Socorro, N.M.; Diego Garcia, Indian Ocean; Maui, Hawaii.
- Components: three telescopes, low-light-level EO cameras, and high-speed computers.

Moron Optical Space Surveillance

- Common name: MOSS
- In brief: optical system that tracks objects such as Earth-orbiting satellites in deep space.
- Function: space surveillance.
- Operator: AFSPC.
- Operational: June 1998.
- Unit location: Moron, Spain.
- Components: optical telescope and high-speed computers.

Pave Phased-Array Warning System

- Common Name: Pave PAWS
- In brief: phased-array radar used to detect and track sea-launched and intercontinental ballistic missiles, as well as Earth-orbiting satellites.
- Function: missile warning and space surveillance.
- Operator: AFSPC.
- Unit location: Beale AFB, Calif.; Cape Cod AFS, Mass.
- Components: AN/FPS-115 phased-array radar; computers for radar control and data processing.

Perimeter Acquisition Radar Attack Characterization System

- Common name: PARCS
- In brief: ICBM and SLBM warning and space surveillance of Earth-orbiting satellites in deep space.
- Function: ballistic missile warning and space surveillance.
- Operator: AFSPC.
- Unit location: Cavalier AFS, N.D.
- Components: One AN-FPQ-16 single-faced, phased-array radar.

Quickbird 2

- Common name: Quickbird 2
- In brief: high-resolution imagery for mapping, military surveillance, weather research, and other uses.
- Function: remote sensing.
- Operator: DigitalGlobe.
- Constellation: one.
- Orbit altitude: 279 miles.

Telstar

- Constellation: two.
- Orbit altitude: 517 miles.

Tracking and Data Relay Satellite System

- Common name: TDRSS
- In brief: global network that allows other spacecraft in LEO to communicate with a control center without an elaborate network of ground stations.
- Function: communications relay.
- Operator: NASA.
- First launch: April 1983.
- Constellation: seven.
- Orbit altitude: 22,300 miles.
Milestones in Military Space

March 22, 1946. JPL-Ordnance WAC, first US rocket to leave Earth’s atmosphere, reaches 50-mile height after launch from White Sands Proving Ground, N.M.

Oct. 4, 1957. USSR launches Sputnik 1, first man-made satellite, into Earth orbit.


Dec. 18, 1958. Project Score spacecraft conducts first US active communication from space.

Feb. 28, 1959. USAF successfully launches Discoverer 1 (of then-classified Corona program), world’s first polar-orbiting satellite, from Vandenberg AFB, Calif.

April 6, 1959. The first military unit to be charged with conducting military satellite operations, USAF’s 6594th Test Wing, is established at Palo Alto, Calif.

April 13, 1959. Air Force Thor/Agena A boosts into orbit Discoverer 2 satellite, first satellite to be stabilized in orbit in all three axes, to be maneuvered on command from Earth, to separate a re-entry vehicle on command, and to send its re-entry vehicle back to Earth.


Aug. 18, 1960. Discoverer/Corona satellite takes first image of Soviet territory ever snapped from space.

April 12, 1961. Soviet cosmonaut Yuri Gagarin pilots Vostok 1 through nearly one orbit to become first human in space.


March 18, 1965. First space walk conducted by Alexei Leonov from Soviet Voskhod 2.


June 18, 1965. USAF accepts Titan III, first Air Force vehicle specifically designed and developed as a military space booster.


Jan. 25, 1966. Soviets complete first successful fractional orbital bombardment system test, deorbiting Kosmos 139 satellite re-entry vehicle to an impact point within Soviet Union.


July 20, 1969. At 10:56 p.m. EDT, Apollo 11 astronaut Neil A. Armstrong puts his foot on the surface of the moon, becoming the first human to do so.


April 19, 1971. First space station, Salyut 1, goes aloft.


April 12-14, 1981. Space shuttle performs its first orbital flight and becomes first reusable spacecraft to land back on Earth.


May 29, 1998. USAF hands control of DMSP spacecraft to NOAA—the first transfer of a fully operational military space system to civilian agency.


Nov. 21, 2000. For the first time, a single Delta II rocket, lifting off from Vandenberg AFB, Calif., launches two different primary payloads.

April 22, 2003. AFSPC’s 14th Air Force activates first-of-its-kind space intelligence squadron, the 614th SIS, to identify and devise means to respond to threats to US space systems.

Jan. 11, 2007. Chinese ASAT destroys orbiting Chinese satellite, making China only the third nation (after the US and Russia) to do so.

Major Space Treaties and Laws

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<td>Rescue Agreement</td>
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<td>Convention on International Liability for Damage Caused by Space Objects</td>
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<td>Agreement Governing the Activities of States on the Moon and Other Celestial Bodies</td>
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Acknowledgements

This almanac was compiled by Air Force Magazine, with assistance and information from Steve Garber, NASA History Office; Joseph J. Burger, Space Analysis and Research, Inc.; and US Strategic Command and Air Force Space Command Public Affairs Offices.

Figures that appear in this section will not always agree because of different cutoff dates, rounding, or different methods of reporting. The information is intended to illustrate trends in space activity.