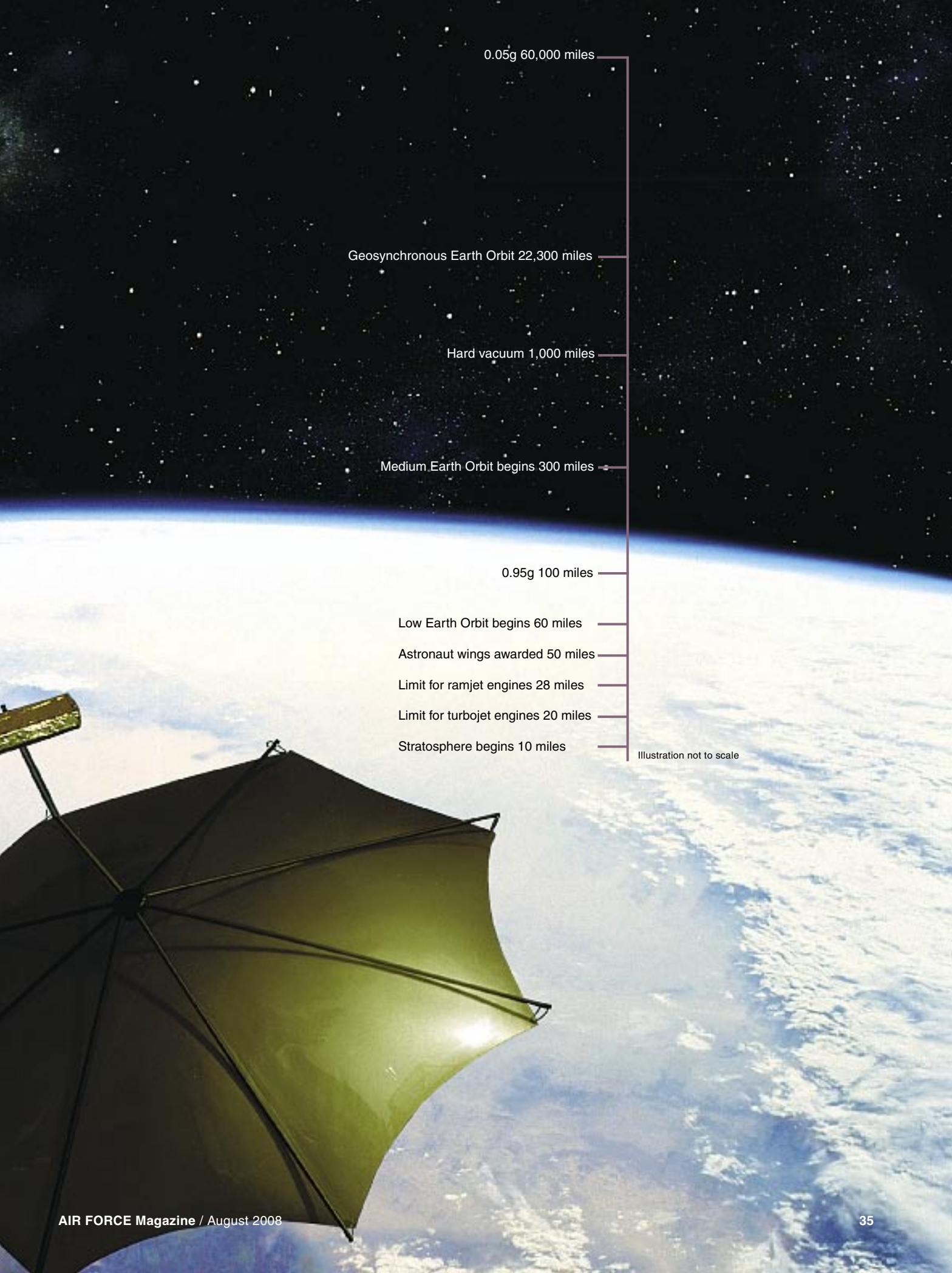


2008 Space Almanac

The US military space operation in facts and figures.

Compiled by **Tamar A. Mehuron**, Associate Editor, and the staff of *Air Force Magazine*



0.05g 60,000 miles

Geosynchronous Earth Orbit 22,300 miles

Hard vacuum 1,000 miles

Medium Earth Orbit begins 300 miles

0.95g 100 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

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.

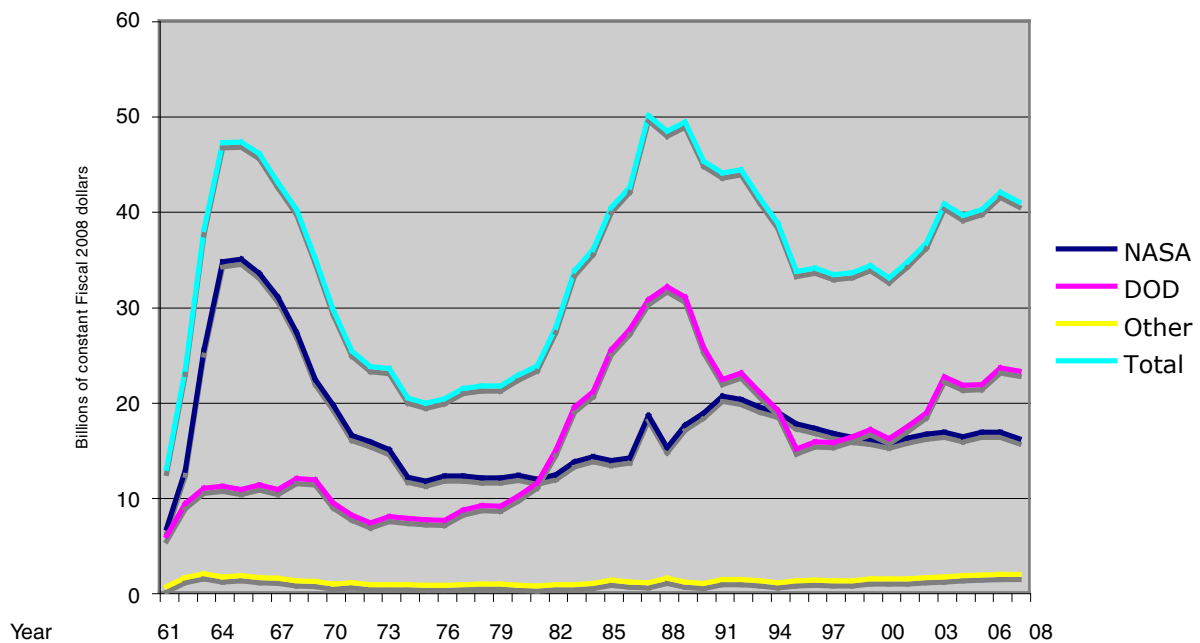
Space Control

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



Figures in millions of constant Fiscal 2008 dollars

Year	NASA	DOD	Other	Total	Year	NASA	DOD	Other	Total
1959	1,913	3,592	249	5,755	1984	14,091	20,948	811	35,850
1960	3,330	4,044	310	7,684	1985	13,734	25,323	1,158	40,215
1961	6,609	5,809	485	12,903	1986	13,945	27,494	928	42,367
1962	12,698	9,172	1,406	23,276	1987	18,428	30,598	875	49,901
1963	25,293	10,812	1,793	37,898	1988	15,019	31,905	1,337	48,261
1964	34,540	11,011	1,467	47,018	1989	17,387	30,835	964	49,187
1965	34,823	10,668	1,633	47,124	1990	18,723	25,514	826	45,063
1966	33,361	11,125	1,410	45,895	1991	20,456	22,235	1,211	43,902
1967	30,856	10,630	1,361	42,848	1992	20,093	22,869	1,214	44,176
1968	27,160	11,784	1,068	40,012	1993	19,308	20,848	1,080	41,236
1969	22,211	11,698	990	34,899	1994	18,758	18,966	911	38,635
1970	19,501	9,226	775	29,502	1995	17,576	14,915	1,063	33,554
1971	16,331	7,963	853	25,146	1996	17,099	15,664	1,126	33,890
1972	15,671	7,180	681	23,532	1997	16,566	15,595	1,050	33,211
1973	14,862	7,799	708	23,369	1998	16,127	16,177	1,099	33,403
1974	11,943	7,645	684	20,272	1999	15,957	16,910	1,258	34,124
1975	11,566	7,507	626	19,699	2000	15,509	16,029	1,308	32,846
1976	12,095	7,437	631	20,163	2001	16,030	17,261	1,280	34,571
1977	12,114	8,494	681	21,289	2002	16,450	18,666	1,418	36,535
1978	11,857	8,961	740	21,557	2003	16,647	22,476	1,513	40,635
1979	11,850	8,927	729	21,506	2004	16,166	21,577	1,653	39,395
1980	12,124	9,969	599	22,692	2005	16,641	21,661	1,691	39,993
1981	11,725	11,340	550	23,615	2006	16,676	23,392	1,742	41,811
1982	12,226	14,771	692	27,689	2007	16,019	23,068	1,729	40,816
1983	13,561	19,328	701	33,590	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

Gen. Kevin P. Chilton, formerly head of Air Force Space Command, Peterson AFB, Colo., assumes command of US Strategic Command, Offutt AFB, Neb. Gen. C. Robert Kehler, former STRATCOM deputy commander, becomes head of Air Force Space Command.

Oct. 10

Cape Canaveral AFS, Fla., space

operators oversee launch of the first Wide-band 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 shutdown 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

CURRENT



Space Badge



Missile Badge



Astronaut



Missile Badge With Operations Designator

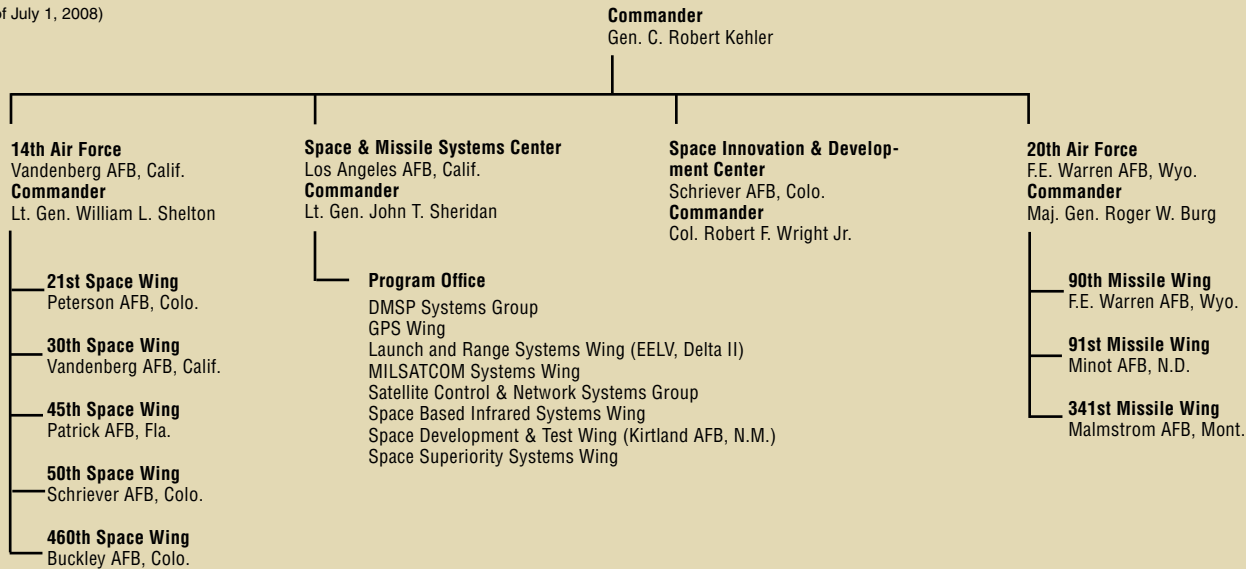
HISTORICAL



Space/Missile Badge

Air Force Space Command, Peterson AFB, Colo.

(As of July 1, 2008)



Space Leaders

(As of June 30, 2008. A = Acting)

US Space Command

Gen. Robert T. Herres	Sept. 23, 1985	Feb. 5, 1987
Gen. John L. Piotrowski	Feb. 6, 1987	March 30, 1990
Gen. Donald J. Kutyna	April 1, 1990	June 30, 1992
Gen. Charles A. Horner	June 30, 1992	Sept. 12, 1994
Gen. Joseph W. Ashy	Sept. 13, 1994	Aug. 26, 1996
Gen. Howell M. Estes III	Aug. 27, 1996	Aug. 13, 1998
Gen. Richard B. Myers	Aug. 14, 1998	Feb. 22, 2000
Gen. Ralph E. Eberhart	Feb. 22, 2000	Oct. 1, 2002

US Strategic Command

Adm. James O. Ellis Jr.	Oct. 1, 2002	July 9, 2004
Gen. James E. Cartwright, USMC	July 9, 2004	Aug. 10, 2007
Lt. Gen. C. Robert Kehler, USAF (A)	Aug. 10, 2007	Oct. 3, 2007
Gen. Kevin P. Chilton, USAF	Oct. 3, 2007	

US Space Command was inactivated Oct. 1, 2002, and its mission transferred to US Strategic Command.

Air Force Space Command

Gen. James V. Hartinger	Sept. 1, 1982	July 30, 1984
Gen. Robert T. Herres	July 30, 1984	Oct. 1, 1986
Maj. Gen. Maurice C. Padden	Oct. 1, 1986	Oct. 29, 1987
Lt. Gen. Donald J. Kutyna	Oct. 29, 1987	March 29, 1990
Lt. Gen. Thomas S. Moorman Jr.	March 29, 1990	March 23, 1992
Gen. Donald J. Kutyna	March 23, 1992	June 30, 1992
Gen. Charles A. Horner	June 30, 1992	Sept. 13, 1994
Gen. Joseph W. Ashy	Sept. 13, 1994	Aug. 26, 1996
Gen. Howell M. Estes III	Aug. 26, 1996	Aug. 14, 1998
Gen. Richard B. Myers	Aug. 14, 1998	Feb. 22, 2000
Gen. Ralph E. Eberhart	Feb. 22, 2000	April 19, 2002
Gen. Lance W. Lord	April 19, 2002	March 3, 2006
Lt. Gen. Frank G. Klotz (A)	March 3, 2006	June 26, 2006
Gen. Kevin P. Chilton	June 26, 2006	Oct. 3, 2007
Lt. Gen. Michael A. Hamel (A)	Oct. 3, 2007	Oct. 12, 2007
Gen. C. Robert Kehler	Oct. 12, 2007	

Army Space & Missile Defense Command

Lt. Gen. John F. Wall	July 1, 1985	May 24, 1988
Brig. Gen. R.L. Stewart (A)	May 24, 1988	July 11, 1988
Lt. Gen. Robert D. Hammond	July 11, 1988	June 30, 1992
Brig. Gen. W.J. Schumacher (A)	June 30, 1992	July 31, 1992
Lt. Gen. Donald M. Lionetti	Aug. 24, 1992	Sept. 6, 1994
Lt. Gen. Jay M. Garner	Sept. 6, 1994	Oct. 7, 1996
Lt. Gen. Edward G. Anderson III	Oct. 7, 1996	Aug. 6, 1998
Col. Stephen W. Flohr (A)	Aug. 6, 1998	Oct. 1, 1998
Lt. Gen. John Costello	Oct. 1, 1998	March 28, 2001
Brig. Gen. J.M. Urias (A)	March 28, 2001	April 30, 2001
Lt. Gen. J.M. Cosumano Jr.	April 30, 2001	Dec. 16, 2003
Lt. Gen. Larry J. Dodgen	Dec. 16, 2003	Dec. 18, 2006
Lt. Gen. Kevin T. Campbell	Dec. 18, 2006	

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

National Reconnaissance Office

Joseph V. Charyk	Sept. 6, 1961	March 1, 1963
Brockway McMillan	March 1, 1963	Oct. 1, 1965
Alexander H. Flax	Oct. 1, 1965	March 11, 1969
John L. McLucas	March 17, 1969	Dec. 20, 1973
James W. Plummer	Dec. 21, 1973	June 28, 1976
Thomas C. Reed	Aug. 9, 1976	April 7, 1977
Charles W. Cook (A)	April 7, 1977	Aug. 3, 1977
Hans Mark	Aug. 3, 1977	Oct. 8, 1979
Robert J. Hermann	Oct. 8, 1979	Aug. 2, 1981
Edward C. Aldridge Jr.	Aug. 3, 1981	Dec. 16, 1988
Martin C. Faga	Sept. 26, 1989	March 5, 1993
Jimmie D. Hill (A)	March 5, 1993	May 19, 1994
Jeffrey K. Harris	May 19, 1994	Feb. 26, 1996
Keith R. Hall (A)	Feb. 27, 1996	March 27, 1997
Keith R. Hall	March 28, 1997	Dec. 13, 2001
Peter B. Teets	Dec. 13, 2001	March 25, 2005
Dennis D. Fitzgerald (A)	March 25, 2005	July 22, 2005
Donald M. Kerr	July 22, 2005	Oct. 8, 2007
Scott F. Large (A)	Oct. 9, 2007	Oct. 18, 2007
Scott F. Large	Oct. 19, 2007	

Naval Space Command

RAdm. Richard H. Truly	Oct. 1, 1983	Feb. 28, 1986
Col. R.L. Phillips, USMC (A)	March 1, 1986	April 30, 1986
RAdm. D. Bruce Cargill	April 30, 1986	Oct. 24, 1986
RAdm. Richard C. Macke	Oct. 24, 1986	March 21, 1988
RAdm. David E. Frost	March 21, 1988	April 2, 1990
Col. C.R. Geiger, USMC (A)	April 2, 1990	May 31, 1990
RAdm. L.E. Allen Jr.	May 31, 1990	Aug. 12, 1991
RAdm. Herbert A. Browne Jr.	Aug. 12, 1991	Oct. 28, 1993
RAdm. Leonard N. Oden	Oct. 28, 1993	Jan. 31, 1994
RAdm. Lyle G. Bien	Jan. 31, 1994	Dec. 13, 1994
RAdm. Phillip S. Anselmo	Dec. 13, 1994	April 18, 1995
RAdm. Katharine L. Laughton	April 18, 1995	Feb. 28, 1997
RAdm. Patrick D. Money maker	Feb. 28, 1997	Sept. 10, 1998
Col. M.M. Henderson, USMC (A)	Sept. 10, 1998	Oct. 1, 1998
RAdm. Thomas E. Zelibor	Oct. 1, 1998	June 8, 2000
RAdm. J.J. Quinn	June 8, 2000	March 31, 2001
RAdm. Richard J. Mauldin	March 31, 2001	Dec. 10, 2001
RAdm. John P. Cryer	Dec. 10, 2001	July 11, 2002

Naval Space Command on July 11, 2002 ceased functioning as the Navy's primary space component. Its functions were transferred to the Naval Network Warfare Command.

Naval Network Warfare Command

VAdm. Richard Mayo	July 11, 2002	March 26, 2004
VAdm. James D. McArthur Jr.	March 26, 2004	June 15, 2007
VAdm. H. Denby Starling II	June 15, 2007	

AD SPACE

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
Synchronize 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

Major US Agencies With Roles in Space

Central Intelligence Agency

Headquarters: McLean, Va.
Established: 1947
Director: Michael V. Hayden

Mission

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 Geospatial-Intelligence Agency

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

Mission

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).

National Reconnaissance Office

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

Mission

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

Mission

Protect US communications
Produce foreign signals intelligence

US Military Payloads by Mission, 1958-2007

(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
USSOUTHCOM	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.

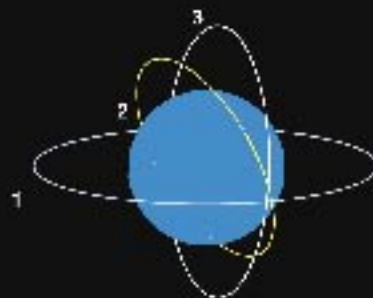
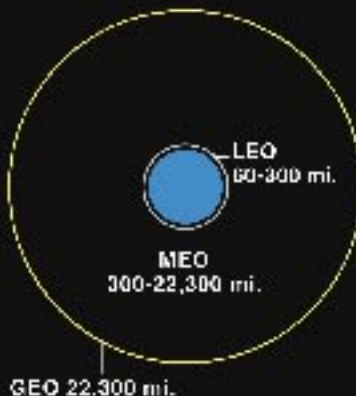


Orbital Altitude

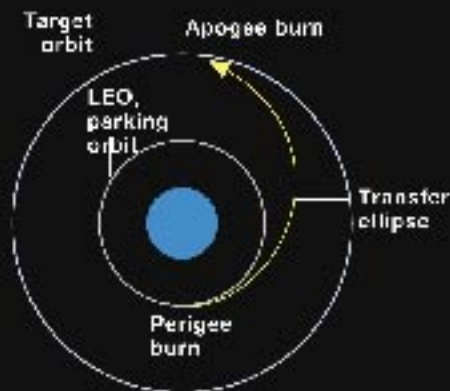
- LFO Low Earth orbit
- MEO Medium Earth orbit
- GEO Geosynchronous Earth orbit
- HFO High Earth orbit

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 apogee 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)

Year	Military	Civil	Total	Year	Military	Civil	Total	Year	Military	Civil	Total	Year	Military	Civil	Total
1958	0	7	7	1971	16	16	32	1984	11	11	22	1997	8	29	37
1959	6	5	11	1972	14	17	31	1985	4	13	17	1998	5	29	34
1960	11	5	16	1973	11	12	23	1986	4	2	6	1999	7	23	30
1961	19	10	29	1974	8	16	24	1987	6	2	8	2000	11	17	28
1962	32	20	52	1975	9	19	28	1988	8	4	12	2001	7	14	21
1963	25	13	38	1976	11	15	26	1989	11	7	18	2002	1	16	17
1964	33	24	57	1977	10	14	24	1990	11	16	27	2003	11	12	23
1965	34	29	63	1978	14	18	32	1991	6	12	18	2004	5	11	16
1966	35	38	73	1979	8	8	16	1992	11	17	28	2005	6	6	12
1967	29	29	58	1980	8	5	13	1993	12	11	23	2006	7	10	17
1968	23	22	45	1981	7	11	18	1994	11	15	26	2007	8	10	18
1969	17	23	40	1982	6	12	18	1995	9	18	27	Total	603	740	1,343
1970	18	11	29	1983	8	14	22	1996	11	22	33				

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

Sites for Space Launches, 1957-Present

As of Dec. 31, 2007

Launch Site	Operator	Total Launches
Plesetsk	Russia	1,563
Tyuratam/Baikonur, Kazakhstan	Russia	1,277
Vandenberg AFB, Calif.	US	643
Cape Canaveral AFS, Fla.	US	635
Kourou, French Guiana	ESA	188
JFK Space Center, Fla.	US	141
Kapustin Yar	Russia	101
Xichang	China	49
Tanegashima	Japan	45
Shuang Cheng-tsu/Jiuquan	China	40
Kagoshima	Japan	34
Wallops Flight Facility, Va.	US	32
Taiyuan	China	26
Pacific Ocean Platform	Sea Launch	24
Sriharikota	India	24
Edwards AFB, Calif.	US	21
Indian Ocean Platform	US	9
Palmachim	Israel	7
Svobodny	Russia	5
Hammaguir, Algeria	France	4
Woomera, Australia	Australia	4
Alcantara	Brazil	3
Barents Sea	Russia	3
Kwajalein, Marshall Islands	US	3
Dombarovski	Russia	2
Kodiak, Alaska	US	1
Musudan ri	North Korea	1
Tenerife, Canary Islands	US	1
Total		4,886

What's Up There

As of Dec. 31, 2007

Country Organization	Payloads in Orbit			Total
	Satellites	Space Probes	Debris	
US	986	60	2,551	3,597
Russia*	1,369	35	2,033	3,437
People's Republic of China	63	1	2,595	2,659
France	45	0	212	257
Japan	102	10	32	144
India	34	0	97	131
European Space Agency	37	6	30	73
Intl. Telecom Sat. Org.	63	0	0	63
Globalstar	60	0	0	60
CHBZ	3	0	56	59
Orbcomm	35	0	0	35
European Telecom Sat. Org.	28	0	0	28
Canada	25	0	2	27
Germany	25	2	0	27
United Kingdom	25	0	0	25
Luxembourg	15	0	0	15
Italy	14	0	0	14
Saudi Arabia	12	0	0	12
Australia	11	0	0	11
Brazil	11	0	0	11
Int. Maritime Sat. Org.	11	0	0	11
Sweden	11	0	0	11
Argentina	10	0	0	10
Indonesia	10	0	0	10
South Korea	10	0	0	10
ISS	1	3	5	9
Spain	9	0	0	9
Arab Sat. Comm. Org.	8	0	0	8
NATO	8	0	0	8
Taiwan	8	0	0	8
Israel	7	0	0	7
Mexico	7	0	0	7
Thailand	6	0	0	6
Czech Republic	5	0	0	5
Netherlands	5	0	0	5
Turkey	5	0	0	5
Other**	45	0	2	47
Total	3,129	117	7,615	10,861

* 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.

US Satellites Placed in Orbit or Deep Space

(As of Dec. 31, 2007)

Year	Military	Civil*	Total	Year	Military	Civil*	Total	Year	Military	Civil*	Total	Year	Military	Civil*	Total
1958	0	7	7	1971	26	18	44	1984	17	16	33	1997	9	81	90
1959	6	5	11	1972	18	14	32	1985	13	17	30	1998	7	87	94
1960	12	5	17	1973	14	10	24	1986	7	4	11	1999	8	74	82
1961	20	12	32	1974	11	8	19	1987	10	1	11	2000	15	36	51
1962	35	20	55	1975	12	16	28	1988	11	9	20	2001	8	24	32
1963	33	22	55	1976	17	12	29	1989	15	9	24	2002	2	25	27
1964	44	25	69	1977	14	5	19	1990	22	17	39	2003	12	14	26
1965	49	39	88	1978	16	17	33	1991	22	13	35	2004	5	11	16
1966	52	47	99	1979	10	7	17	1992	12	18	30	2005	6	14	20
1967	51	34	85	1980	12	4	16	1993	12	18	30	2006	16	21	37
1968	35	26	61	1981	7	10	17	1994	18	18	36	2007	13	31	44
1969	32	27	59	1982	8	9	17	1995	15	23	38	Total	864	1,022	1,886
1970	23	8	31	1983	16	12	28	1996	16	22	38				

*Includes some military payloads.

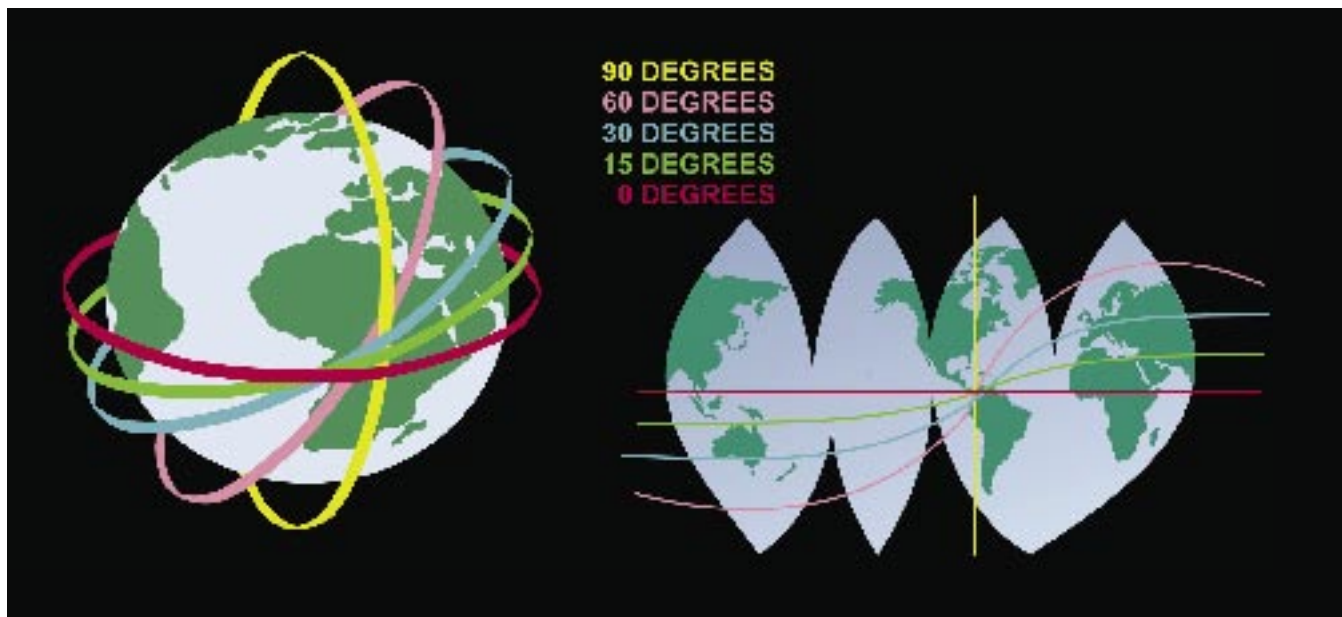
Air Force Personnel in Space Organizations

As of Sept. 30, 2007

	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
Active Duty Air Force	19,198	18,201	17,337	17,004	19,064	19,495	19,862	16,758	18,345	17,617
Selected Guard and Reserve										
Air National Guard	285	285	354	354	519	519	649	653	663	1,339
Air Force Reserve Command	508	629	699	705	847	987	1,024	1,050	1,379	1,401
Total Guard and Reserve	793	914	1,053	1,059	1,366	1,506	1,673	1,703	2,042	2,740
Direct-hire Civilian	4,354	4,140	4,351	4,665	6,325	6,333	6,396	6,541	6,534	8,404

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.



DOD Image

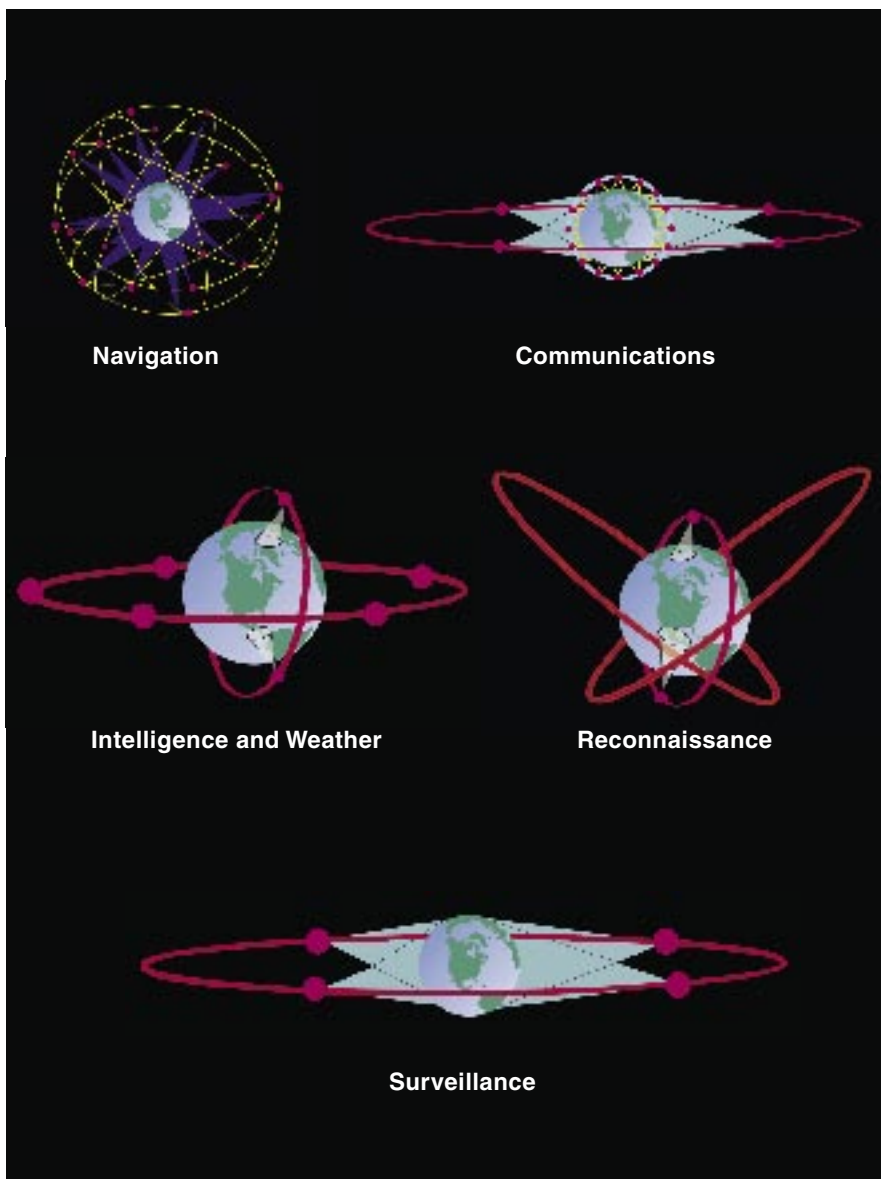
AFSPC Squadrons by Mission Type

(As of Sept. 30, 2007)

Component	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
Active force										
ICBM	14	14	14	14	14	11	11	10	10	10
Space operations	10	10	8	8	8	8	9	8	8	7
Space communications	1	1	1	1	0	0	6	7	7	6
Space warning	8	8	7	7	8	8	6	6	6	6
Space surveillance	6	6	6	4	3	3	3	0	0	0
Space launch	5	5	3	3	3	4	4	3	3	3
Range	2	2	2	2	2	2	2	2	2	2
Space control and tactics	1	1	2	3	3	3	3	5	6	6
Space aggressor	0	0	0	0	0	1	1	1	1	0
Total active force	47	47	43	42	41	40	45	42	43	40
Reserve forces										
ANG										
Space operations	0	0	0	0	1	1	3	4	3	1
Space warning	0	0	0	0	1	1	1	2	1	2
AFRC										
Space operations	3	3	3	4	4	4	4	4	4	4
Space warning	1	1	1	1	1	1	1	1	1	1
Space aggressor	0	0	0	0	0	0	1	1	1	1
Total reserve forces	4	4	4	5	7	7	10	10	10	9
Total all components	51	51	51	48	49	48	50	57	53	49

US Manned Spaceflights

Year	Flights	Persons
1961	2	2
1962	3	3
1963	1	1
1964	0	0
1965	5	10
1966	5	10
1967	0	0
1968	2	6
1969	4	12
1970	1	3
1971	2	6
1972	2	6
1973	3	9
1974	0	0
1975	1	3
1976	0	0
1977	0	0
1978	0	0
1979	0	0
1980	0	0
1981	2	4
1982	3	8
1983	4	20
1984	5	28
1985	9	58
1986	1	7
1987	0	0
1988	2	10
1989	5	25
1990	6	32
1991	6	35
1992	8	53
1993	7	42
1994	7	42
1995	7	42
1996	7	43
1997	8	53
1998	5	33
1999	3	19
2000	5	32
2001	6	38
2002	5	34
2003	1	7
2004	0	0
2005	1	7
2006	3	20
2007	3	21
Total	150	784



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

NASA photo



Athena II

USAF photo



Atlas V

USAF photo



Delta II

Major US Launchers in US Military Use

Athena I

Function: lift low to medium weights.
 First launch: Aug. 22, 1997.
 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.
 First launch: Aug. 21, 2002.
 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.
 First launch: Feb. 14, 1989.
 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 125.2 ft, max body diameter 8 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.

**Delta IV****Space Shuttle****Taurus****Pegasus**

Function: lift low weights.
 Variants: Standard and XL.
 First launch: (Standard) April 5, 1990; (XL) June 27, 1994.
 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.
 First launch: March 13, 1994.
 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.

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: DMSP
 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.
 First launch: Aug. 23, 1962.
 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

Major Military Satellite Systems, Continued

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.

First launch: March 1998 (Phase 2 payload on UHF Follow-On). Continues on Wideband Global SATCOM (WGS) in 2008.

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.

First launch: Feb. 7, 1994.

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, netcentric 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.

Artist's conception by Erik Simonsen



Space Based Infrared System High

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.

Reading About Space

Burrows, William E. *Deep Black.* New York: Berkley Publishers Group, 1988.

Canan, James W. *War in Space.* New York: Harper & Row, 1982.

Collins, John M. *Military Space Forces.* Washington, D.C.: Pergamon-Brassey's, 1989.

Hall, R. Cargill, and Jacob Neufeld, eds. *The US Air Force in Space: 1945 to the 21st Century: Proceedings, Air Force Historical Foundation Symposium.* Washington, D.C.: USAF History and Museums Program, 1998.

Lambeth, Benjamin S. *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space.* Santa Monica, Calif., RAND, 2003 (on Web at www.rand.org/pubs/monograph_reports/MR1649).

McDougall, Walter A. *The Heavens and the Earth: A Political History of the Space Age.* Baltimore: Johns Hopkins University Press, 1997.

Richelson, Jeffrey T. *America's Secret Eyes in Space.* New York: Harper & Row, 1990.

Wolfe, Tom. *The Right Stuff.* New York: Bantam Books, 1980.

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.

Operator: International Maritime Satellite Organization.

First launch: February 1982 (first lease), Oct. 30, 1990 (first launch).

Constellation: nine.

Orbit altitude: 22,300 miles.

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.*

Major Civilian Satellites in US Military Use, Continued

First launch: 1983.
Constellation: 21.
Orbit altitude: 22,300 miles.
*Merged with Intelsat 2005-06

Polar-orbiting Operational Environmental Satellite

(also known as NOAA-K, L, and M before launch; NOAA-15, 16, and 17, respectively, once on orbit).

Common name: POES

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.

Function: extended weather forecasting.

Operator: NOAA (on-orbit); NASA (launch).

First launch: May 13, 1998 (NOAA-15).

Constellation: two.

Orbit altitude: 517 miles.

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.

First launch: Oct. 18, 2001.

Constellation: one.

Orbit altitude: 279 miles.

Satellite Pour l'Observation de la Terre

Common name: SPOT

In brief: terrain images used for mission-planning systems, terrain analysis, and mapping.

Function: remote sensing.

Operator: SPOT Image S.A. (France).

First launch: Feb. 22, 1986.

Constellation: three.

Orbit altitude: 509 miles.

Telstar

Common name: Telstar

In brief: commercial satellite-based,

rooftop-to-rooftop communications for US Army and other DOD agencies.

Function: communications.

Operator: Loral Skynet.

First launch: November 1994.

Constellation: three.

Orbit altitude: 22,300 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.

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 transmitter sites.

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.

Operational: Jan. 29, 1969.

Unit location: Eglin AFB, Fla.

Components: AN/FPS-85 solid-state phased-array radar.

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: GEODSS

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.

Operational: August 1980.

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.

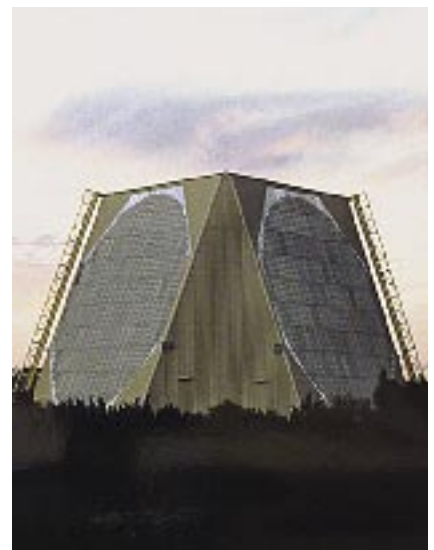
Function: ballistic missile warning and space surveillance.

Operator: AFSPC.

Operational: 1977.

Unit location: Cavalier AFS, N.D.

Components: One AN-FPQ-16 single-faced, phased-array radar.



The AN-FPS-115 Pave PAWS phased-array warning system radar.

Raytheon photo

AD SPACE

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.

Jan. 31, 1958. US launches its first satellite, Explorer 1.

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. 7, 1959. Explorer 6 spacecraft transmits first television pictures from space.

June 22, 1960. US launches Galactic Radiation and Background (GRAB) satellite, the nation's first successful reconnaissance spacecraft. It collects electronic intelligence (Elint) from Soviet air defense radars.

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.

May 5, 1961. Lt. Cmdr. Alan B. Shepard Jr., aboard Freedom 7 Mercury capsule, becomes first American in space, climbing to 116.5 miles during suborbital flight lasting 15 minutes, 28 seconds.

Feb. 20, 1962. Project Mercury astronaut Lt. Col. John H. Glenn Jr., aboard Friendship 7 capsule, completes first US

manned orbital flight.

May 15, 1963. USAF Maj. L. Gordon Cooper Jr. makes nearly 22 orbits in spacecraft Faith 7, becoming the first American astronaut to perform an entirely manual re-entry.

Oct. 17, 1963. Vela Hotel satellite performs first space-based detection of nuclear explosion.

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

June 3, 1965. Gemini 4 astronaut USAF Maj. Edward H. White II performs first American space walk.

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

Dec. 15, 1965. Crews of Gemini 6 and Gemini 7 rendezvous in space. Navy Capt. Walter M. Schirra and USAF Maj. Thomas P. Stafford in Gemini 6 maneuver to within a foot of Gemini 7 crew.

Jan. 25, 1967. Soviets complete first successful fractional orbital bombardment system test, deorbiting Kosmos 139 satellite re-entry vehicle to an impact point within Soviet Union.

July 3-4, 1967. Air Force, Army, and Navy conduct first satellite-based tactical communications.

Oct. 20, 1968. Soviet Kosmos 249 spacecraft carries out first co-orbital antisatellite test, exploding Kosmos 248 target satellite into cloud of debris.

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.

November 1970. USAF launches first classified Defense Support Program satellite, whose infrared sensors provide space-based early warning of missile launches.

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

Feb. 22, 1978. Atlas booster carries first

Global Positioning System Block I satellite into orbit, paving way for a revolution in civil, commercial, and military navigation.

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

Aug. 30, 1983. USAF Col. Guion S. Bluford Jr. becomes the first African American in space, as a mission specialist aboard *Challenger*.

Sept. 13, 1985. First US anti-satellite intercept test destroys Solwind scientific satellite by air-launched weapon.

Jan. 17, 1991. What USAF calls "the first space war," Operation Desert Storm, opens with air attacks.

Jan. 13, 1993. USAF Maj. Susan J. Helms, flying aboard space shuttle *Endeavour*, becomes first US military woman in space.

Feb. 6, 1995. USAF Lt. Col. Eileen M. Collins is first woman to pilot a US spaceship, doing so when *Discovery* and space station Mir perform first US-Russian space rendezvous in 20 years.

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

July 23-27, 1999. USAF Col. Eileen M. Collins becomes first woman to command a shuttle mission, *Columbia* (STS-93).

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

Long Title	Nickname	Entry Into Force
Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water	Nuclear Test Ban	Oct. 10, 1963
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies	Outer Space Treaty	Oct. 10, 1967
Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space	Rescue Agreement	Dec. 3, 1968
Convention on International Liability for Damage Caused by Space Objects	Liability Convention	Sept. 1, 1972
Convention on Registration of Objects Launched Into Outer Space	Registration Convention	Sept. 15, 1976
Agreement Governing the Activities of States on the Moon and Other Celestial Bodies	Moon Agreement	July 11, 1984

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.

AD SPACE