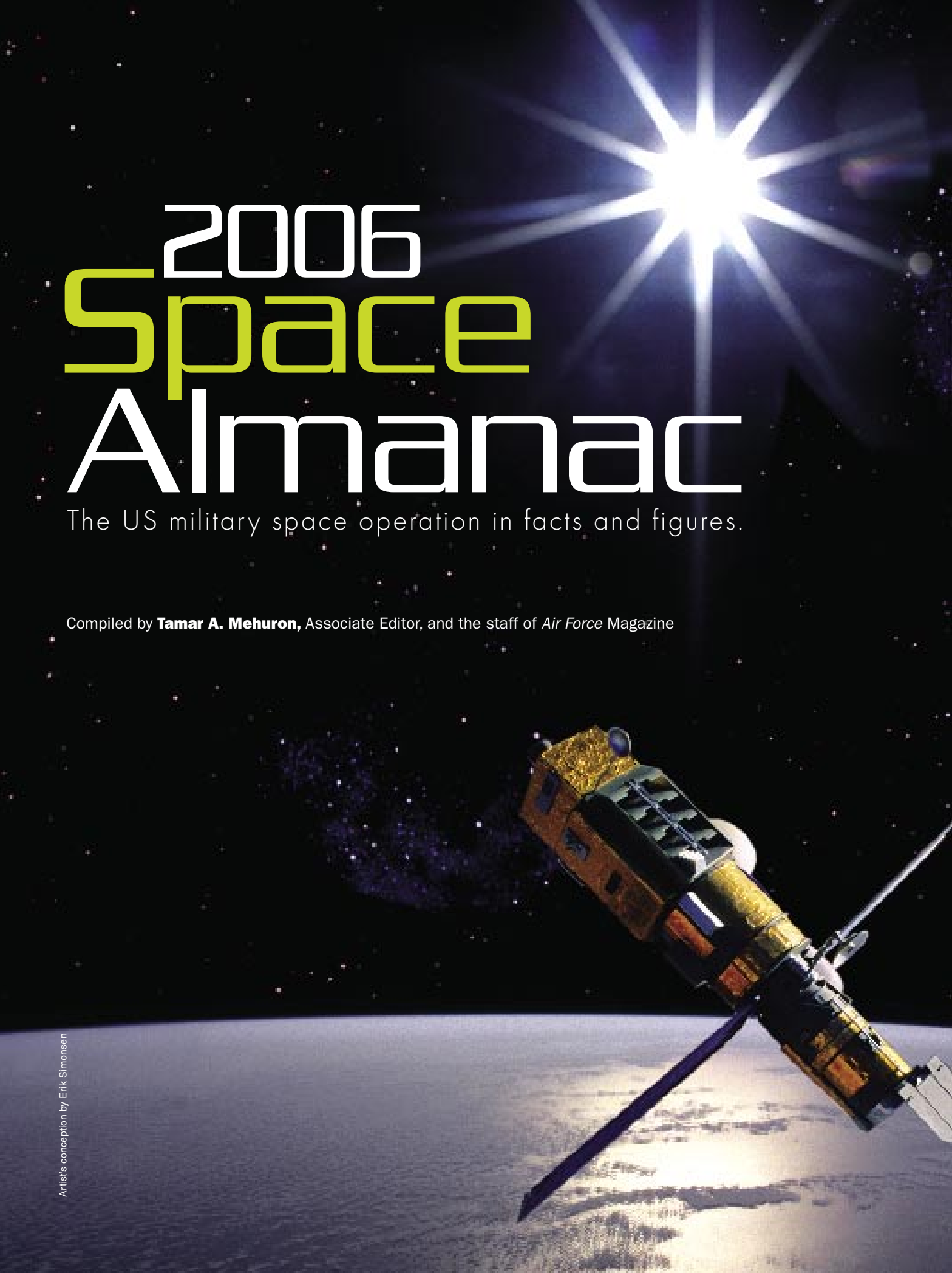
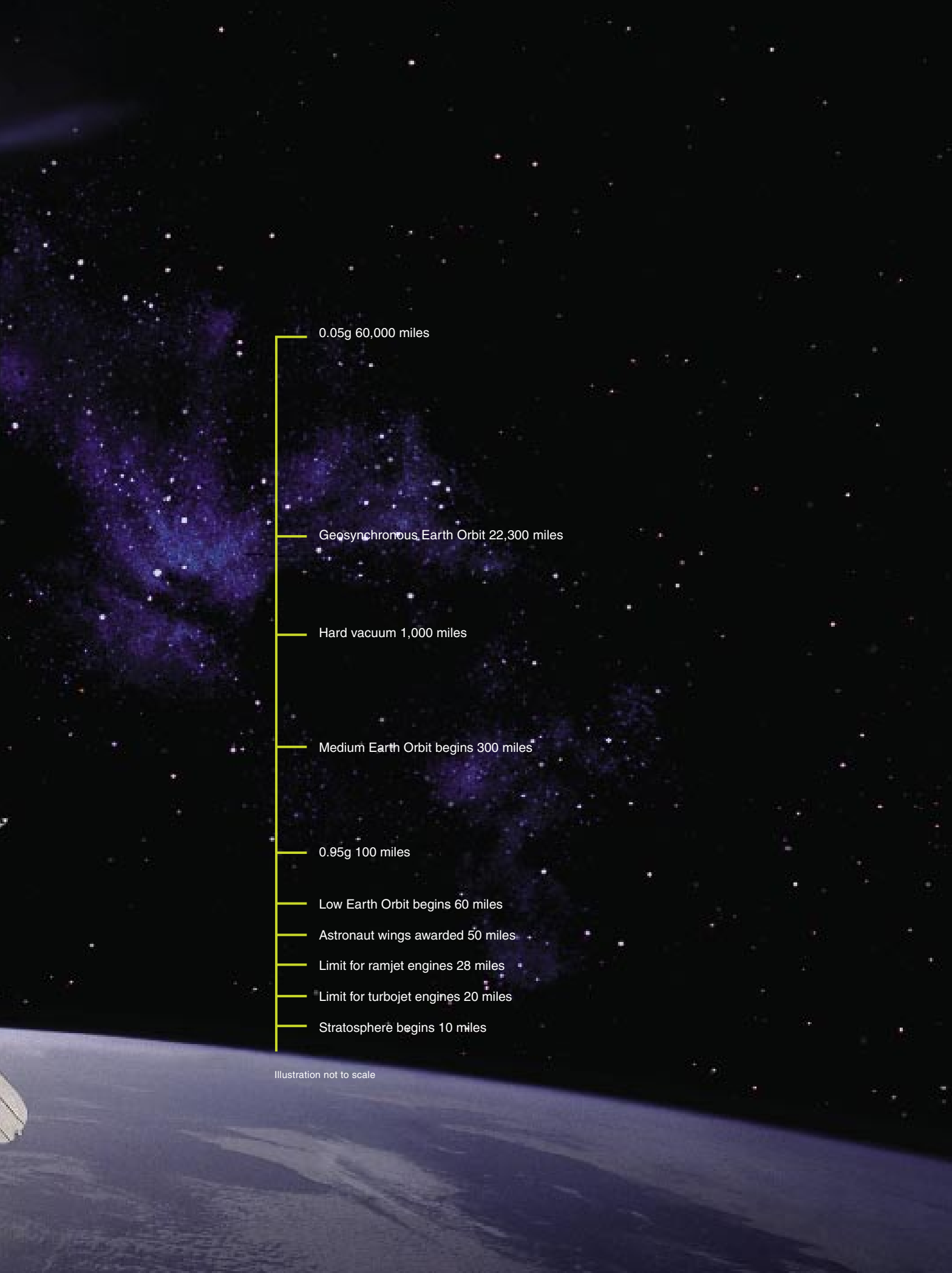
2006 Space Almanac

The US military space operation in facts and figures.

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



Artist's conception by Erik Simonsen


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 Force Support
Launch of satellites and other high-value payloads into space and operation of those satellites through a worldwide network of ground stations.

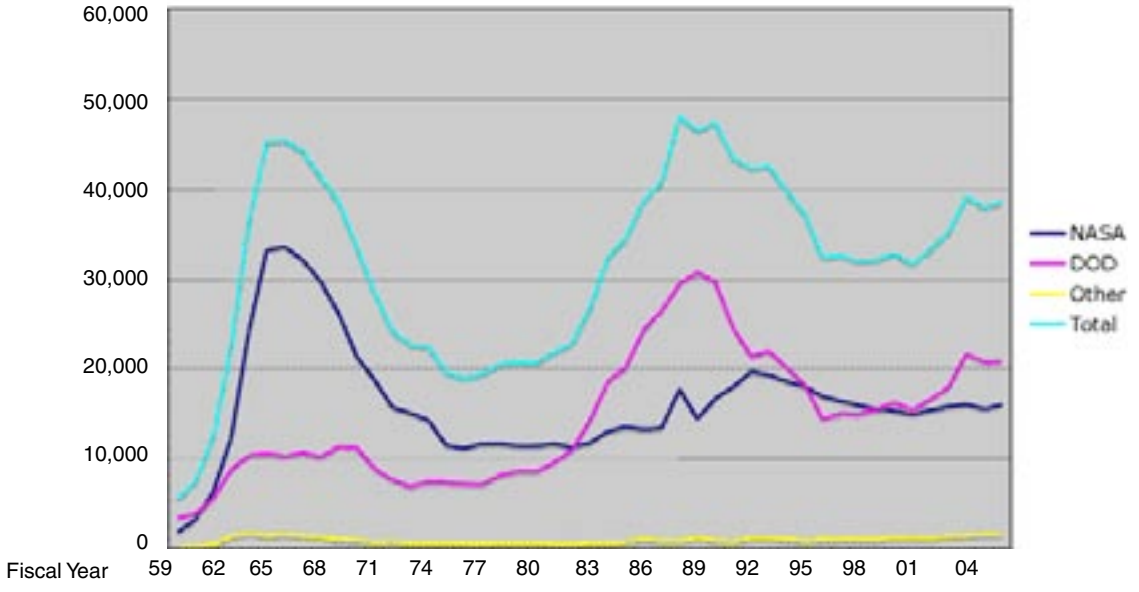
Space Force Enhancement
Provide satellite communications, navigation, weather, missile warning, and intelligence to the warfighter.

Space Control
Assure US access to and freedom of operation in space and deny enemies the use of space.

Space Force Application
Pursue research and development of capabilities for the probable application of combat operations in, through, and from space to influence the course and outcome of conflict.

US Space Funding

Millions of constant Fiscal 2007 dollars



Fiscal Year	NASA	DOD	Other	Total
1959	1,841	3,457	240	5,538
1960	3,205	3,892	298	7,395
1961	6,360	5,591	467	0
1962	12,221	8,827	1,353	22,401
1963	24,342	10,406	1,725	36,473
1964	33,241	10,597	1,412	45,250
1965	33,514	10,267	1,572	45,352
1966	32,106	10,706	1,357	44,169
1967	29,696	10,231	1,310	41,237
1968	26,139	11,341	1,028	38,508
1969	21,376	11,258	953	33,587
1970	18,768	8,879	746	28,393
1971	15,717	7,663	821	24,201
1972	15,082	6,910	655	22,647
1973	14,303	7,505	681	22,490
1974	11,494	7,357	658	19,510
1975	11,131	7,225	602	18,959
1976	11,640	7,157	607	19,405
1977	11,658	8,174	656	20,488
1978	11,411	8,624	712	20,747
1979	11,404	8,591	702	20,698
1980	11,668	9,594	576	21,839
1981	11,284	10,913	530	22,727
1982	11,766	14,216	666	26,648

Fiscal Year	NASA	DOD	Other	Total
1983	13,051	18,601	675	32,327
1984	13,561	20,160	781	34,502
1985	13,218	24,371	1,114	38,703
1986	13,421	26,460	893	40,774
1987	17,735	29,448	842	48,025
1988	14,454	30,706	1,287	46,447
1989	16,734	29,675	928	47,337
1990	18,019	24,554	795	43,369
1991	19,686	21,399	1,165	42,251
1992	19,337	22,009	1,169	42,515
1993	18,582	20,064	1,040	39,686
1994	18,053	18,253	877	37,182
1995	16,915	14,354	1,023	32,293
1996	16,457	15,075	1,084	32,616
1997	15,943	15,009	1,010	31,963
1998	15,521	15,569	1,058	32,147
1999	15,357	16,274	1,210	32,841
2000	14,926	15,426	1,258	31,611
2001	15,427	16,612	1,231	33,271
2002	15,831	17,965	1,365	35,161
2003	16,021	21,631	1,456	39,108
2004	15,559	20,765	1,590	37,914
2005	16,016	20,846	1,627	38,489
2006	16,085	21,724	1,672	39,481
Total	**$777,280**	**$706,332**	**$47,478**	**$1,531,090**

The Year in Space

July 22, 2005
Donald M. Kerr, former CIA official, takes charge of the National Reconnaissance Office ... Breaks 44-year tradition of Air Force undersecretary leading NRO.
July 29 Ronald M. Sega confirmed as new Air Force undersecretary ... Also serves as DOD executive agent for space.
September
Air Force Space Command provides unique low-light imagery from Defense Meteorological Satellite Program satellites to aid Hurricane Katrina recovery efforts.
Sept. 12
NRO lifts veil on Cold War electronic intelligence satellite called Poppy ... First launched in early 1960s ... Used to detect radar emissions from Soviet naval vessels.
Sept. 20
Two Russian GLONASS operators visit their Global Positioning System satellite counterparts at Schriever AFB, Colo. ... Landmark visit included discussion for possible integration of the two navigation and timing satellite systems.
Sept. 25
USAF launches first modernized GPS satellite ... GPS IIR-M is first in a series of eight GPS IIR satellites to be built by Lockheed Martin.
Sept. 29
USAF C-17 drops dummy QuickReach booster out its rear cargo door at 6,000 feet ... Test proves the 65.8-foot, 50,000-pound dummy would clear the aircraft.
Oct. 3
Air Force creates a new position—assistant to the Secretary of the Air Force for intelligence space technology—for NRO Director Donald Kerr.
Oct. 19
USAF launches last of Titan IVB heavy-lift expendable launch vehicles ... Launching from Vandenberg AFB, Calif., the Titan boosts a classified NRO payload into orbit.
Oct. 20
At Onizuka AFS, Calif., Air Force powers down Satellite Operations Center-52—better known as the "Blue Cube" ... Marks end of 36 years of 24-hour satellite command and control from Onizuka.
Oct. 24
Air Force Research Lab's Space Vehicles Directorate says a 220-pound microsatellite has rendezvoused several times with a Minotaur I launch vehicle upper stage.
Oct. 27
Iran launches its first satellite ... Built by Iran and Russia.
Nov. 1
Gen. Lance W. Lord, commander of Air Force Space Command, authorizes wear of a new space badge ... Goes to officer and enlisted space operators and acquisition personnel, replacing the space and missile badge and "pocket rocket" missile operator badge.
Dec. 28
Russian rocket boosts into orbit the first satellite that will form the European Union's Galileo global navigation system.
Feb. 23, 2006
Arnold Engineering and Development Center, Arnold AFB, Tenn., issues a request for information seeking industry input for creation of a Space Threat Assessment Test Bed.
March 8
AFSPC changes name of the Space Warfare Center at Schriever AFB, Colo., to the Space Innovation and Development Center.
March 10
AFSPC activates a unique space unit—the 3rd Space Experimentation Squadron—under the newly renamed SIDC ... Mission of 3rd SES is to develop operational concepts for space systems.
April 1
Gen. Lance W. Lord, AFSPC commander, retires from the Air Force after 37 years of service.
April 14
AFSPC's 527th Space Aggressor Squadron at Schriever AFB, Colo., is realigned to Air Combat Command ... Unit devises simulated attacks on space systems.
April 24
Space and Missile Systems Center at Los Angeles AFB, Calif., dedicates its new home as the Schriever Space Complex.
April 24
AFSPC marks 10th anniversary of the Midcourse Space Experiment satellite, a key space-based surveillance asset, since AFSPC took it over in 2000 from Ballistic Missile Defense Organization.
June 26
Gen. Kevin P. Chilton, former astronaut, takes command of Air Force Space Command.

Space and Missile Badges

CURRENT

Space Badge

Astronaut

Missile Badge

HISTORICAL

Space/Missile Badge

Missile Badge With Operations Designator

Air Force Space Command, Peterson AFB, Colo.

(As of July 1, 2006)

Commander
Gen. Kevin P. Chilton

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

- **21st Space Wing**
  Peterson AFB, Colo.
- **30th Space Wing**
  Vandenberg AFB, Calif.
- **45th Space Wing**
  Patrick AFB, Fla.
- **50th Space Wing**
  Schriever AFB, Colo.
- **460th Space Wing**
  Buckley AFB, Colo.

Space & Missile Systems Center
Los Angeles AFB, Calif.
Commander
Lt. Gen. Michael A. Hamel

- **Program Offices**
  DMSP
  Launch and Range
  Launch Programs
  MILSATCOM-Joint
  Navstar Global Positioning System-Joint
  Satellite and Launch Control
  Space Based Infrared Systems
  Space Radar-Joint (Chantilly, Va.)
  Space Superiority System

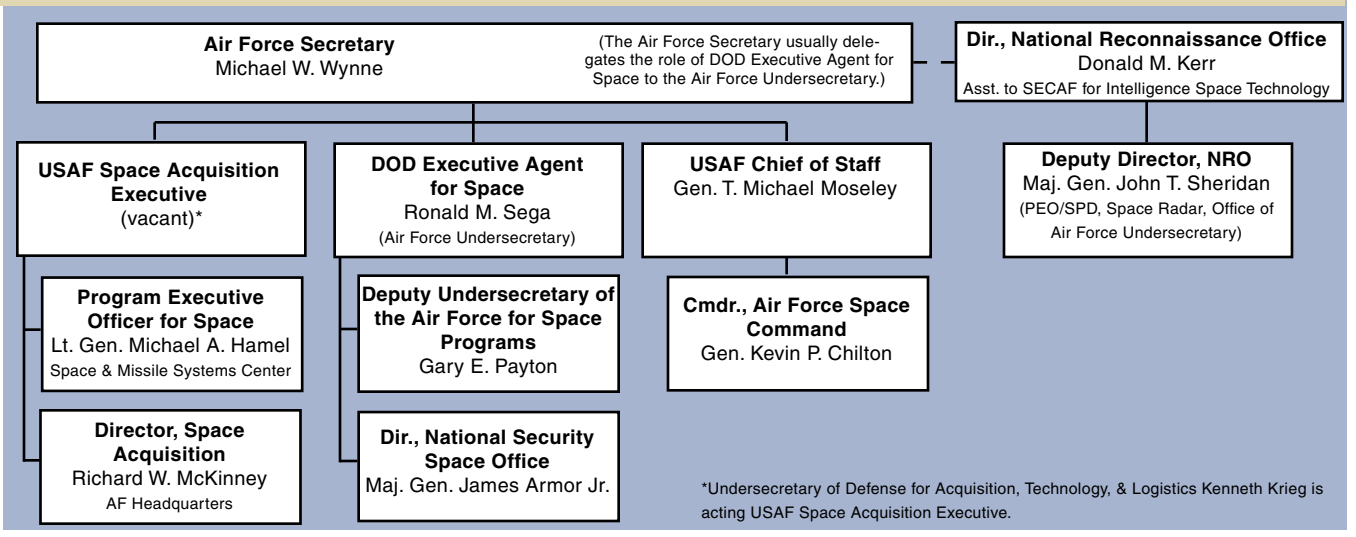
Space Innovation & Development Center
Schriever AFB, Colo.
Commander
Col. Larry J. Chodzko

20th Air Force
F.E. Warren AFB, Wyo.
Commander
Brig. Gen. Thomas F. Deppe

- **90th Space Wing**
  F.E. Warren AFB, Wyo.
- **91st Space Wing**
  Minot AFB, N.D.
- **341st Space Wing**
  Malmstrom AFB, Mont.

Staff map by Zaur Eylanbekov

Key USAF Positions in National Security Space



*Undersecretary of Defense for Acquisition, Technology, & Logistics Kenneth Krieg is acting USAF Space Acquisition Executive.

Space Leaders

(As of June 30, 2006. 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	

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	April 1, 2006
Lt. Gen. Frank G. Klotz (A)	April 1, 2006	June 26, 2006
Gen. Kevin P. Chilton	June 26, 2006	

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
B.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	

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	

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. Moneymaker	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	

Major Military Commands With Space Functions

The Unified Command

US Strategic Command

Headquarters: Offutt AFB, Neb.
Established: June 1, 1992
Cmdr.: Gen. J.E. Cartwright, USMC

MISSIONS

Establish and provide full-spectrum global strike and coordinated space and information operations capabilities
Deliver operational space support and integrated missile defense
Provide global C4ISR and specialized joint planning expertise

The Service Components

Air Force Space Command

Headquarters: Peterson AFB, Colo.
Established: Sept. 1, 1982
Cmdr.: Gen. Kevin P. Chilton

MISSIONS

Operate missile-warning radars, sensors, and satellites; national space launch facilities and operational boosters; worldwide space surveillance radars and optical systems; worldwide space environmental systems; operate and test USAF ICBM forces for STRATCOM
Provide command and control for DOD satellites; ballistic missile warning to NORAD and STRATCOM; space weather support to entire DOD
Track space debris
Develop tactics, techniques, and procedures to integrate space capabilities with air, land, and sea capabilities
Produce and acquire advanced space systems

Naval Network Warfare Command

Headquarters: Norfolk, Va.
Established: July 11, 2002
Cmdr.: Vice Adm. James D. McArthur Jr.

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

US Military Payloads by Mission, 1958-2005

(Orbital only)

Applications	**353**
Communications	*126*
Weather	*44*
Navigation	*95*
Launch vehicle/spacecraft tests	*4*
Other military	*84*
Weapons-Related Activities	**46**
SDI tests	*11*
Antisatellite targets	*2*
Antisatellite interceptors	*33*
Reconnaissance	**440**
Photographic/radar imaging	*252*
Electronic intelligence	*49*
Ocean surveillance	*48*
Nuclear detection	*12*
Radar calibration	*40*
Early warning	*39*
Total	**839**

Major US Agencies With Roles in Space

Central Intelligence Agency

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

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: Donald M. Kerr

Mission

Design, build, and operate reconnaissance satellites
Acquire innovative technology
Provide systems engineering
Support monitoring of arms control agreements, military activities, natural disasters, and other worldwide events of interest to the US

National Security Agency

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

Mission

Protect US communications
Produce foreign signals intelligence

Army Space & Missile Defense Command

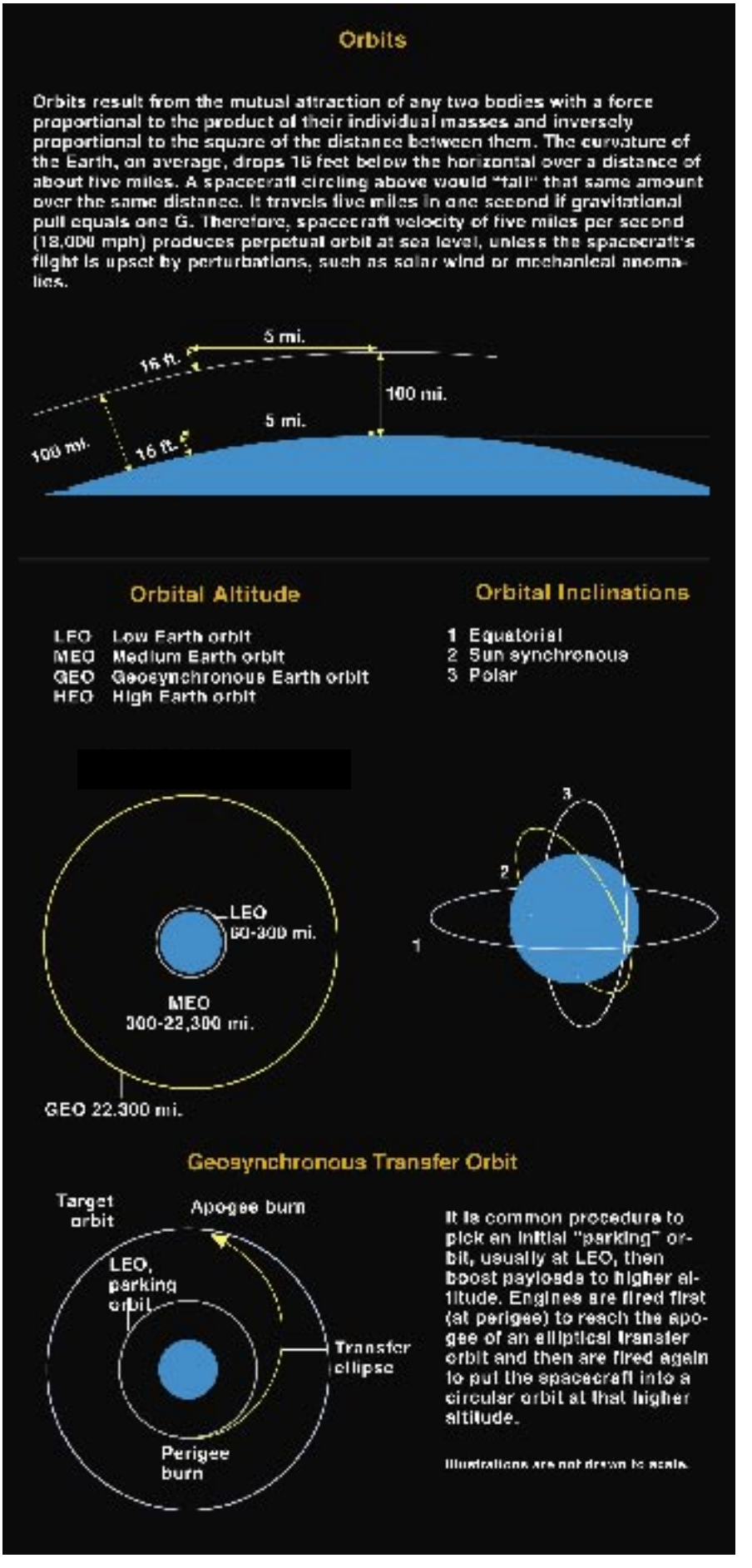
Headquarters: Arlington, Va.
Established: Oct. 1, 1997
Cmdr.: Lt. Gen. Larry J. Dodgen

MISSIONS

Serve as service component command to US Strategic Command
Serve as specified proponent for space and ground-based midcourse missile defense
Serve as Army's operational integrator for global missile defense
Oversee space- and missile-related R&D for Army Title 10 responsibilities

AFSPC Personnel Deployed by Unified Command

Total deployed	**857**
USCENTCOM	778
USEUCOM	19
USJFCOM	0
USNORTHCOM	42
USSOUTHCOM	16
USSOCOM	0
USPACOM	2
USTRANSCOM	0
Western and Southern Europe	
Germany	6
UK	0
Italy	0
Turkey	7
Spain	0
Other countries	4
East Asia and Pacific	
Japan/Okinawa	0
South Korea	0
Other countries	2
Africa, Near East, South Asia	
Saudi Arabia	4
Egypt	0
Other countries	774
Western hemisphere	
Canada	0
Other countries	58



US Military/Civil Launches

(As of Dec. 31, 2005)

Year	Military	Civil	Total	Year	Military	Civil	Total	Year	Military	Civil	Total	Year	Military	Civil	Total
1958	0	7	7	1970	18	11	29	1982	6	12	18	1994	11	15	26
1959	6	5	11	1971	16	16	32	1983	8	14	22	1995	9	18	27
1960	11	5	16	1972	14	17	31	1984	11	11	22	1996	11	22	33
1961	19	10	29	1973	11	12	23	1985	4	13	17	1997	9	28	37
1962	32	20	52	1974	8	16	24	1986	4	2	6	1998	5	29	34
1963	25	13	38	1975	9	19	28	1987	6	2	8	1999	7	23	30
1964	33	24	57	1976	11	15	26	1988	8	4	12	2000	11	17	28
1965	34	29	63	1977	10	14	24	1989	11	7	18	2001	7	14	21
1966	35	38	73	1978	14	18	32	1990	11	16	27	2002	1	16	17
1967	29	29	58	1979	8	8	16	1991	6	12	18	2003	11	16	27
1968	23	22	45	1980	8	5	13	1992	11	17	28	2004	5	12	17
1969	17	23	40	1981	7	11	18	1993	12	11	23	2005	6	13	19
												Total	**589**	**731**	**1,320**

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

Sites for Space Launches, 1957-Present

As of Dec. 31, 2005

Launch Site	Operator	Total Launches
Plesetsk	Russia	1,553
Tyuratam/Baikonur, Kazakhstan	Russia	1,240
Vandenberg AFB, Calif.	US	634
Cape Canaveral AFS, Fla.	US	618
Kourou, French Guiana	ESA	178
JFK Space Center, Fla.	US	135
Kapustin Yar	Russia	101
Xichang	China	40
Tanegashima	Japan	38
Shuang Cheng-tsu/Jiuquan	China	38
Kagoshima	Japan	32
Wallops Flight Facility, Va.	US	30
Taiyuan	China	21
Edwards AFB, Calif.	US	20
Sriharikota	India	20
Pacific Ocean Platform	Sea Launch	18
Indian Ocean Platform	US	9
Palmachim	Israel	6
Hammaguir, Algeria	France	4
Svobodny	Russia	4
Woomera, Australia	Australia	4
Alcantara	Brazil	3
Barents Sea	Russia	2
Kodiak, Alaska	US	1
Kwajalein, Marshall Islands	US	1
Musudan ri	North Korea	1
Tennerife, Canary Islands	US	1
Total		**4,752**

What's Up There

As of Dec. 31, 2005

Country Organization	Payloads in Orbit: Satellites	Payloads in Orbit: Space Probes	Debris	Total
US	927	55	2,381	3,363
Russia*	1,358	35	1,780	3,173
People's Republic of China	51	0	277	328
France	43	0	202	245
India	31	0	103	134
Japan	89	7	25	121
European Space Agency	36	6	27	69
Intl. Telecom Sat. Org.	62	0	0	62
Globalstar	52	0	0	52
Orbcomm	35	0	0	35
European Telecom Sat. Org.	27	0	0	27
Canada	23	0	1	24
Germany	21	2	1	24
United Kingdom	23	0	1	24
Italy	11	0	2	13
Luxembourg	13	0	0	13
Australia	9	0	2	11
Intl. Maritime Sat. Org	11	0	0	11
Brazil	10	0	0	10
Sweden	10	0	0	10
Argentina	9	0	0	9
Indonesia	9	0	0	9
NATO	8	0	0	8
South Korea	8	0	0	8
Spain	8	0	0	8
Arab Sat. Comm. Org.	7	0	0	7
Mexico	6	0	0	6
Saudi Arabia	6	0	0	6
Czech Republic	5	0	0	5
Israel	5	0	0	5
Netherlands	5	0	0	5
Thailand	5	0	0	5
Turkey	5	0	0	5
Other**	41	3	0	44
Total	**2,969**	**108**	**4,802**	**7,879**

* 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, 2005)

Year	Military	Civil*	Total	Year	Military	Civil*	Total	Year	Military	Civil*	Total	Year	Military	Civil*	Total
1958	0	7	7	1970	23	8	31	1982	8	9	17	1994	18	19	37
1959	6	5	11	1971	26	18	44	1983	16	12	28	1995	15	24	39
1960	12	5	17	1972	18	14	32	1984	17	16	33	1996	16	24	40
1961	20	12	32	1973	14	10	24	1985	13	17	30	1997	10	82	92
1962	35	20	55	1974	11	8	19	1986	7	4	11	1998	7	90	97
1963	33	22	55	1975	12	16	28	1987	10	1	11	1999	8	74	82
1964	44	25	69	1976	17	12	29	1988	11	9	20	2000	12	40	52
1965	49	39	88	1977	14	6	20	1989	15	9	24	2001	8	24	32
1966	52	47	99	1978	16	17	33	1990	22	16	38	2002	2	25	27
1967	51	34	85	1979	10	7	17	1991	17	18	35	2003	11	12	23
1968	35	26	61	1980	12	4	16	1992	12	17	29	2004	5	12	17
1969	32	27	59	1981	7	10	17	1993	12	18	30	2005	6	13	19
												Total	**827**	**984**	**1,811**

*Includes some military payloads.

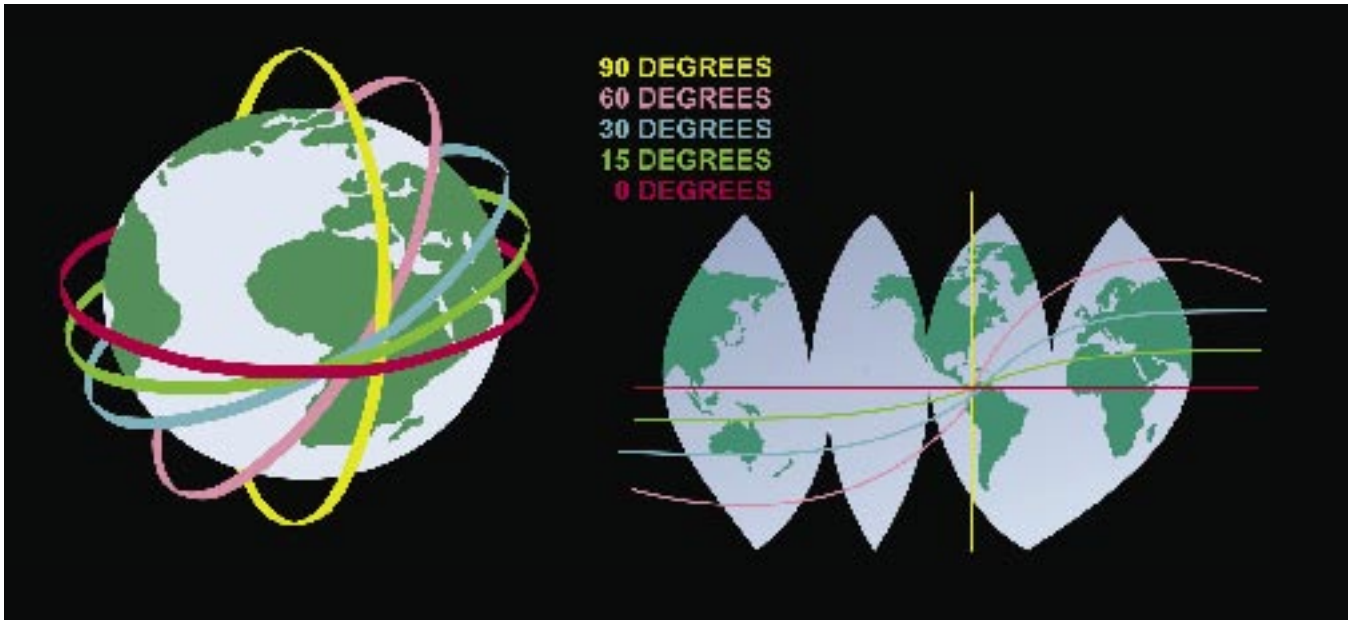
Air Force Personnel in Space

As of Sept. 30, 2005

	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05
Active Duty Air Force	**22,224**	**21,049**	**19,198**	**18,201**	**17,337**	**17,004**	**19,064**	**19,495**	**19,862**	**16,758**
Selected Guard and Reserve										
Air National Guard	0	0	285	285	354	354	519	519	649	653
Air Force Reserve Command	336	435	508	629	699	705	847	987	1,024	1,050
Total Guard and Reserve	**336**	**435**	**793**	**914**	**1,053**	**1,059**	**1,366**	**1,506**	**1,673**	**1,703**
Direct-hire Civilian	**4,758**	**4,740**	**4,354**	**4,140**	**4,351**	**4,665**	**6,325**	**6,333**	**6,396**	**6,541**

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

US Space Launch Sites

Alaska Spaceport
Location: 57.5° N, 153° W.
Type: Commercial.
Mission/operations: Polar and near-polar launches of communications, remote sensing, and scientific satellites up to 8,000 pounds.
Operator: Alaska Aerospace Development Corp.
Launches: Nine.
Launch vehicles: Athena I, suborbital.
History: Established in 1998; funded through AADC.

Cape Canaveral AFS, Fla.
Location: 28.5° N, 80° W.
Type: Military, civil, commercial.
Mission/operations: Geosynchronous launches for civil, military, and commercial missions and military ballistic missile tests.
Operator: USAF.
Launches: 618 (from 1957).
Launch vehicles: Athena I, II; Atlas II, III, V; Delta II, III, IV; Titan IV.
History: Designated in 1950 Operating Sub-Division #1; changed to Cape Canaveral Auxiliary AFB, then Cape Canaveral Missile Test Annex, Cape Kennedy Air Force Station, Cape Canaveral Air Force Station, Cape Canaveral Air Station, and, in 2000, back to Cape Canaveral AFS.

Florida Space Authority
Location: 28.5° N, 80° W.
Type: Civil, commercial.
Mission/operations: Florida, through FSA, developed, financed, or owns infrastructure at Launch Complexes 46 and 47 and manages a multiuser launch control facility, space experiments research and processing laboratory, and other facilities.
Operator: FSA.
Launches: Five.
Launch vehicles: Athena I, II; Super Loki; Terrier; Viper.
History: Established in 1989.

John F. Kennedy Space Center, Fla.
Location: 28° N, 80° W.
Type: Civil, commercial, military.
Mission/operations: Primary space shuttle facility.
Operator: NASA.
Launches: 135.
Launch vehicles: Pegasus, space shuttle, Taurus.
History: NASA acquired land in 1962; by 1967, Complex 39 was operational; modified in 1970s to accommodate space shuttle program.

Mid-Atlantic Regional Spaceport
Location: 38° N, 76° W.
Type: Civil, commercial.
Mission/operations: Maryland and Virginia cooperative. Launches to inclined and sun-synchronous orbits; recovery support for ballistic and guided re-entry vehicles; vehicle and payload storage and processing facilities; two commercial pads; suborbital launch rails for civil, commercial, and military scientific missions.
Operator: Virginia Commercial Spaceflight Authority.
Launches: 13 (since 1995).
Launch vehicles: Athena I, II; Black Brant; Falcon; Lockheed Martin HYSR; Minotaur; Orion; Pegasus; Taurus; Terrier.

Sea Launch
Location: Equator, 154° W, Pacific Ocean.
Type: Commercial.
Mission/operations: Heavy lift GTO launch services. Owned by an international partnership: Boeing, RSC Energia, Kvaerner ASA, and SDO Yuzhnoye/PO Yuzhmash.
Operators: Partners listed above.
Launches: 18.
Launch vehicles: Zenit-3SL.
History: Established in April 1995; demonstration launch March 1999.

Spaceport Systems Intl., L.P.
Location: 34.70° N, 120.46° W.
Type: Commercial, civil, military.
Mission/operations: Polar and near-polar LEO launches; small to medium launch vehicles up to one million pound thrust; payload processing facility for small and heavy satellites.
Operator: Spaceport Systems Intl.
Launches: Three.
Launch vehicles: Minotaur.
History: SSI, a limited partnership formed by ITT and California Commercial Spaceport, Inc., achieved full operational status of the spaceport in May 1999.

Vandenberg AFB, Calif.
Location: 35° N, 121° W.
Type: Military, civil, commercial.
Mission/operations: Launches into polar orbits; sole site for test launches of USAF ICBM fleet; basic support for R&D tests for DOD, USAF, and NASA space, ballistic missile, and aeronautical systems; facilities and essential services for more than 60 aerospace contractors.
Operator: USAF.
Launches: 634.
Launch vehicles: Athena I; Atlas II, III, V; Delta II, III, IV; Pegasus; Taurus; Titan II, IV.
History: Originally Army's Camp Cooke; turned over to USAF 1957; renamed Vandenberg Oct. 4, 1958.

Wallops Flight Facility, Va.
Location: 38° N, 76° W.
Type: Civil, military, commercial.
Mission/operations: Suborbital research launch site.
Operator: NASA
Launches: 30.
Launch vehicles: 14 suborbital sounding rockets.
History: Established in 1945, it is one of world's oldest launch sites.

AFSPC Squadrons by Mission Type

(As of Sept. 30, 2005)

Component	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05
Active force										
ICBM	14	14	14	14	14	14	14	11	11	10
Space operations	10	10	10	10	8	8	8	8	9	8
Space communications	1	1	1	1	1	1	0	0	6	7
Space warning	8	8	8	8	7	7	8	8	6	6
Space surveillance	6	6	6	6	6	4	3	3	3	0
Space launch	5	5	5	5	3	3	3	4	4	3
Range	2	2	2	2	2	2	2	2	2	2
Space control	1	1	1	1	2	3	3	3	3	5
Space aggressor	0	0	0	0	0	0	0	1	1	1
Total active force	**47**	**47**	**47**	**47**	**43**	**42**	**41**	**40**	**45**	**42**
Reserve forces										
ANG										
Space operations	0	0	0	0	0	1	1	3	4	3
Space warning	0	0	0	0	0	1	1	1	2	1
AFRC										
Space operations	3	3	3	3	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	0	1	1	1
Total reserve forces	**4**	**4**	**4**	**4**	**5**	**7**	**7**	**10**	**10**	**10**
Total all components	**51**	**51**	**51**	**51**	**48**	**49**	**48**	**50**	**57**	**52**

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.

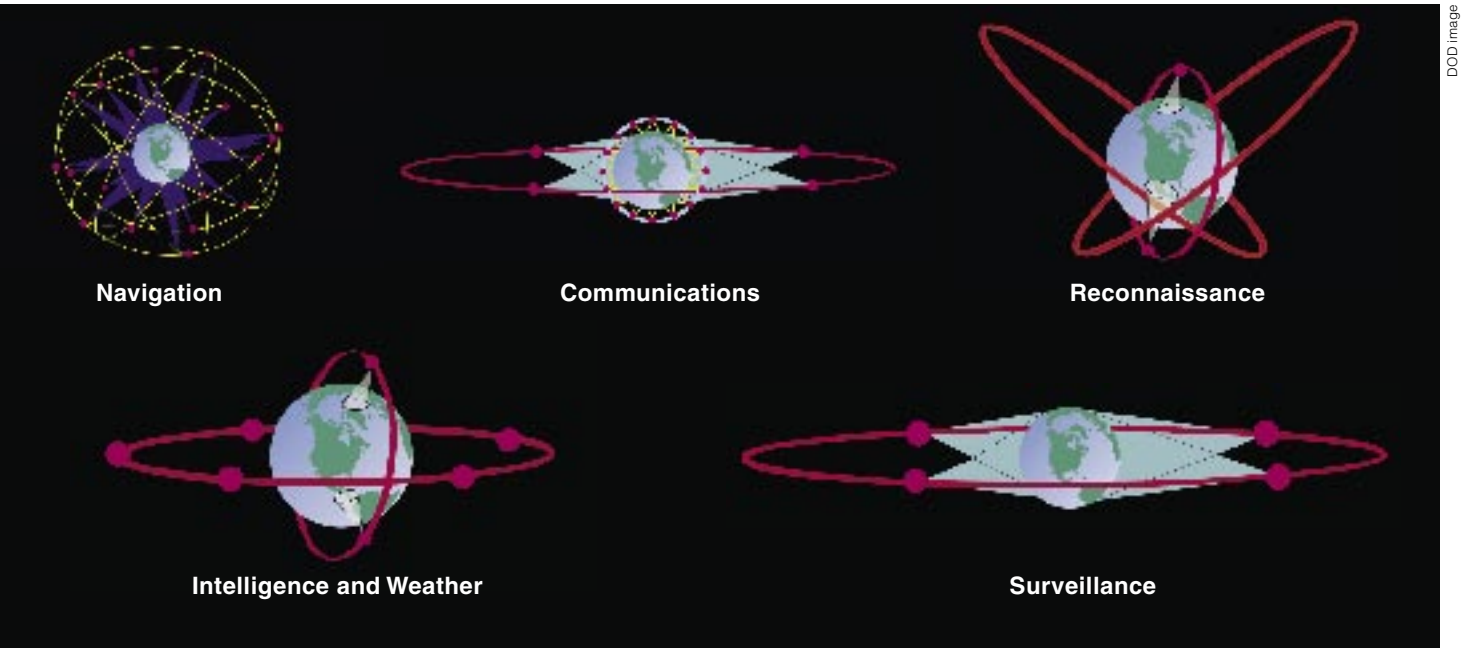
Some **surveillance** systems need continuous access to areas of interest, calling for high altitude, long dwell time orbits.

The Golden Age of NASA

Name	**Project Mercury**
Duration	**Nov. 3, 1958-May 16, 1963**
Cost	$392.1 million (cost figures are in then-year dollars)
Distinction	First US manned spaceflight program
Highlight	Astronauts are launched into space and returned safely to Earth
Number of flights	Six
Key events	**May 5, 1961** Lt. Cmdr. Alan B. Shepard Jr. makes first US manned flight, a 15-minute suborbital trip **Feb. 20, 1962** Lt. Col. John H. Glenn Jr. becomes first American to orbit Earth **May 15, 1963** Maj. L. Gordon Cooper Jr. begins flight of 22 orbits in 34 hours
Name	**Project Gemini**
Duration	**Jan. 15, 1962-Nov. 15, 1966**
Cost	$1.3 billion
Distinction	First program to explore docking, long-duration flight, rendezvous, space walks, and guided re-entry
Highlight	Dockings and rendezvous techniques practiced in preparation for Project Apollo
Number of flights	10
Key events	**June 3-7, 1965** Flight in which Maj. Edward H. White II makes first space walk **Aug. 21-29, 1965** Cooper and Lt. Cmdr. Charles "Pete" Conrad Jr. withstand extended weightlessness **March 16, 1966** Neil A. Armstrong and Maj. David R. Scott execute the first space docking **Sept. 15, 1966** Conrad and Richard F. Gordon Jr. make first successful automatic, computer-steered re-entry
Name	**Project Apollo**
Duration	**July 25, 1960-Dec. 19, 1972**
Cost	$24 billion
Distinction	Space program that put humans on the moon
Highlights	Neil Armstrong steps onto lunar surface. Twelve astronauts spend 160 hours on the moon
Number of flights	11
Key events	**May 28, 1964** First Apollo command module is launched into orbit aboard a Saturn 1 rocket **Jan. 27, 1967** Lt. Col. Virgil I. "Gus" Grissom, Lt. Cmdr. Roger B. Chaffee, and White die in a command module fire in ground test **Oct. 11-22, 1968** First manned Apollo flight proves "moonworthiness" of spacecraft **Dec. 21-27, 1968** First manned flight to moon and first lunar orbit **July 16-24, 1969** Apollo 11 takes Armstrong, Col. Edwin E. "Buzz" Aldrin Jr., and Lt. Col. Michael Collins to the moon and back Armstrong and Aldrin make first and second moon walks **Dec. 7-19, 1972** Final Apollo lunar flight produces sixth manned moon landing

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
Total	**144**	**743**



DOD image

USAF photo

Athena II

USAF photo

Atlas V

Boeing 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: CCAFS, VAFB.
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 AMCROSS LLC RD-180 engine with two chambers, 860,200 lb thrust; stage 2: Centaur, one or two Pratt & Whitney RL10A-4-2 engines, 22,221-44,442 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 lb-1.2 million lb.
Payload: (400 series) 27,558 lb to LEO, 10,913-16,843 to GTO; (500 series) 22,707-45,238 lb to LEO, 8,752-19,114 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: 13,281 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, 1,750 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 max: (Medium) 2,508 lb to GEO, 20,075 lb to LEO; (Medium-Plus) 4,489-6,142 lb to GEO, 27,116-30, 575 lb to GEO; (Heavy) 13,837 lb to GEO, 48,264 lb to LEO. (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 to cut launch costs by 25 to 50 percent. These systems replaced Atlas II, Titan II, and Titan IV launch vehicles.

USAF photo

Delta IV

Boeing photo

Space Shuttle

USAF photo

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: KSC.
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 184.2 ft; span 76.6 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, VAFB, Wallops Island.
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 to 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: April 2008, 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: May 23, 1962.
On orbit: two (primary).
Orbit altitude: approx 575 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 Polar Military Satellite Communications, below), which provides only a fraction of the polar communications capability required by aircraft, submarines, and other forces operating in the high northern latitudes. Pre-acquisition, system definition, and risk reduction efforts start in Fiscal 2006.
Function: EHF communications.
Operator: MILSATCOM JPO (acquisition); AFSPC.
First launch: circa 2013.
On orbit: none.
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 and continued on Wideband Gap-filler).
On orbit: three.
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 (M-code) on two channels launches 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 antijam and higher quality data is slated for initial launch in 2013.
Function: worldwide navigation and precise time transfer.
Operator: AFSPC.
First launch: Feb. 22, 1978 (Block I).
On orbit: 28.
Orbit altitude: 12,600 miles.

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 2009.
Function: UHF tactical communications.
Operator: Navy.
First launch: 2009, planned.
On orbit: none.
Orbit altitude: 22,300 miles.

Polar Military Satellite Communications
(also known as Interim Polar and Adjunct Polar)
Common name: Polar MILSATCOM
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. Polars 2 and 3 slated for availability in 2006 and 2007, respectively.
Function: EHF polar communications.
Operator: Navy.
First launch: 1997.
On orbit: one.
Orbit altitude: 25,300 miles (apogee).

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. 81).
Function: infrared space surveillance.
Operator: AFSPC.
First launch: 2008, planned.
On orbit: none.
Orbit altitude: 22,300 miles.

Space Radar
Common name: SR
In brief: spaceborne capability, providing deep look, all weather, day and night forward presence and situation awareness for the Intelligence Community and joint warfighters.
Function: track moving ground targets.
Operator: AFSPC.
First launch: 2015, planned.
On orbit: none.
Orbit altitude: LEO.

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: 2007 for R&D, planned.
On orbit: none.

Transformational Satellite Communications System
Common name: TSAT
In brief: joint communications satellite being designed to provide Internet-like connectivity to warfighters. 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. 81), it is slated for launch around 2014. Currently in design and risk-reduction phase.
Function: EHF communications.
Operator: MILSATCOM JPO (acquisition); AFSPC.
First launch: 2014, planned.
On orbit: none.
Orbit altitude: 22,300 miles.

UHF Follow-On Satellite
Common name: UFO
In brief: new generation satellites providing secure, antijam communications;

Artist's conception by Erik Simonsen

Global Positioning System

Major Military Satellite Systems, Continued

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 Gap-filler System
Common name: WGS
In brief: high data rate satellite broadcast system (primarily commercial product) meant to bridge the communications gap between current systems—DSCS and GBS—and TSAT (see p. 81 and 82).
Function: wideband communications and point-to-point service (Ka-band and X-band frequencies).
Operator: AFSPC.
First launch: 2007, planned.
On orbit: none.
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.

Boeing illustration

Wideband Gap-filler System

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. Slated for shutdown in 2007.
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: 28.
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: NASA.
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. 84).
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 (slated for launch 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: six.
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.

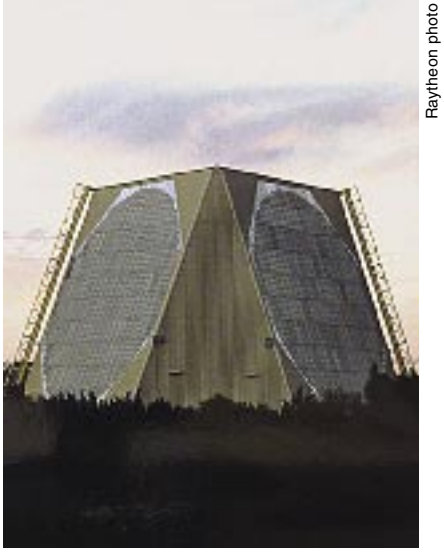
Ballistic Missile Early Warning System
Common name: BMEWS
In brief: phased-array radar used for tactical warning and attack assessment and tracking Earth-orbiting satellites.
Function: ballistic missile attack and space surveillance.
Operator: AFSPC.
Operational: 1959 (Trinidad, British West Indies); July 1, 1961 (Clear AFS, Alaska).
Unit location: Clear AFS, Alaska; RAF Fylingdales, UK; 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: Provides 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.



Raytheon photo

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

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 4, 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 antisatellite 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.

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

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Space Terms

Aerospace. A physical region made up of Earth's atmosphere and the space beyond.

Apogee. The point of greatest distance from Earth (or the moon, a planet, etc.) achieved by a body in elliptical orbit. Usually expressed as distance from Earth's surface.

Atmosphere. Earth's enveloping sphere of air.

Boost phase. Powered flight of a ballistic missile—i.e., before the rocket burns out.

Burn. The process in which rocket engines consume fuel or other propellant.

Circumterrestrial space. "Inner space" or the atmospheric region that extends from 60 miles to about 50,000 miles from Earth's surface.

Constellation. A formation of satellites orbiting for a specific combined purpose.

Deep space. All space beyond the Earth-moon system, or from about 480,000 miles altitude outward.

Eccentric orbit. An extremely elongated elliptical orbit.

Ecliptic plane. The plane defined by the circle on the celestial sphere traced by the path of the sun.

Elliptical orbit. Any noncircular, closed spaceflight path.

Exosphere. The upper limits of Earth's atmosphere, ranging from about 300 miles altitude to about 2,000 miles altitude.

Ferret. A satellite whose primary function is to gather electronic intelligence, such as microwave, radar, radio, and voice emissions.

Geostationary Earth orbit. A geosynchronous orbit with 0° inclination in which the spacecraft circles Earth 22,300 miles above the equator and appears from Earth to be standing still.

Geosynchronous Earth orbit (GEO). An orbit at 22,300 miles that is synchronized with Earth's rotation. If a satellite in GEO is not at 0° inclination, its ground path describes a figure eight as it travels around Earth.

Geosynchronous transfer orbit (GTO). An orbit that originates with the parking orbit and then reaches apogee at the GEO.

Ground track. An imaginary line on Earth's surface that traces the course of another imaginary line between Earth's center and an orbiting satellite.

High Earth orbit (HEO). Flight path above geosynchronous altitude (22,300 to 60,000 miles from Earth's surface).

Ionosphere. A region of electrically charged thin air layers that begins about 30 miles above Earth's atmosphere.

Low Earth orbit (LEO). Flight path between Earth's atmosphere and the bottom of the Van Allen belts, i.e., from about 60 to 300 miles altitude.

Magnetosphere. A region dominated by Earth's magnetic field, which traps charged particles, including those in the Van Allen belts. It begins in the upper atmosphere, where it overlaps the ionosphere, and extends several thousand miles farther into space.

Medium Earth orbit (MEO). Flight path between LEO and GEO.

Mesosphere. A region of the atmosphere about 30 to 50 miles above Earth's surface.

Orbital decay. A condition in which spacecraft lose orbital altitude and orbital energy because of aerodynamic drag and other physical forces.

Orbital inclination. Angle of flight path in space relative to the equator of a planetary body. Equatorial paths are 0° for flights headed east, 180° for those headed west.

Outer space. Space that extends from about 50,000 miles above Earth's surface to a distance of about 480,000 miles.

Parking orbit. Flight path in which spacecraft go into LEO, circle the globe in a waiting posture, and then transfer payload to a final, higher orbit.

Payload. Any spacecraft's crew or cargo; the mission element supported by the spacecraft.

Perigee. The point of minimum altitude above Earth (or the Moon, a planet, etc.) maintained by a body in elliptical orbit.

Period. The amount of time a spacecraft requires to go through one complete orbit.

Polar orbit. Earth orbit with a 90° inclination. Spacecraft on this path could pass over every spot on Earth as Earth rotates under the satellite's orbit (see orbital inclination).

Rocket. An aerospace vehicle that carries its own fuel and oxidizer and can operate outside Earth's atmosphere.

Semisynchronous orbit. An orbit set at an altitude of 12,834 miles. Satellites in this orbit revolve around Earth in exactly 12 hours.

Stratosphere. That section of atmosphere about 10 to 30 miles above Earth's surface.

Sun synchronous orbit. An orbit inclined about 98° to the equator and at LEO altitude. At this inclination and altitude, a satellite's orbital plane always maintains the same relative orientation to the sun.

Thermosphere. The thin atmosphere about 50 to 300 miles above Earth's surface. It experiences dramatically increased levels of heat compared to the lower layers.

Transfer. Any maneuver that changes a spacecraft orbit.

Troposphere. The region of the atmosphere from Earth's surface to about 10 miles above the equator and five miles above the poles. This is where most clouds, wind, rain, and other weather occurs.

Van Allen belts. Zones of intense radiation trapped in Earth's magnetosphere that could damage unshielded spacecraft.

Acknowledgements

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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.