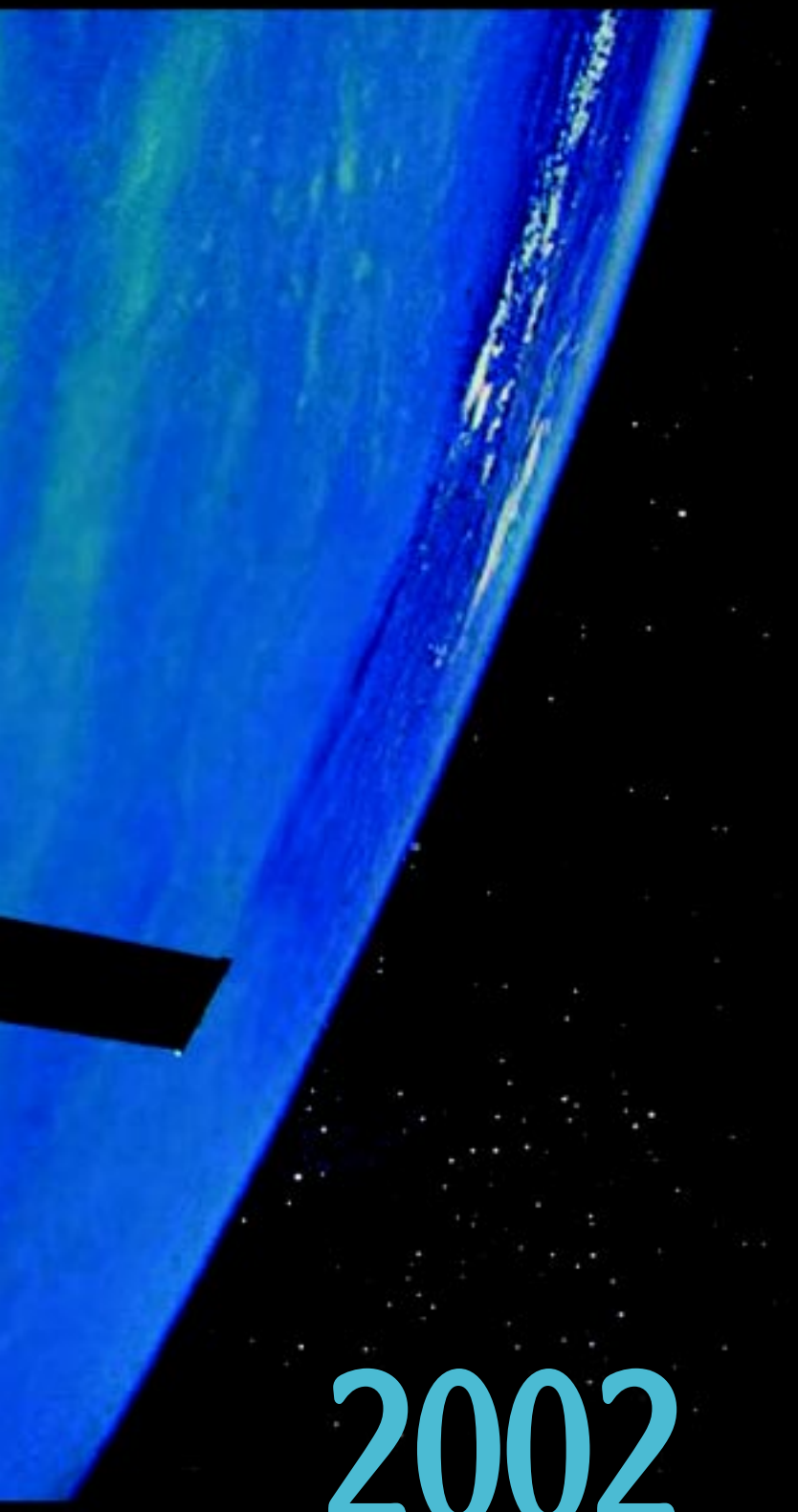
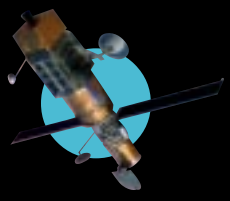
Artist's concept by Erik Simonsen

The spacecraft depicted in this artist's concept represents a generic electronic intelligence-gathering satellite.



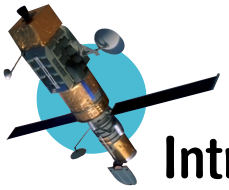
2002 Space Almanac

By Tamar A. Mehuron, Associate Editor



On the following pages appears a variety of information and statistical material about space—particularly military activity in space. This almanac was compiled by *Air Force* Magazine, with assistance and information from Steve Garber, NASA History Office; Phillip S. Clark, Molniya Space Consultancy; Joseph J. Burger, Space Analysis and Research, Inc.; and US 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.

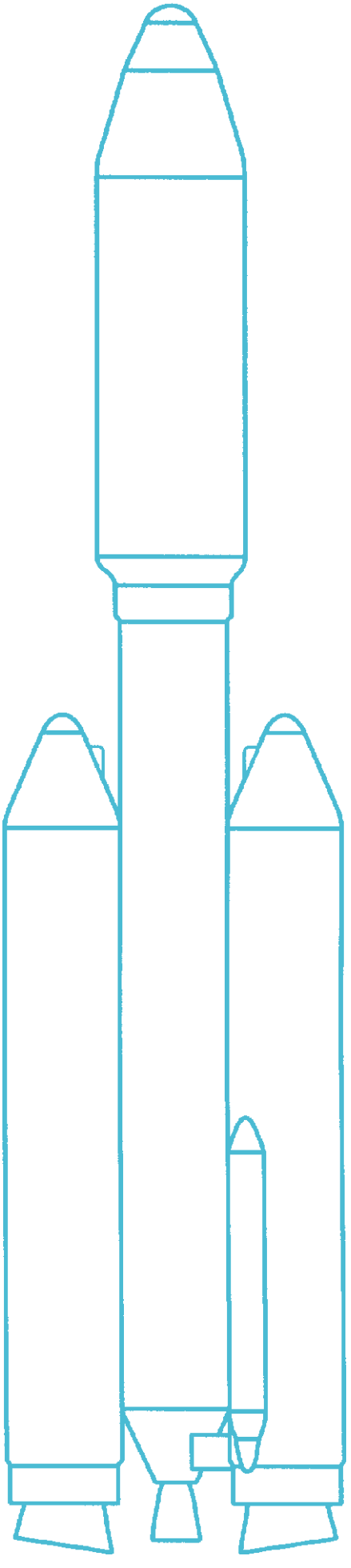


Introduction

What's Up There

As of May 31, 2002

Country/Organization	Satellites	Space Probes	Debris	Total
CIS (Russia/former USSR)	1,336	35	2,507	3,878
USA	878	46	2,815	3,739
People's Republic of China	34	0	299	333
European Space Agency	32	2	282	316
India	22	0	175	197
Japan	72	5	48	125
Intl. Telecom Sat. Org.	60	0	0	60
Globalstar	52	0	0	52
France	33	0	14	47
Orbcomm	35	0	0	35
United Kingdom	21	0	1	22
Germany	18	2	1	21
European Telecom Sat. Org.	20	0	0	20
Canada	17	0	0	17
Italy	11	0	3	14
Luxembourg	13	0	0	13
Brazil	10	0	0	10
Sweden	10	0	0	10
Australia	7	0	2	9
Indonesia	9	0	0	9
Intl. Maritime	9	0	0	9
NATO	8	0	0	8
Arab Sat. Comm. Org.	7	0	0	7
Sea Launch (Launch Demo)	1	0	6	7
South Korea	7	0	0	7
Mexico	6	0	0	6
Argentina	5	0	0	5
Spain	5	0	0	5
Czech Republic	4	0	0	4
Intl. Space Station	1	3	0	4
Thailand	4	0	0	4
Turkey	4	0	0	4
Asia Sat. Telecom Co.	3	0	0	3
Israel	3	0	0	3
Malaysia	3	0	0	3
Norway	3	0	0	3
Egypt	2	0	0	2
France/Germany	2	0	0	2
Philippines	2	0	0	2
Saudi Arabia	2	0	0	2
Chile	1	0	0	1
China/Brazil	1	0	0	1
Denmark	1	0	0	1
Nico	1	0	0	1
Pakistan	1	0	0	1
Portugal	1	0	0	1
Republic of China (Taiwan)	1	0	0	1
Saudi Arabia/France	1	0	0	1
Singapore/Taiwan	1	0	0	1
South Africa	1	0	0	1
UAE	1	0	0	1
Total	**2,782**	**93**	**6,153**	**9,028**



Worldwide Orbital Launch Sites, 1957–2001

Launch Site	Owner	Total
Plesetsk	Russia	1,526
Tyuratam/Baikonur, Kazakhstan	Russia	1,176
Vandenberg AFB, Calif.	US	617
Cape Canaveral AFS, Fla.	US	575
Kourou, French Guiana	ESA	155
JFK Space Center, Fla.	US	127
Kapustin Yar	Russia	101
Xichang	China	33
Tanegashima	Japan	32
Kagoshima	Japan	30
Wallops Flight Facility, Va.	US	30
Shuang Cheng-tsu/Jiuquan	China	28
Edwards AFB, Calif.	US	20
Sriharikota	India	15
Taiyuan	China	13
Indian Ocean Platform	US	9
Pacific Ocean Platform	Sea Launch	7
Woomera, Australia	Australia	5
Hammaguir, Algeria	France	4
Palmachim	Israel	4
Svobodny	Russia	4
Alcantara	Brazil	2
Barents Sea	Russia	1
Kodiak, Alaska	US	1
Kwajalein, Marshall Islands	US	1
Musudan ri	North Korea	1
Gando AB, Canary Islands	Spain	1
Total		**4,518**

Space on the Web

(Some of the space-related sites on the World Wide Web)

Defense	***Web address***
US Space Command	www.spacecom.mil
Air Force Space Command	www.spacecom.af.mil/hqafspc
21st Space Wing	www.spacecom.af.mil/21sw
30th Space Wing	www.vandenberg.af.mil
45th Space Wing	https://www.patrick.af.mil
50th Space Wing	www.schriever.af.mil
Space & Missile Systems Ctr.	www.losangeles.af.mil
Industry	
Boeing Space Systems	www.boeing.com/defense-space/space
Lockheed Martin Astronautics	www.ast.lmco.com
Orbital Sciences	www.orbital.com
TRW	www.trw.com
NASA	
Integrated Launch Schedule *(Launch forecast for shuttle and NASA payloads on ELVs)*	www-pao.ksc.nasa.gov/kscpao/schedule/mixfleet.htm
Jet Propulsion Laboratory	www.jpl.nasa.gov
Mars Global Surveyor	mars.jpl.nasa.gov/mgs
NASA Human Spaceflight	spaceflight.nasa.gov
Space Center Houston	spacecenter.org
Other	
European Space Agency	www.esa.int
Florida Today *(Current and planned space activity)*	www.flatoday.com/space
Space and Technology	www.spaceandtech.com
Quest: The History of Spaceflight Quarterly	www.spacebusiness.com/quest

Space and Missile Badges

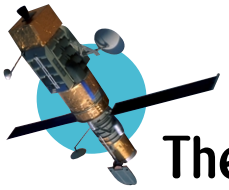
Space/Missile Badge

Astronaut Pilot*

Missile Badge

Missile Badge with Operations Designator

*The astronaut designator indicates a USAF rated officer qualified to perform duties in space (50 miles and up) and who has completed at least one operational mission. Pilot wings are used here only to illustrate the position of the designator on the wings.



The Year in Space

July 13, 2001
AFSPC announces Schriever AFB, Colo., as the site of the Space Based Infrared System mission control backup station. The main SBIRS mission control station will be at Buckley AFB, Colo. The Schriever SBIRS backup station is expected to achieve initial operational capability in Fiscal 2005.

July 14
In a missile defense test, a Minuteman ICBM prototype interceptor, launched from the Ronald Reagan Missile Site, Kwajalein Atoll, in the Pacific Ocean, successfully targets and destroys an unarmed Minuteman II ICBM launched from Vandenberg AFB, Calif., about 20 minutes earlier. The test is to support the Ground-based Midcourse Defense Segment, formerly called the National Missile Defense program.

Aug. 10–Sept. 7
The 527th Space Aggressor Squadron from Schriever Air Force Base participates for the first time in the annual Red Flag warfighting exercise. Acting as an adversary, the unit uses electronic warfare equipment carried on a truck to jam Global Positioning System satellite signals. The loss of GPS signals so hampers search-and-rescue efforts for "downed" airmen that the truck is targeted and "destroyed" by an F-16.

Aug. 24
Russian Space Forces launch a classified military satellite, Kosmos 2379, into orbit aboard a Proton-K rocket from the Baikonur Cosmodrome in Kazakhstan.

Sept. 29
An Athena I rocket launches one NASA and three military research satellites into polar orbit from the Kodiak Launch Complex in Alaska. It is the first orbital launch from Kodiak, which earlier had successfully conducted three Air Force missile tests on suborbital missions.

Oct. 1
The Space and Missile Systems Center at Los Angeles AFB, Calif., realigns from Air Force Materiel Command to Air Force Space Command—folding space procurement and operations activities into one organization. The realignment fulfills one of several recommendations of the Space Commission.

Oct. 9
Space Launch Complex 37 at Patrick AFB, Fla., is completed and ready for the new Boeing Delta IV, part of USAF's Evolved Expendable Launch Vehicle program.

Oct. 10
Vandenberg Air Force Base launches its third National Reconnaissance Office spy satellite in two months.

Oct. 25
Russian Space Forces launch a Molniya-M military communications satellite into orbit from the northern cosmodrome in Plesetsk, Russia.

Nov. 9
A rocket fired from Alaska's Kodiak Launch Complex as part of the missile defense program is destroyed just seconds after liftoff when launch officials lose telemetry data and data transmission.

Nov. 10
Maxwell W. Hunter, 79, dies. He led the design of the Nike anti-aircraft missile and later oversaw development of the Thor intermediate-range ballistic missile. The Thor evolved into the Delta rocket, still used to lift payloads into orbit.

Dec. 1
Russia launches three military navigation satellites to resupply its global positioning constellation, the GLONASS network.

Dec. 13
Peter B. Teets is sworn in as undersecretary of the Air Force and director of the National Reconnaissance Office. The dual tasking was a Space Commission recommendation, as was making Teets the Air Force acquisition executive for space. The Air Force was named DOD executive agent for space in May 2001.

Jan. 8, 2002
Secretary of Defense Donald H. Rumsfeld announces that the Ballistic Missile Defense Organization is now the Missile Defense Agency.

Jan. 15
A Titan IVB rocket blasts off from Cape Canaveral AFS, Fla., and inserts a Milstar 2 satellite into orbit 22,300 miles above the equator. The new military communications satellite cuts the transmission of air tasking orders from one hour to just six seconds. The transmission of images the size of an 8X10 picture will no longer take 22 hours, but just two minutes.

Feb. 11
A Boeing Delta II rocket launches from Vandenberg Air Force Base, placing five Iridium communications satellites into orbit. They join 73 other Iridium satellites operating in Low Earth Orbit. DOD is a key customer, with a $72 million contract for Iridium's global mobile phone system services.

March 15
The Missile Defense Agency achieves a fourth successful intercept in six attempts when an ICBM target launched from Vandenberg Air Force Base is intercepted by a prototype interceptor launched from the Ronald Reagan Missile Site, Kwajalein Atoll, in the Pacific Ocean.

March 18
Media reports reveal that NASA will not disclose launch times for the space shuttle until 24 hours in advance, as a security precaution against terrorist attack.

March 22
Officials approve the appointment of Robert S. Dickman, a retired Air Force major general, as the deputy for military space, a new office established by Teets, undersecretary of the Air Force, as he revamps the national security space apparatus.

March 25
China launches its third unmanned spacecraft, Shenzhou III. The craft is boosted into orbit from the Jiuquan launch center in the northwestern province of Gansu aboard a Long March II-F rocket. China plans manned spaceflights by 2005 and hopes to put a man on the Moon.

April 17
DOD announces Unified Command Plan revisions, one of which realigns NORAD from US Space Command to a new entity chartered with homeland defense and called US Northern Command. The head of NORTHCOM will also serve as head of NORAD.

April 19
Gen. Lance W. Lord becomes commander of Air Force Space Command. The position was boosted to four-star level and separated from US Space Command, following a Space Commission recommendation. Since March 1992 the commander in chief of SPACECOM had also served as commander of AFSPC.

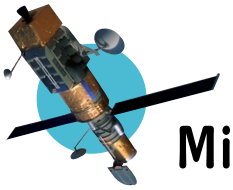
April 26
Lord announces that AFSPC officials are developing a space concepts of operation to identify capabilities for the future. The concepts will address six key areas: command and control for space forces; space situational awareness; global information services such as weather and mapping; global surveillance, tracking, and targeting; rapid global strike; and space control (counterspace).

May 1
The last Titan IVB to be launched from Cape Canaveral Air Force Station arrives at the station. The Cape's last Titan IVB launch is scheduled for 2003.

May 2
The last Titan IVB to be launched from Vandenberg Air Force Base arrives at the base and is scheduled for launch in 2005. After that, payloads in the 10,000-lb. class will be boosted using either the Boeing Delta IV or Lockheed Atlas V, both part of USAF's EELV program.

May 28
Israel launches a military spy satellite, Ofek 5, to fill a year-long gap in intelligence coverage. It follows the failed 1998 launch of Ofek 4 and the loss of Ofek 3 last year. The new satellite will focus its cameras on Syria, Iraq, and Iran, according to media reports.

June 26
Defense Secretary Rumsfeld announces the merger of US Space Command, headquartered at Peterson AFB, Colo., and US Strategic Command, headquartered at Offutt AFB, Neb. The new command, which is likely to reside at Offutt, will handle both early warning of and defense against missile attack, as well as long-range conventional attacks.



Military & Civilian Space Budgets

US Space Funding, Current Dollars

(Millions, as of Sept. 30, 2001)

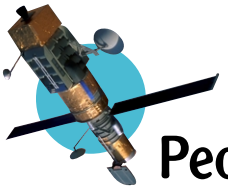
FY	NASA	DOD	Other	Total
1959	$261	$490	$34	$785
1960	462	561	43	1,066
1961	926	814	68	1,808
1962	1,797	1,298	199	3,294
1963	3,626	1,550	257	5,433
1964	5,016	1,599	213	6,828
1965	5,138	1,574	241	6,953
1966	5,065	1,689	214	6,968
1967	4,830	1,664	213	6,707
1968	4,430	1,922	174	6,526
1969	3,822	2,013	170	6,005
1970	3,547	1,678	141	5,366
1971	3,101	1,512	162	4,775
1972	3,071	1,407	133	4,611
1973	3,093	1,623	147	4,863
1974	2,759	1,766	158	4,683
1975	2,915	1,892	158	4,965
1976	4,074	2,443	211	6,728
1977	3,440	2,412	194	6,046
1978	3,623	2,738	226	6,587
1979	4,030	3,036	248	7,314
1980	4,680	3,848	231	8,759
1981	4,992	4,828	234	10,054
1982	5,528	6,679	313	12,520
1983	6,328	9,019	327	15,674
1984	6,858	10,195	395	17,448
1985	6,925	12,768	584	20,277
1986	7,165	14,126	477	21,768
1987	9,809	16,287	466	26,562
1988	8,322	17,679	741	26,742
1989	10,097	17,906	560	28,563
1990	11,460	15,616	506	27,582
1991	13,046	14,181	772	27,999
1992	13,199	15,023	798	29,020
1993	13,064	14,106	731	27,901
1994	13,022	13,166	632	26,820
1995	12,543	10,644	759	23,946
1996	12,569	11,514	828	24,911
1997	12,457	11,727	789	24,973
1998	12,321	12,359	839	25,519
1999	12,459	13,203	982	26,644
2000	12,521	12,941	1,056	26,518
2001	13,304	14,326	1,073	28,703
Total	**$291,695**	**$307,822**	**$17,697**	**$617,214**

US Space Funding, Constant Dollars

(Millions, as of Sept. 30, 2001)

FY	NASA	DOD	Other	Total
1959	$1,275	$2,395	$166	$3,836
1960	2,215	2,689	206	5,110
1961	4,397	3,866	323	8,586
1962	8,420	6,082	932	15,435
1963	16,783	7,174	1,190	25,147
1964	22,946	7,315	974	31,235
1965	23,203	7,108	1,088	31,400
1966	22,490	7,500	950	30,940
1967	20,567	7,086	907	28,559
1968	18,654	8,093	734	27,480
1969	15,520	8,174	692	24,385
1970	13,790	6,524	548	20,861
1971	11,442	5,579	598	17,619
1972	10,772	4,935	468	16,176
1973	10,349	5,431	493	16,273
1974	8,827	5,650	506	14,983
1975	8,708	5,652	471	14,831
1976	11,068	6,637	574	18,279
1977	8,433	5,913	474	14,820
1978	8,517	6,436	531	15,484
1979	8,871	6,683	546	16,100
1980	9,557	7,858	472	17,886
1981	9,387	9,078	441	18,905
1982	9,482	11,456	536	21,475
1983	10,160	14,480	525	25,165
1984	10,538	15,665	607	26,810
1985	10,257	18,911	865	30,032
1986	10,279	20,265	684	31,227
1987	13,744	22,821	653	37,218
1988	11,360	24,133	1,012	36,504
1989	13,353	23,679	741	37,773
1990	14,590	19,881	644	35,115
1991	16,002	17,394	947	34,342
1992	15,603	17,759	943	34,305
1993	15,103	16,308	845	32,257
1994	14,683	14,845	713	30,242
1995	13,825	11,732	836	26,393
1996	13,567	12,428	894	26,889
1997	13,192	12,419	836	26,447
1998	12,830	12,869	874	26,573
1999	12,810	13,575	1,010	27,394
2000	12,708	13,134	1,071	26,914
2001	13,304	14,326	1,073	28,703
Total	**$533,579**	**$471,938**	**$30,592**	**$1,036,108**

Figures may not sum due to rounding. NASA totals represent space activities only. "Other" category includes the Departments of Energy, Commerce, Agriculture, Interior, and Transportation; the National Science Foundation; and the Environmental Protection Agency (only through 1998). (Note: NSF recalculated its space expeditures since 1968, making them significantly higher in some years than previously reported.) Fiscal 2001 figures are preliminary.



People & Organizations

Space Leaders

(As of July 1, 2002)

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–

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–

Army Space & Missile Defense Command*

Lt. Gen. John F. Wall	July 1, 1985–May 24, 1988
Brig. Gen. Robert L. Stewart (acting)	May 24, 1988–July 11, 1988
Lt. Gen. Robert D. Hammond	July 11, 1988–June 30, 1992
Brig. Gen. William J. Schumacher (acting)	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 (acting)	Aug. 6, 1998–Oct. 1, 1998
Lt. Gen. John Costello	Oct. 1, 1998–March 28, 2001
Brig. Gen. John M. Urias	March 28, 2001–April 30, 2001
Lt. Gen. Joseph M. Cosumano Jr.	April 30, 2001–

*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
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
Jeffrey K. Harris	May 19, 1994–Feb. 26, 1996
Keith R. Hall (acting)	Feb. 27, 1996–March 27, 1997
Keith R. Hall	March 28, 1997–Dec. 13, 2001
Peter B. Teets	Dec. 13, 2001–

Naval Space Command

RAdm. Richard H. Truly	Oct. 1, 1983–Feb. 28, 1986
Col. Richard L. Phillips, USMC (acting)	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. Charles R. Geiger, USMC (acting)	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. Michael M. Henderson, USMC (acting)	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–

USECAF/DNRO Organization

(As of July 1, 2002)

Undersecretary of the Air Force and
Director, National Reconnaissance Office
Peter B. Teets

Deputy for Military Space
Robert S. Dickman

Director of Air Force Space Acquisition
Maj. Gen. Joseph B. Sovey

Program Executive Officer for Air Force Space
Lt. Gen. Brian A. Arnold

Director of National Security Space Integration
Maj. Gen. Claude R. Kehler

National Security Space Architect
Brig. Gen. Stephen J. Ferrell, USA

Deputy Director of NRO
Dennis Fitzgerald

Air Force Space Command, Peterson AFB, Colo.

(As of July 1, 2002)

Commander
Gen. Lance W. Lord

Space and Missile Systems Center
Hq., Los Angeles AFB, Calif.
Cmdr.: **Lt. Gen. Brian A. Arnold**

- Defense Meteorological Satellite System Program Office
- Launch Programs SPO
- Advanced Systems SPO
- Satellite and Launch Control SPO
- Space Based Laser Project Management Office
- Space & Missile Test & Evaluation Directorate, Kirtland AFB, N.M.

Space Warfare Center
Schriever AFB, Colo.
Cmdr.: **Brig. Gen. Douglas M. Fraser**

14th Air Force
Hq., Vandenberg AFB, Calif.
Cmdr.: **Maj. Gen. Michael A. Hamel**

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

20th Air Force
Hq., F.E. Warren AFB, Wyo.
Cmdr.: **Maj. Gen. Timothy J. McMahon**

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

Major Military Space Commands

Unified Command	Personnel	FY03 Budget	Functions
US Space Command Peterson AFB, Colo.	844	$87.3 million	Coordinates the use of Air Force, Army, and Navy space forces to provide space support, force enhancement, space control, force application, computer network defense, computer network attack, and information operations.
Service Commands			
Air Force Space Command Peterson AFB, Colo.	37,400	$8.0 billion	Operates military space systems, ground-based missile-warning radars and sensors, missile-warning satellites, national launch centers, and ranges; tracks space debris; operates and maintains the USAF ICBM force.
Naval Space Command Dahlgren, Va.	475	$101.4 million	Operates assigned space systems for surveillance and warning; provides spacecraft telemetry and on-orbit engineering; develops space plans, programs, concepts, and doctrine; advocates naval warfighting requirements in the joint arena.
Army Space Command Colorado Springs, Colo.	650	$59.0 million	Manages joint tactical use of DSCS; operates space support teams; operates Joint Tactical Ground Stations for missile early warning to deployed forces; acts as Army focal point for terminal missile defense system; manages Army astronaut program.

Major US Agencies in Space

National Imagery and Mapping Agency (NIMA)
Headquarters: Bethesda, Md.
Established: Oct. 1, 1996
Director: James R. Clapper Jr.

Mission, Purpose, Operations
Provide timely, relevant, and accurate imagery intelligence and geospatial information to support national security objectives. This DOD–chartered combat support agency is also a member of the Intelligence Community.
Structure
Major facilities in Virginia, Maryland, Washington, D.C., and Missouri, with the National Geospatial Intelligence College located at Ft. Belvoir, Va. Also, customer support teams and technical representatives stationed around the world at major customer locations.
Personnel
Classified.

Central Intelligence Agency (CIA)
Headquarters: McLean, Va.
Established: 1947
Director: George J. Tenet

Mission, Purpose, Operations
The CIA's Directorate for Science and Technology includes the Office of Development and Engineering, which develops systems from requirements definition through design, testing, and evaluation to operations. Works with systems not available commercially. Disciplines include laser communications, digital imagery processing, real-time data collection and processing, electro-optics, advanced signal collection, artificial intelligence, advanced antenna design, mass data storage and retrieval, and large systems modeling and simulations. Work includes new concepts and systems upgrades.
Structure
Classified.
Personnel
Classified.

National Reconnaissance Office (NRO)
Headquarters: Chantilly, Va.
Established: September 1961
Director: Peter B. Teets

Mission, Purpose, Operations
Design, build, and operate reconnaissance satellites to support global information superiority for the US. It has operated hundreds of satellites since it was formed in 1960 and officially recognized in 1961. Responsible for innovative technology; systems engineering; development, acquisition, and operation of space reconnaissance systems; and related intelligence activities. Supports monitoring of arms control agreements, military operations and exercises, natural disasters, environmental issues, and worldwide events of interest to the US.
Structure
NRO is a DOD agency, funded through part of the National Foreign Intelligence Program, known as the National Reconnaissance Program. Both the Secretary of Defense and Director of Central Intelligence have approval of the program. The NRO has four deputy directors for resources, oversight, and management; national support; military support; and systems engineering. Three offices and four directorates report up to the level of the director. Offices are management services and operations, human resources, and space launch. Directorates are signals intelligence systems acquisition and operations, communications systems acquisition and operations, imagery systems acquisition and operations, and advanced systems and technology.
Personnel
Staffed by CIA (40 percent), USAF (50 percent), Navy/Marines (9 percent), Army (2 percent). Exact personnel numbers are classified.

National Security Agency (NSA)
Headquarters: Ft. Meade, Md.
Established: 1952
Director: USAF Lt. Gen. Michael V. Hayden

Mission, Purpose, Operations
Protect US communications and produce foreign intelligence information. Tasked with two primary missions: an information assurance mission and a foreign signals intelligence mission. To accomplish these missions, the director's responsibilities include: prescribing security principles, doctrines, and procedures for the government; organizing, operating, and managing certain activities and facilities to produce foreign intelligence information; and conducting defensive information operations.
Structure
Established by a presidential directive in 1952 as a separately organized agency within DOD under the direction, authority, and control of the Secretary of Defense, who serves as the executive agent of the US government for the foreign signals intelligence and communications security activities of the government. A 1984 presidential directive charged the agency with an additional mission: computer security. An operations security training mission was added in 1988. The Central Security Service was established in 1972 by a presidential memorandum to provide a more unified cryptological organization within DOD. The NSA director also serves as chief of the CSS.
Personnel
Classified.

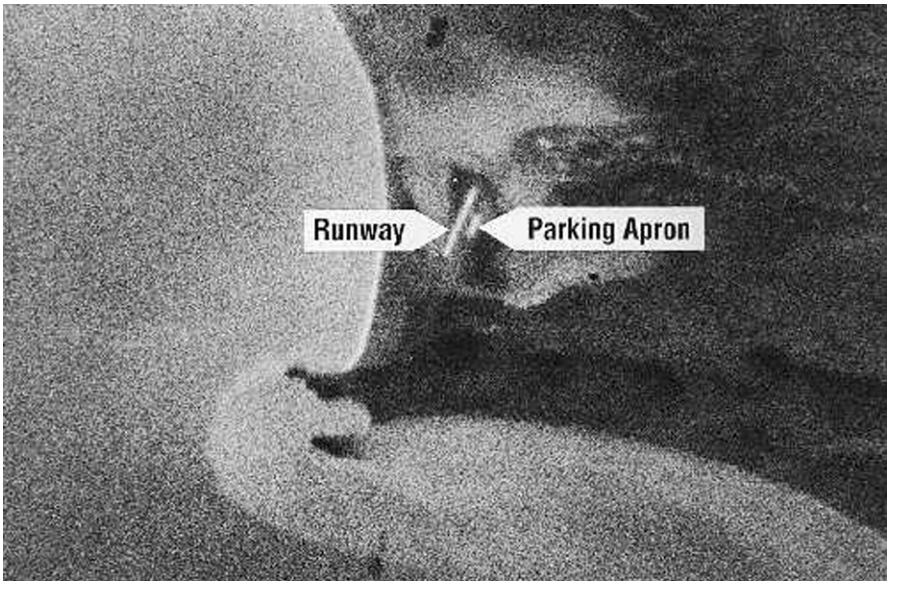
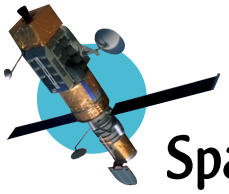


Photo courtesy National Reconnaissance Office

This photo from Corona, the first US photoreconnaissance satellite program, shows an airfield in the Soviet Union in August 1960.



Space Operations

US Space Launch Sites

Military Sites (Orbital)

Cape Canaveral AFS, Fla.
Location: 28.5° N, 80° W. USAF's East Coast launch site.
Mission/operations: Launches satellites into geosynchronous orbit via ELVs. Hub of Eastern Range operations for civil, military, and commercial space launches and military ballistic missile tests.
Launches: 575.
Launch vehicles: Athena I, II; Atlas II, III, V; Delta II, III, IV; Titan IV.
History: Designated simply as Operating Sub-Division #1 in 1950, it became Cape Canaveral Missile Test Annex and, for a time, Cape Kennedy Air Force Station, then it became Cape Canaveral Air Force Station again in 1974.
Acres: 15,700.

Vandenberg AFB, Calif.
Location: 35° N, 121° W. USAF's West Coast launch site.
Mission/operations: Satellite (weather, remote sensing, navigation, communications, and reconnaissance) launches into polar orbits via ELVs; 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 on base.
Launches: 617.
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 Air Force January 1957. Renamed Vandenberg Oct. 4, 1958.
Acres: 99,099.

Civil/Commercial Sites (Orbital)

Alaska Spaceport
Location: 57.5° N, 153° W.
Mission/operations: Commercial launch facility for polar and near-polar launches of communications, remote sensing, and scientific satellites up to 8,000 pounds.
Status: Construction of Kodiak Launch Complex is complete. Funding secured by Alaska Aerospace Development Corp., Alaska's spaceport authority. Complex designed for all indoor processing of payload and launch vehicles.
Launches: Four.
Launch vehicles: Athena I, suborbital.
Acres: 3,100.

Florida Space Authority
Location: 28.5° N, 80° W.
Mission/operations: Various launch complexes and support facilities developed, operated, or financed by the state of Florida at the Cape Canaveral Spaceport (comprising Cape Canaveral Air Force Station and Kennedy Space Center). FSA developed or owns infrastructure at launch complexes 37 and 41 and manages a multiuser launch control facility, space experiments research and processing laboratory, and other facilities.
Launch vehicles: Athena I, II; Minotaur; Minuteman III; Taurus; Terrier.
History: Established in 1989.

John F. Kennedy Space Center, Fla.
Location: 28° N, 80° W.
Mission/operations: NASA's primary launch base for space shuttle.
Launches: 127.
Launch vehicles: Pegasus, space shuttle, Taurus.
History: NASA began acquiring land across the Banana River from Cape Canaveral in 1962. By 1967, its first launch complex—Complex 39—was operational. KSC facilities were modified in the mid to late 1970s to accommodate the space shuttle program.
Acres: 140,000 (land and water).

Sea Launch
Location: Equator, 154° W, Pacific Ocean.
Mission/operations: Provide heavy lift GTO launch services for commercial customers worldwide. Sea Launch is owned by an international partnership: Boeing, RSC Energia, Ango–Norwegian Kvaerner Group, and SDO Yuzhnoye/PO Yuzhmash.
Launches: Seven.
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.
Mission/operations: Polar and near-polar LEO launches from Vandenberg; payload processing and launches for commercial, NASA, and USAF customers; small to medium launch vehicles up to 1 million pound thrust; payload processing facility for small and heavy satellites.
Launches: Two.
Launch vehicles: MM II–Delta III class.
History: SSI, a limited partnership formed by ITT and California Commercial Spaceport, Inc., achieved full operational status of the spaceport in May 1999.

Virginia Space Flight Center
Location: 38° N, 76° W (south end of Wallops Flight Facility).
Mission/operations: State-owned, commercially operated launch facility for access to inclined and sun-synchronous orbits; recovery support for ballistic and guided re-entry vehicles; vehicle and payload storage and processing facilities; two commercially licensed launchpads and suborbital launch rails for commercial, military, scientific, and experimental launch customers.
Operator: DynSpace Corp.
Launches: 12 (since 1995).
Launch vehicles: Athena I, II; Black Brant; Lockheed Martin HYSR; Minotaur; Orion; Pegasus; Taurus; Terrier.

Wallops Flight Facility, Va.
Location: 38° N, 76° W.
Mission/operations: East Coast launch site for Orbital Sciences' Pegasus and DOD missions.
Launches: 30.
Launch vehicles: Pegasus.
History: Established in 1945, it is one of world's oldest launch sites.
Acres: 6,166.

Note: Launches 1957–2001, except where noted.

Military Functions in Space

Communications
Provide communications from national leaders to Joint Force Commander. Provide communications from JFC to squadron-level commanders. Permit transfer of imagery and situational awareness to tactical operations. Permit rapid transmission of JFC intent, ground force observations, and adaptive planning.

Environmental/Remote Sensing
Use space systems to create topographical, hydrographic, and geological maps and charts and to develop systems of topographic measurement.

Force Application
US Space Command is identifying potential future roles, missions, and systems which, if authorized by civilian leadership for development and deployment, could attack terrestrial and space targets from space in support of national defense.

Missile Defense
Employ space assets to support identification, acquisition, tracking, and destruction of ballistic and cruise missiles launched against forward deployed US forces, allied forces, or US territory.

Navigation and Timing
Operate GPS network. Enable commanders to determine precise locations of friendly and enemy forces and targets. Permit accurate, timely rendezvous of combat forces. Map minefields and other obstacles. Provide precise time standard for forces deployed globally.

On-Orbit Support
Track and control satellites, operate their payloads, and disseminate data from them.

Reconnaissance and Surveillance
Identify possible global threats and surveillance of specific activity that might be threatening to US or allied military forces or US territory. Reduce effectiveness of camouflage and decoys. Identify "centers of gravity" in enemy forces. Accurately characterize electronic emissions.

Space Control
Control and exploit space using offensive and defensive measures to ensure that friendly forces can use space capabilities, while denying their use to the enemy. This mission is assigned to USCINCSPACE in the Unified Command Plan.

Space Environment/Meteorological Support
Operate ground-based systems and direct National Oceanic and Atmospheric Administration on the operations of space-based DMSP weather satellite systems to provide solar/geophysical support to the warfighter. Provide data on worldwide and local weather systems affecting combat operations.

Spacelift
Oversee satellite and booster preparation and integration. Conduct launch countdown activities. Operate Eastern and Western Ranges to support ballistic and spaceflight missions.

Strategic Early Warning
Operate satellites to give national leaders early warning of all possible strategic events, including launch of ICBMs. Identify launch locations and impact areas. Cue area and point defense systems.

Tactical Warning/Attack Assessment
Execute the NORAD mission calling for use of all sensors to detect and characterize an attack on US or Canadian territory. US Space Command carries out similar tactical warning in other theaters.

ANG photo by MSgt. Shaun Withers

A Florida Air National Guard F-15 on combat air patrol flies above the space shuttle* Endeavour. *The John F. Kennedy Space Center is NASA's primary launch base for shuttle missions.

Continued on p. 36.

Continued from p. 34.

US Military/Civil Launches
(As of Dec. 31, 2001)

Launch Year	Military	Civil*	Total
1958	0	7	7
1959	6	5	11
1960	11	5	16
1961	19	10	29
1962	32	20	52
1963	25	13	38
1964	33	24	57
1965	34	29	63
1966	35	38	73
1967	29	29	58
1968	23	22	45
1969	17	23	40
1970	18	11	29
1971	16	16	32
1972	14	17	31
1973	11	12	23
1974	8	16	24
1975	9	19	28
1976	11	15	26
1977	10	14	24
1978	14	18	32
1979	8	8	16
1980	8	5	13
1981	7	11	18
1982	6	12	18
1983	8	14	22
1984	11	11	22
1985	4	13	17
1986	4	2	6
1987	6	2	8
1988	8	4	12
1989	11	7	18
1990	11	16	27
1991	6	12	18
1992	11	17	28
1993	12	11	23
1994	11	15	26
1995	9	18	27
1996	11	22	33
1997	9	28	37
1998	5	29	34
1999	7	23	30
2000	11	17	28
2001	7	14	21
Total	**566**	**674**	**1,240**

Note: Data changes in prior years in the table above are based on recategorization of civil to military launches.

US Satellites Placed in Orbit and Deep Space
(As of Dec. 31, 2001)

Launch Year	Military	Civil*	Total
1958	0	7	7
1959	6	5	11
1960	12	5	17
1961	20	12	32
1962	35	20	55
1963	33	22	55
1964	44	25	69
1965	49	39	88
1966	52	47	99
1967	51	34	85
1968	35	26	61
1969	32	27	59
1970	23	8	31
1971	26	18	44
1972	18	14	32
1973	14	10	24
1974	11	8	19
1975	12	16	28
1976	17	12	29
1977	14	6	20
1978	16	17	33
1979	10	7	17
1980	12	4	16
1981	7	10	17
1982	8	9	17
1983	16	12	28
1984	17	16	33
1985	13	17	30
1986	7	4	11
1987	10	1	11
1988	11	9	20
1989	15	9	24
1990	22	16	38
1991	17	18	35
1992	12	17	29
1993	12	18	30
1994	18	19	37
1995	15	24	39
1996	16	24	40
1997	10	82	92
1998	7	90	97
1999	8	73	81
2000	12	40	52
2001	8	23	31
Total	**803**	**920**	**1,723**

*Includes some military payloads.

Upcoming Shuttle Flights

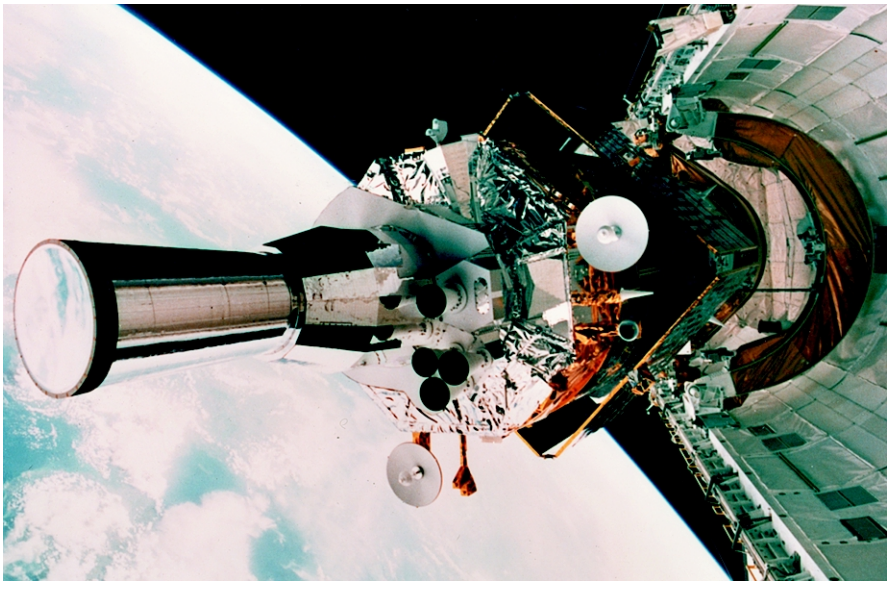
Month/Year	Mission	Name
10/2002	**STS-113**	*Endeavour*
1/2003	**STS-114**	*Atlantis*
4/2003	**STS-115**	*Endeavour*
6/2003	**STS-116**	*Atlantis*
9/2003	**STS-117**	*Endeavour*

US Military Payloads by Mission, 1958–2001 (Orbital only)

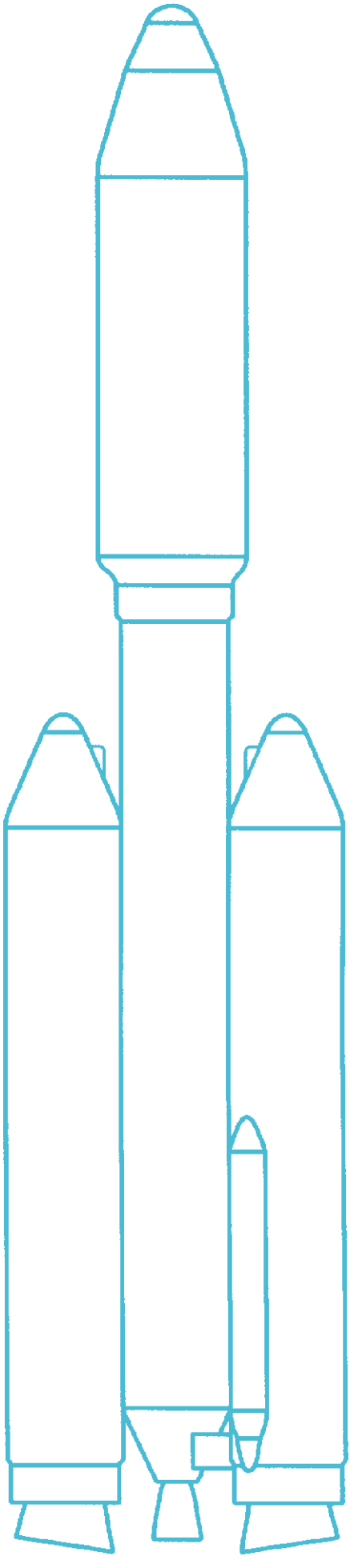
Category	*Number*
Applications	**334**
Communications	120
Weather	43
Navigation	88
Launch vehicle/spacecraft tests	3
Other military	80
Weapons-related Activities	**46**
SDI tests	11
Anti-satellite targets	2
Anti-satellite interceptors	33
Reconnaissance	**434**
Photographic/radar imaging	250
Electronic intelligence	48
Ocean surveillance	45
Nuclear detection	12
Radar calibration	40
Early warning	39
Total	**814**

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
Total	**137**	**695**

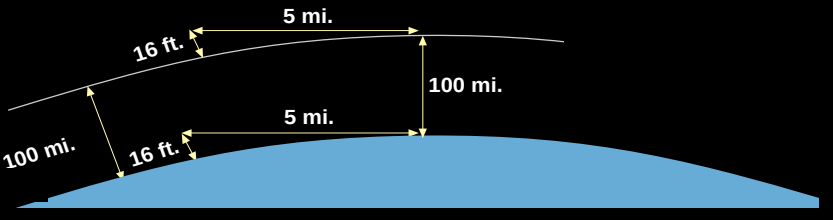


Defense Support Program satellites, such as this one launched in November 1991 from a space shuttle, provide early warning of missile launches.



Orbits

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

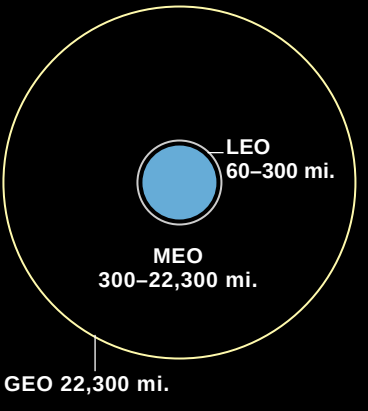


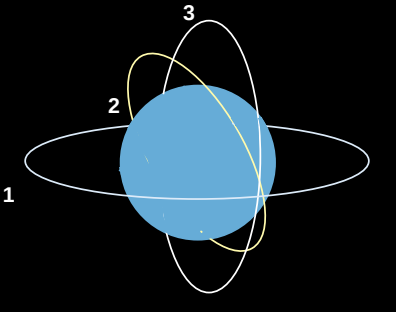
Orbital Altitude

LEO Low Earth Orbit
MEO Medium Earth Orbit
GEO Geosynchronous Earth Orbit
HEO High Earth Orbit

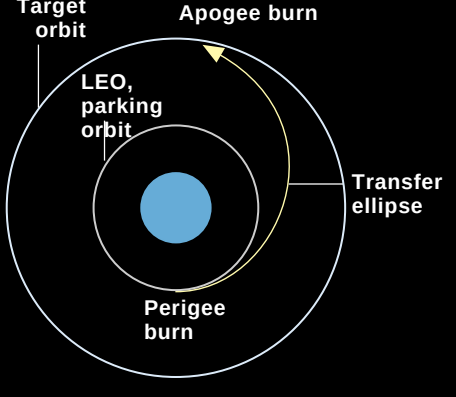
Orbital Inclinations

1 Equatorial
2 Sun synchronous
3 Polar





Geosynchronous Transfer Orbit



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

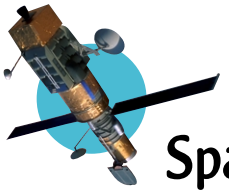
Illustrations are not drawn to scale.

Space Shuttle Flights, 1981–2002

(As of June 19, 2002)

Flight	Mission	Launch	Return
1	STS-1	4/12/81	4/14/81
2	STS-2	11/12/81	11/14/81
3	STS-3	3/22/82	3/30/82
4	STS-4*	6/27/82	7/4/82
5	STS-5	11/11/82	11/16/82
6	STS-6	4/4/83	4/9/83
7	STS-7	6/18/83	6/24/83
8	STS-8	8/30/83	9/5/83
9	STS-9	11/28/83	12/8/83
10	STS-10	2/3/84	2/11/84
11	STS-11	4/6/84	4/13/84
12	STS-12	8/30/84	9/5/84
13	STS-13	10/5/84	10/13/84
14	STS-14	11/8/84	11/16/84
15	STS-15*	1/24/85	1/27/85
16	STS-16	4/12/85	4/19/85
17	STS-17	4/29/85	5/6/85
18	STS-18	6/17/85	6/24/85
19	STS-19	7/29/85	8/6/85
20	STS-20	8/27/85	9/3/85
21	STS-21*	10/3/85	10/7/85
22	STS-22	10/30/85	11/6/85
23	STS-23	11/26/85	12/3/85
24	STS-24	1/12/86	1/18/86
25	STS-25	1/28/86	No Landing
26	STS-26	9/29/88	10/3/88
27	STS-27*	12/2/88	12/6/88
28	STS-29	3/13/89	3/18/89
29	STS-30	5/4/89	5/8/89
30	STS-28*	8/8/89	8/13/89
31	STS-34	10/18/89	10/23/89
32	STS-33*	11/22/89	11/27/89
33	STS-32	1/9/90	1/20/90
34	STS-36*	2/28/90	3/4/90
35	STS-31	4/24/90	4/29/90
36	STS-41	10/6/90	10/10/90
37	STS-38*	11/15/90	11/20/90
38	STS-35	12/2/90	12/10/90
39	STS-37	4/5/91	4/11/91
40	STS-40	6/5/91	6/14/91
41	STS-43	8/2/91	8/11/91
42	STS-48	9/12/91	9/18/91
43	STS-44*	11/24/91	12/1/91
44	STS-39*	4/28/91	5/6/91
45	STS-42	1/22/92	1/30/92
46	STS-45	3/24/92	4/2/92
47	STS-49	5/7/92	5/16/92
48	STS-50	6/25/92	7/9/92
49	STS-46	7/31/92	8/8/92
50	STS-47	9/12/92	9/20/92
51	STS-52	10/22/92	11/1/92
52	STS-53*	12/2/92	12/9/92
53	STS-54	1/13/93	1/19/93
54	STS-56	4/8/93	4/17/93
55	STS-55	4/26/93	5/6/93
56	STS-57	6/21/93	7/1/93
57	STS-51	9/12/93	9/22/93
58	STS-58	10/18/93	11/1/93
59	STS-61	12/2/93	12/13/93
60	STS-60	2/3/94	2/11/94
61	STS-62	3/4/94	3/18/94
62	STS-59	4/9/94	4/20/94
63	STS-65	7/8/94	7/23/94
64	STS-64	9/9/94	9/20/94
65	STS-68	9/30/94	10/11/94
66	STS-66	11/3/94	11/14/94
67	STS-63	2/3/95	2/11/95
68	STS-67	3/2/95	3/18/95
69	STS-71	6/27/95	7/7/95
70	STS-70	7/13/95	7/22/95
71	STS-69	9/7/95	9/18/95
72	STS-73	10/20/95	11/5/95
73	STS-74	11/12/95	11/20/95
74	STS-72	1/11/96	1/20/96
75	STS-75	2/22/96	3/9/96
76	STS-76	3/22/96	3/31/96
77	STS-77	5/19/96	5/29/96
78	STS-78	6/20/96	7/7/96
79	STS-79	9/16/96	9/26/96
80	STS-80	11/19/96	12/7/96
81	STS-81	1/12/97	1/22/97
82	STS-82	2/11/97	2/21/97
83	STS-83	4/4/97	4/8/97
84	STS-84	5/15/97	5/24/97
85	STS-94	7/1/97	7/17/97
86	STS-85	8/7/97	8/19/97
87	STS-86	9/25/97	10/6/97
88	STS-87	11/19/97	12/5/97
89	STS-89	1/22/98	1/31/98
90	STS-90	4/17/98	5/3/98
91	STS-91	6/2/98	6/12/98
92	STS-95	10/29/98	11/7/98
93	STS-88	12/4/98	12/15/98
94	STS-96	5/27/99	6/6/99
95	STS-93*	7/22/99	7/27/99
96	STS-103	12/19/99	12/27/99
97	STS-99	2/11/00	2/22/00
98	STS-101	5/19/00	5/29/00
99	STS-106*	9/8/00	9/19/00
100	STS-92	10/11/00	10/24/00
101	STS-97	11/30/00	12/11/00
102	STS-98*	2/7/01	2/20/01
103	STS-102*	3/8/01	3/20/01
104	STS-100	4/19/01	5/1/01
105	STS-104*	7/12/01	7/24/01
106	STS-105*	8/10/01	8/22/01
107	STS-108	12/5/01	12/17/01
108	STS-109	3/1/02	3/9/02
109	STS-110	4/8/02	4/19/02
110	STS-111	6/5/02	6/19/02

*DOD payload.



Space Systems

Major Military Satellite Systems

Advanced Extremely High Frequency Satellite Communications System

Common name: AEHF
In brief: successor to Milstar, AEHF will provide assured strategic, worldwide C^2 communications with at least five times the capacity of Milstar II but in a smaller package.
Function: EHF communications.
Operator: MILSATCOM JPO (acquisition); AFSPC.
First launch: 2006, planned.
Constellation: four.
Orbit altitude: 22,300 miles.
Contractors: Lockheed Martin, TRW.
Power plant: N/A.
Dimensions: N/A.
Weight: approx. 13,000 lb (on orbit).

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.
Function: environmental monitoring satellite.
Operator: NPOESS Integrated Program Office.
First launch: May 23, 1962.
Constellation: two (primary).
Orbit altitude: 500 miles (nominal).
Contractor: Lockheed Martin, Northrop Grumman.
Power plant: solar array, 500–600 watts.
Dimensions: width 4 ft, length 20.2 ft (with array deployed).
Weight: 2,545 lb (including 592-lb sensor).

Defense Satellite Communications System III

Common name: DSCS III
In brief: nuclear-hardened and jam-proof spacecraft used to transmit high-priority C^2 messages to battlefield commanders.
Function: SHF communications.
Operator: AFSPC.
First launch: October 1982.
Constellation: five.
On orbit: 10.
Orbit altitude: 22,000+ miles.
Contractor: Lockheed Martin.
Power plant: solar array, avg. 1,269 watts (pre–System Life Enhancement Program); avg. 1,500 watts (SLEP; first SLEP satellite launched Jan. 20, 2000.
Dimensions: rectangular body is 6 ft x 6 ft x 7 ft; 38-ft span (deployed).
Weight: 2,580 lb (pre–SLEP); 2,716 lb (SLEP).

Defense Support Program

Common name: DSP
In brief: early warning spacecraft whose infrared sensors detect heat generated by a missile or booster plume.
Function: strategic and tactical missile launch detection.
Operator: AFSPC.
First launch: November 1970.
Constellation: classified.
On orbit: classified.
Orbit altitude: 22,000+ miles.
Contractor: TRW.
Power plant: solar array, 1,485 watts.
Dimensions: width 22 ft (on orbit), length 32.8 ft (on orbit).
Weight: approx. 5,000 lb.

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).
Constellation: three.
On orbit: three.
Orbit altitude: 23,230 miles.
Contractor: Raytheon (Phase 2).
Power plant: (interim host satellite: UHF Follow-On) 3,800 watts.
Dimensions: numerous items integrated throughout host.

Global Positioning System

Common name: GPS
In brief: constellation of satellites used by military and civilians to determine a precise location anywhere on Earth.
Function: worldwide navigation.
Operator: AFSPC.
First launch: Feb. 22, 1978.
Constellation: 28.
Orbit altitude: 12,636 miles (Block IIA); 12,532 miles (Block IIR).
Contractors: Boeing, Lockheed Martin.
Power plant: solar array, 700 watts (Block IIA); 1,136 watts (Block IIR)
Dimensions: body 8 ft x 8 ft x 12 ft, including solar arrays 11 ft x 19 ft (II/IIA); body 8 ft x 6 ft x 10 ft, span including arrays 37 ft (IIR).
Weight: 2,174 lb (Block IIA, on orbit); 2,370 lb (Block IIR, on orbit).

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.
Constellation: four.
On orbit: four.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin, Boeing.
Power plant: solar array, almost 5,000 watts.
Dimensions: length 51 ft; solar array 116 ft (deployed).
Weight: approx. 10,000 lb.

Polar Military Satellite Communications

Common name: Polar MILSATCOM
In brief: USAF deployed a modified Navy EHF payload on a host polar-orbiting satellite to provide an interim solution for a cheaper alternative to Milstar to ensure warfighters have protected polar communications capability.
Function: polar communications.
Operator: Navy.
First launch: 1997.
Constellation: three.
On orbit: one.
Orbit altitude: 25,300 miles (apogee).
Contractor: classified.
Power plant: 410 watts consumed by payload (power from host solar array).
Dimensions: numerous items integrated throughout host.

Space Based Infrared System

Common name: SBIRS
In brief: advanced surveillance system for missile warning, missile defense, battlespace characterization, and technical intelligence. System includes High (satellites in GEO and HEO) and Low (satellites in LEO) components
Function: infrared space surveillance.
Operator: AFSPC.
First launch: planned, High FY07; Low TBD.
Constellation: High: four GEO sats, two highly elliptical orbit sensors. Low: TBD.
On orbit: none.
Contractor: Lockheed Martin (High); TRW and Spectrum Astro for preliminary system designs (Low).
Power plant: N/A.
Dimensions: N/A.
Weight: N/A.

Continued on p. 42.

Continued from p. 40.

UHF Follow-On Satellite

Common name: UFO
In brief: new generation of satellites providing secure, anti-jam communications; replaced FLTSATCOM satellites.
Function: UHF and EHF communications.
Operator: Navy, AFSPC.
First launch: March 25, 1993.
Constellation: four primary, four redundant.
On orbit: nine.
Orbit altitude: 22,300 miles.
Contractor: Hughes Space & Communications (now Boeing Satellite Systems).
Power plant: solar array, 2,500–3,800 watts.
Dimensions: length 60 ft (F-2–F-7); 86 ft (F-8–F10) (deployed).
Weight: 2,600–3,400 lb.

Wideband Gap-Filler System

Common name: WGS
In brief: high data rate satellite broadcast system meant to bridge the communications gap between current systems—DSCS and GBS—and an advanced wideband system, tentatively scheduled for launch in Fiscal 2004.
Function: wideband communications and point-to-point service (Ka-band, X-band frequency).
Operator: AFSPC.
First launch: FY04, planned.
Constellation: three to six.
Orbit altitude: GEO.
Contractor: Boeing.
Power plant: solar arrays, 9,934 watts.
Dimensions: based on Boeing 702 Bus.
Weight: 7,022 lb.

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. Using a page from the Soviet book on naming satellites, the US government started in the 1980s calling all government satellites "USA" with a sequential number. This allowed them to keep secret the names of satellites which monitor the Earth with radar, optical sensors, and electronic intercept capability. 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. However, the move to declassify space systems has led to the release of selected information on some systems. Pictures of the Lacrosse radar imaging satellite have been released without details on the system. Details of the Keyhole optical imaging systems in the Corona program have been released.

Major Civilian Satellites in US Military Use

Advanced Communications Technology Satellite

Common name: ACTS
In brief: technology demonstration satellite for new types of K- and Ka-band communications technologies.
Function: communications.
Operator: NASA.
First launch: Sept. 12, 1993.
Constellation: one.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin.
Power plant: solar array, 1,400 watts.
Dimensions: width 29.9 ft, length 47.1 ft (deployed).
Weight: 3,250 lb.

Geostationary Operational Environmental Satellite

Common name: GOES
In brief: hovers over the equator 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.
Orbit altitude: 22,300 miles.
Contractor: Space Systems/Loral.
Power plant: solar array, 1,050 watts.
Dimensions: 6.6-ft cube, length 88.6 ft (deployed).
Weight: 4,600 lb.

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.
Contractor: Space Systems/Loral.
Power plant: solar array, 1,100 watts.
Dimensions: width 4.9 ft, length 35.3 ft (deployed).
Weight: 990 lb.

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.
Contractor: Lockheed Martin.
Power plant: solar array.
Dimensions: 5.9 ft x 5.9 ft x 5.2 ft.
Weight: 1,600 lb.

Inmarsat

Common name: Inmarsat
In brief: sometimes used for peacetime mobile communications services.
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.
Contractor: Lockheed Martin (Inmarsat 3).
Power plant: solar array, 2,800 watts.
Dimensions: width 6.9 ft, length 5.9 ft, 57.8 ft (deployed).
Weight: 4,545 lb (Inmarsat 3).

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: 20.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin (Intelsat 8).
Power plant: solar array, 4,800 watts.
Dimensions: width 8.3 x 7.2 ft, length 11.3 ft, 35.4 ft (deployed) (Intelsat 8).
Weight: 7,480 lb (Intelsat 8).

Iridium

Common name: Iridium
In brief: voice, fax, data transmission.
Function: handheld, mobile communications.
Operator: Iridium LLC.
First Launch: May 5, 1997.
Constellation: 66 (six on-orbit spares).
Orbit: 485 miles.
Contractor: Motorola, Lockheed Martin.
Power plant: solar array, 590 watts.
Dimensions: diameter 3.3 ft, length 13.5 ft.
Weight: 1,516 lb.

Landsat

Common name: Landsat
In brief: imagery use includes mapping and planning for tactical operations.
Function: remote sensing.
Operator: NASA/NOAA.
First launch: July 23, 1972.
Constellation: one.
Orbit altitude: 438 miles (polar).
Contractor: Lockheed Martin.
Power plant: solar array, 1,550 watts.
Dimensions: diameter 9 ft, length 14 ft.
Weight: 4,800 lb.

Loral Orion

Common name: Telstar (formerly Orion)
In brief: commercial satellite-based, rooftop-to-rooftop communications for US Army and other DOD agencies.
Function: communications.
Operator: Loral Orion.
First launch: November 1994.
Constellation: three.
Orbit altitude: 22,300 miles.
Contractor: Space Systems/Loral (Orion 2).
Power plant: solar array, 7,000 watts.
Dimensions: width 5.6 ft, length 6.9 ft, 72.2 ft (deployed).
Weight: 8,360 lb (Orion 2).

NOAA-15 (NOAA-K) and NOAA-16 (NOAA-L)

Common name: NOAA (with number on orbit) (also known as Television Infrared Observation Satellite or TIROS)
In brief: weather updates for all areas of the world every six hours.
Function: long-term weather forecasting.
Operator: NOAA (on-orbit); NASA (launch).
First launch: October 1978 (TIROS-N).
Constellation: two.
Orbit altitude: 530 miles.
Contractor: Lockheed Martin.
Power plant: solar array, 1,000+ watts.
Dimensions: diameter 6.2 ft, length 13.8 ft (NOAA-15).
Weight: approx. 4,900 lb (NOAA-15).

Orbcomm

Common name: Orbcomm
In brief: potential military use under study in Joint Interoperability Warfighter Program.
Function: mobile communications.
Operator: Orbcomm Global LP.
First launch: April 1995.
Constellation: 35.
Orbit altitude: 500–1,200 miles.
Contractor: Orbital Sciences.
Power plant: solar array, 160 watts.
Dimensions: width 7.3 ft, length 14.2 ft.
Weight: 90 lb.

Pan Am Sat

Common name: Pan Am Sat
In brief: routine communications providing telephone, TV, radio, and data.
Function: communications.
Operator: Pan Am Sat.
First launch: 1983.
Constellation: 21.
Orbit altitude: 22,300 miles.
Contractor: Boeing.
Power plant: solar array, 4,800 watts.
Dimensions: 16.2 ft x 8.8 ft x 12 ft width (stowed) (Galaxy III-R). Length solar arrays: 86 ft width, antenna 24 ft (Galaxy III-R).
Weight: 6,760 lbs (Galaxy III-R).

Quickbird 2

Common name: Quickbird 2
In brief: high-resolution imagery for mapping, military surveillance, weather research, and other uses.
Function: remote sensing.
Operator: Digital Globe.
First launch: Oct. 18, 2001.
Constellation: one.
Orbit altitude: 279 miles.
Contractor: Ball Aerospace.
Power plant: solar array.
Dimensions: 9.8 ft x 5.2 ft x 5.2 ft.
Weight: 2,088 lb.

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.
Contractor: Matra Marconi Space France.
Power plant: solar array, 2,100 watts (SPOT 4).
Dimensions: 6.6 x 6.6 x 18.4 ft (SPOT 4).
Weight: 5,940 lb (SPOT 4).

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.
Contractor: TRW.
Power plant: solar array, 1,800 watts.
Dimensions: width 45.9 ft, length 57.4 ft (deployed).
Weight: 5,000 lb.

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.

Athena II

Function: lift low to medium weights.
First launch: Jan. 6, 1998.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Atlas II

Function: lift medium weights.
Variants: IIA and IIAS.
First launch: Dec. 7, 1991.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Atlas III

Function: lift medium to heavy weights.
Variants: IIIA and IIIB.
First launch: May 24, 2000 (IIIA).
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Atlas V

Function: lift medium to heavy weights.
First launch: planned for summer 2002.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Delta II

Function: lift medium weights.
First launch: Feb. 14, 1989.
Launch site: CCAFS, VAFB.
Contractor: Boeing.

Delta III

Function: lift medium weights.
First launch: Aug. 26, 1998.
Launch site: CCAFS.
Contractor: Boeing.

Delta IV

Function: lift medium to heavy weights.
First launch: planned for summer 2002.
Launch site: CCAFS, VAFB.
Contractor: Boeing.

Evolved Expendable Launch Vehicle

Function: lift medium to heavy weights.
Note: Atlas V and Delta IV (see individual entries) are participating in USAF's EELV modernization program to cut launch costs by 25 to 50 percent. These systems will eventually replace Delta II, Atlas II, Titan II, and Titan IV launch vehicles.

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.

Space Shuttle

Function: lift heavy weights.
First launch: April 12, 1981.
Launch site: Kennedy Space Center, Fla.
Contractor: Boeing.

Taurus

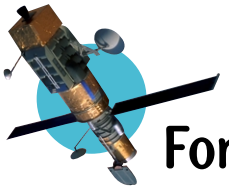
Function: lift low weights.
First launch: March 13, 1994.
Launch site: CCAFS, VAFB, Wallops Is.
Contractor: Orbital Sciences.

Titan II

Function: lift low to medium weights.
First launch: April 8, 1964 (NASA).
Launch site: VAFB.
Contractor: Lockheed Martin.

Titan IVB

Function: lift heavy weights.
First launch: (IVB) Feb. 23, 1997.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.



Foreign Space Activities

Foreign Orbital Launches

(As of Dec. 31, 2001)

Year	China	ESA	France	India	Israel	Japan	Russia	UK
1965			1				48	
1966			1				44	
1967			2				66	
1968							74	
1969							70	
1970	1		2			1	81	
1971	1		1			2	83	1
1972						1	74	
1973							86	
1974						1	81	
1975	3		3			2	89	
1976	2					1	99	
1977						2	98	
1978	1					3	88	
1979		1				2	87	
1980				1		2	89	
1981	1	2		1		3	98	
1982	1					1	101	
1983	1	2		1		3	98	
1984	3	4				3	97	
1985	1	3				2	98	
1986	2	2				2	91	
1987	2	2				3	95	
1988	4	7			1	2	90	
1989		7				2	74	
1990	5	5			1	3	75	
1991	1	8				2	59	
1992	4	7		1		1	54	
1993	1	7				1	47	
1994	5	6		2		2	48	
1995	2	11			1	1	32	
1996	3	10		1		1	25	
1997	6	12		1		2	28	
1998	6	11				2	24	
1999	4	10		1			28	
2000	5	12					35	
2001	1	8		2		1	25	
Total	**66**	**137**	**10**	**11**	**3**	**54**	**2,579**	**1**

Russian Military Launches for 2001

	Launches	Spacecraft
Communications	4	6
Electronic intelligence (ocean recon)	1	1
Navigation	2	3
Photoreconnaissance	1	1
Early warning	1	1
Total	**9**	**12**

Russian Military vs. Civil Launches

(As of Dec. 31, 2001)

Year	Military	Civilian	Total
1957	0	2	2
1958	0	1	1
1959	0	3	3
1960	0	3	3
1961	0	6	6
1962	5	15	20
1963	7	10	17
1964	15	15	30
1965	25	23	48
1966	27	17	44
1967	46	20	66
1968	49	25	74
1969	51	19	70
1970	55	26	81
1971	60	23	83
1972	53	21	74
1973	58	28	86
1974	52	29	81
1975	60	29	89
1976	74	25	99
1977	69	29	98
1978	60	28	88
1979	60	27	87
1980	64	25	89
1981	59	39	98
1982	68	33	101
1983	58	40	98
1984	63	34	97
1985	64	34	98
1986	63	28	91
1987	62	33	95
1988	53	37	90
1989	42	32	74
1990	45	30	75
1991	30	29	59
1992	32	22	54
1993	26	21	47
1994	26	22	48
1995	15	17	32
1996	8	17	25
1997	10	18	28
1998	9	15	24
1999	6	22	28
2000	7	28	35
2001	9	16	25
Total	**1,645**	**1,016**	**2,661**

Russian Operational Military Spacecraft

(As of Dec. 31, 2001)

Mission	Type	Number
Communications	Kosmos (Geizer)	1
	Kosmos (Strela-3)	4
	Molniya-1	4
	Molniya-3	6
	Raduga/Raduga-1	6
Early warning	Kosmos (Oko)	4
	Kosmos (Prognoz)	1
Electronic intelligence	Kosmos (EORSAT)	1
	Kosmos (Tselina-2)	1
	Kosmos (GLONASS)*	9
Navigation	Kosmos (Parus)	6

*Kosmos (GLONASS) is both civilian and military.

Russian Launch Site Activity

(As of Dec. 31, 2001)

Vehicle	Number of launches
Baikonur Cosmodrome, Tyuratam, Kazakhstan	
Proton-K/Blok DM-2	3
Proton-K/Blok DM-3	2
Proton-M/Briz-M*	1
Soyuz-FG*	2
Soyuz-U	6
Tsyklon-M	1
Zenit-2	1
Total	**16**
Svobodny Cosmodrome, Svobodny, Russia	
Start-1	1
Total	**1**
Odyssey Platform, Pacific Ocean (Sea Launch)	
Zenit-3SL	2
Total	**2**
Plesetsk Cosmodrome, Plesetsk, Russia	
Kosmos-3M	1
Molniya-M	2
Soyuz-U	1
Tsyklon (three stages)	2
Total	**6**

*New launch vehicle variants

Russian Military/Civil Payloads by Mission, 1957–2001

(As of Dec. 31, 2001)

Anti-satellite target tests	18
Anti-satellite interceptor tests	20
Communications	325
Early warning	80
Earth orbital science	211
Earth resources	100
Electronic intelligence	133
Fractional orbital bombardment system tests	18
General engineering and materials processing	15
Geodesy	34
Navigation	227
Ocean electronic intelligence	85
Photographic reconnaissance	806
Theater communication	535
Undefined military operations	162
Weather	75
Total	**2,844**

Russian Manned Spaceflights

(As of Dec. 31, 2001)

Year	Flights	Persons*
1961	2	2
1962	2	2
1963	2	2
1964	1	3
1965	1	2
1966	0	0
1967	1	1
1968	1	1
1969	5	11
1970	1	2
1971	2	6
1972	0	0
1973	2	4
1974	3	6
1975	4	8
1976	3	6
1977	3	6
1978	5	10
1979	2	4
1980	6	13
1981	3	6
1982	3	8
1983	2	5
1984	3	9
1985	2	5
1986	1	2
1987	3	8
1988	3	9
1989	1	2
1990	3	7
1991	2	6
1992	2	6
1993	2	5
1994	3	8
1995	2	6
1996	2	5
1997	2	5
1998	2	6
1999	1	3
2000	2	5
2001	2	6
Total	**92**	**211**

*Total number of persons who flew in space in a given year. Some individuals made multiple flights.

Spacefarers

(As of Dec. 31, 2001)

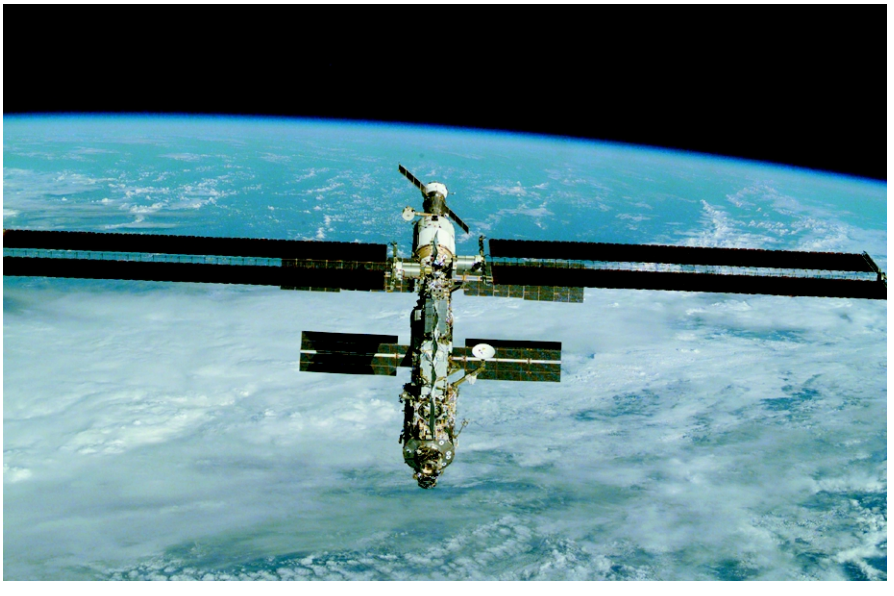
Nation	Persons
Afghanistan	1
Austria	1
Belgium	1
Bulgaria	2
Canada	8
Cuba	1
Czechoslovakia	1
France	8
Germany	9
Hungary	1
India	1
Italy	3
Japan	5
Mexico	1
Mongolia	1
Netherlands	1
Poland	1
Romania	1
Russia	95
Saudi Arabia	1
Slovakia	1
Spain	1
Switzerland	1
Syria	1
Ukraine	1
United Kingdom	1
United States	258
Vietnam	1
Total	**408**

Payloads in Orbit

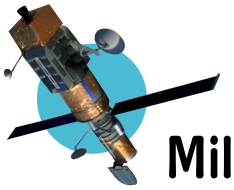
(As of Dec. 31, 2001)

Launcher/operator	Objects
Russia	1,359
United States	1,008
Japan	73
Intl. Telecommunications Satellite Orgn.	58
France	51
ESA	38
China	37
United Kingdom	31
Germany	21
India	21
Canada	17
Italy	12
Luxembourg	12
Brazil	10
Sweden	10
Indonesia	9
Saudi Arabia	9
Australia	8
NATO	8
South Korea	7
Mexico	6
Spain	6
Argentina	5
Czechoslovakia	4
International Space Station	4
Thailand	4
Turkey	4
Israel	3
Malaysia	3
Norway	3
Chile	2
Egypt	2
France/Germany	2
Philippines	2
Denmark	1
Pakistan	1
Portugal	1
Singapore	1
South Africa	1
Taiwan	1
United Arab Emirates	1
Total	**2,866**

US Navy photo by Michael J. Bloomfield



Astronauts from a December 2000* Endeavour *space shuttle mission installed this huge solar array on the International Space Station.



Military Space Lore

Military Space Firsts

March 22, 1946
First US rocket to leave Earth's atmosphere, JPL–Ordnance WAC reaches 50-mile height after launch from White Sands Proving Ground, N.M.
Feb. 24, 1949
Bumper–WAC Corporal two-stage rocket, first with fully tanked second stage, reaches record altitude of 244 miles and velocity of 5,150 mph.
July 24, 1950
Bumper No. 8 becomes first missile launched from Cape Canaveral, Fla.
Sept. 20, 1956
US Jupiter C rocket, part of the Army's 1954 Project Orbiter, achieves record first flight, reaching altitude of 682 miles and landing 3,400 miles from Cape Canaveral.
Oct. 4, 1957
USSR launches Sputnik 1, first man-made satellite, into Earth orbit.
Dec. 17
First successful USAF Atlas ICBM test flight.
Dec. 18, 1958
Project Score spacecraft conducts first US active communication from space.
Aug. 7, 1959
Explorer 6 spacecraft transmits first television pictures from space.
April 1, 1960
TIROS 1 becomes first US weather satellite to go aloft.
April 13
Transit 1B becomes first US navigation satellite in space.
May 24
Atlas D/Agena A booster places MIDAS II, first early warning satellite, in orbit.
Aug. 19
Capsule containing first satellite photographs of Soviet Union ejected from Discoverer 14 becomes first orbital payload recovered in midair by C-119 Flying Boxcar.
April 12, 1961
Soviet cosmonaut Yuri Gagarin pilots Vostok 1 through nearly one orbit to become first human in space.
May 5
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.
July 17
Air Force Capt. Robert M. White earns astronaut wings when he reaches altitude of nearly 60 miles in rocket-powered X-15, first aircraft to be flown to lower edge of space, considered to be 50 miles.
Oct. 17, 1963
Vela Hotel satellite performs first space-based detection of nuclear explosion.
Aug. 14, 1964
First Atlas/Agena D standard launch vehicle successfully fired from Vandenberg.
March 18, 1965
First space walk conducted by Alexei Leonov of Soviet Voskhod 2.
June 4
Gemini 4 astronaut USAF Maj. Edward H. White II performs first American space walk.
Jan. 25, 1967
Soviet Kosmos 139 anti-satellite weapon carries out first fractional orbital bombardment system test.
Jan. 27
First deaths in US spacecraft occur in flash fire in Apollo 1 command module, killing astronauts Lt. Cmdr. Roger B. Chaffee and USAF Lt. Cols. Virgil I. Grissom and Edward H. White II.
Oct. 20, 1968
Soviet Kosmos 248 and Kosmos 249 spacecraft carry out first co-orbital anti-satellite test.
July 20, 1069
Apollo 11's Neil A. Armstrong is first human to walk on moon.
April 19, 1971
First space station, Salyut 1, goes aloft.
Nov. 2
Titan IIIC launches first Defense Satellite Communications System (DSCS) Phase II satellites into GEO.
Feb. 22, 1978
Atlas booster carries first Global Positioning System (GPS) Block I satellite into orbit.
Dec. 13
Successful launch of two DSCS II satellites puts full four-satellite constellation at users' disposal for first time.
April 12–14, 1981
First orbital flight of space shuttle and first landing from orbit of reusable spacecraft.
Dec. 20, 1982
First Defense Meteorological Satellite Program (DMSP) Block 5D-2 satellite launched.
Sept. 13, 1985
First US anti-satellite intercept test destroys Solwind scientific satellite by air-launched weapon.
Oct. 3
Shuttle *Atlantis* performs first launch of pair of DSCS III satellites from space shuttle using Inertial Upper Stage.
Jan. 28, 1986
Space shuttle *Challenger* explodes after liftoff, killing seven astronauts.
Feb. 14, 1989
Launch of first Block II GPS satellite begins operational constellation.
Jan. 17, 1991
What USAF calls "the first space war," Operation Desert Storm, opens with air attacks.
Jan. 13, 1993
USAF Maj. Susan Helms, flying aboard *Endeavour,* becomes first US military woman in space.
July 19
Launch of DSCS Phase III satellite into GEO provides first full five-satellite DSCS III constellation.
Feb. 7, 1994
First Titan IV Centaur booster launches first Milstar Block I satellite into orbit.
March 13
First launch of Taurus booster places two military satellites in orbit.
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.
March 8, 1996
First successful launch of Pegasus XL rocket from beneath modified L-1011 aircraft sends Air Force Radiation Experiment–II satellite into polar orbit.
May 29, 1998
First transfer of operational military space system to civilian agency occurs when Air Force hands to NOAA control of DMSP spacecraft.
July 23–27, 1999
Air Force Col. Eileen M. Collins becomes first woman to command shuttle mission when *Columbia* (STS-93) places Chandra X-Ray Observatory, world's most powerful X-ray telescope, in orbit.

Space Terms

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

Aerospace plane. A reusable spacecraft able to operate effectively in both the atmosphere and space. Also known as a "transatmospheric vehicle" or, more currently, "spaceplane."

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.

Expendable Launch Vehicle (ELV). A launch vehicle that cannot be reused after one flight.

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).

High-resolution imagery. Detailed representations of actual objects that satellites produce electronically or optically on displays, film, or other visual devices.

Inertial Upper Stage (IUS). A two-stage solid-rocket motor used to propel heavy satellites into mission orbit.

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, which ends at about 300 miles altitude, and GEO, which is at an average altitude of 22,300 miles.

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).

Remote imaging. Images of Earth generated from a spacecraft that provide data for mapping, construction, agriculture, oil and gas exploration, news media services, and the like.

Reusable Launch Vehicle (RLV). A launch vehicle that can be reused after flight.

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.

Single-Stage-To-Orbit (SSTO) system. A reusable single-stage rocket that can take off and land repeatedly and is able to boost payloads into orbit.

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.

Transponder. A radar or radio set that, upon receiving a designated signal, emits a radio signal of its own.

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.

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Then–Lt. Gen. Bernard Schriever, commander of Air Research and Development Command, inspects an instrument package similar to one from a Discoverer satellite in 1960. On his right is E.A. Miller, manager of the Discoverer program for General Electric. Then–Brig. Gen. Richard Curtin is on Schriever's left.