Fact File

U.S. Strategic Command Public Affairs, 901 SAC Blvd, Suite 1A1, Offutt AFB NE 68113-6020

Space Control

Re-entry Assessment and Space Surveillance

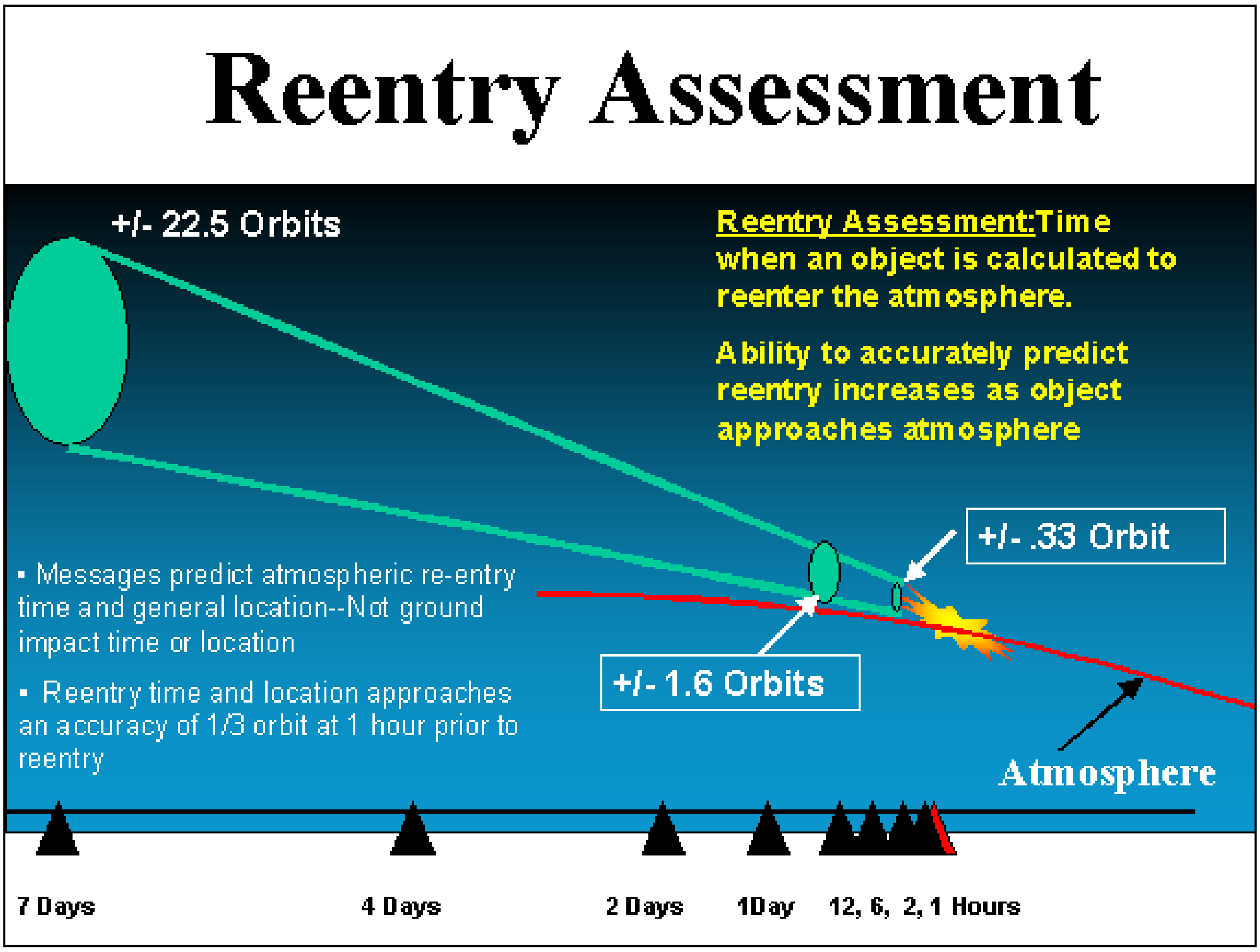
Re-entry Assessment describes the operational procedures by which U.S. Strategic Command predicts the time and location of atmospheric reentry (not ground impact) of decaying man-made objects in space.

Space Surveillance is one component of USSTRATCOM's Space Control mission. The Space Control mission is to ensure the Department of Defense's ability to access space, to ensure U.S. freedom of action within the space medium, and to ensure an ability to deny others the use of space, if required. Space Surveillance involves detecting, tracking, cataloging and identifying man-made objects orbiting Earth. Reentry Assessment provides a means of predicting when and where a decaying object will re-enter the Earth? atmosphere, and so avoid triggering a false alarm in missile-attack warning sensors of the United States and other countries.

The 1st Space Control Squadron (1 SPCS) of the U.S. Air Force Space Command, located inside Cheyenne Mountain Air Force Station in Colorado Springs, is responsible for tracking objects larger than 10 centimeters orbiting Earth. Five 11-person crews work around the clock, 365 days a year, to constantly track these objects. They task the Space Surveillance Network, a worldwide network of 19 space surveillance sensors (radar and optical telescopes, both military and civilian) to observe the objects. Then the crews use computers within the Cheyenne Mountain complex to match sensor observations to the more than 8,500 man-made orbiting objects and update the position of each one. These updates form the Space Catalog, a comprehensive listing of the numbers, types, and orbits of man-made objects in space.

NASA offers to the general public on its website, the opportunity to track various satellites. Click here to go to NASA's J-Track. USSTRATCOM does not make landfall predictions. Current capabilities and procedures give us a limited ability to predict within a 30-minute, 6,000-mile window when and where a particular object will re-enter the Earth's upper atmosphere.

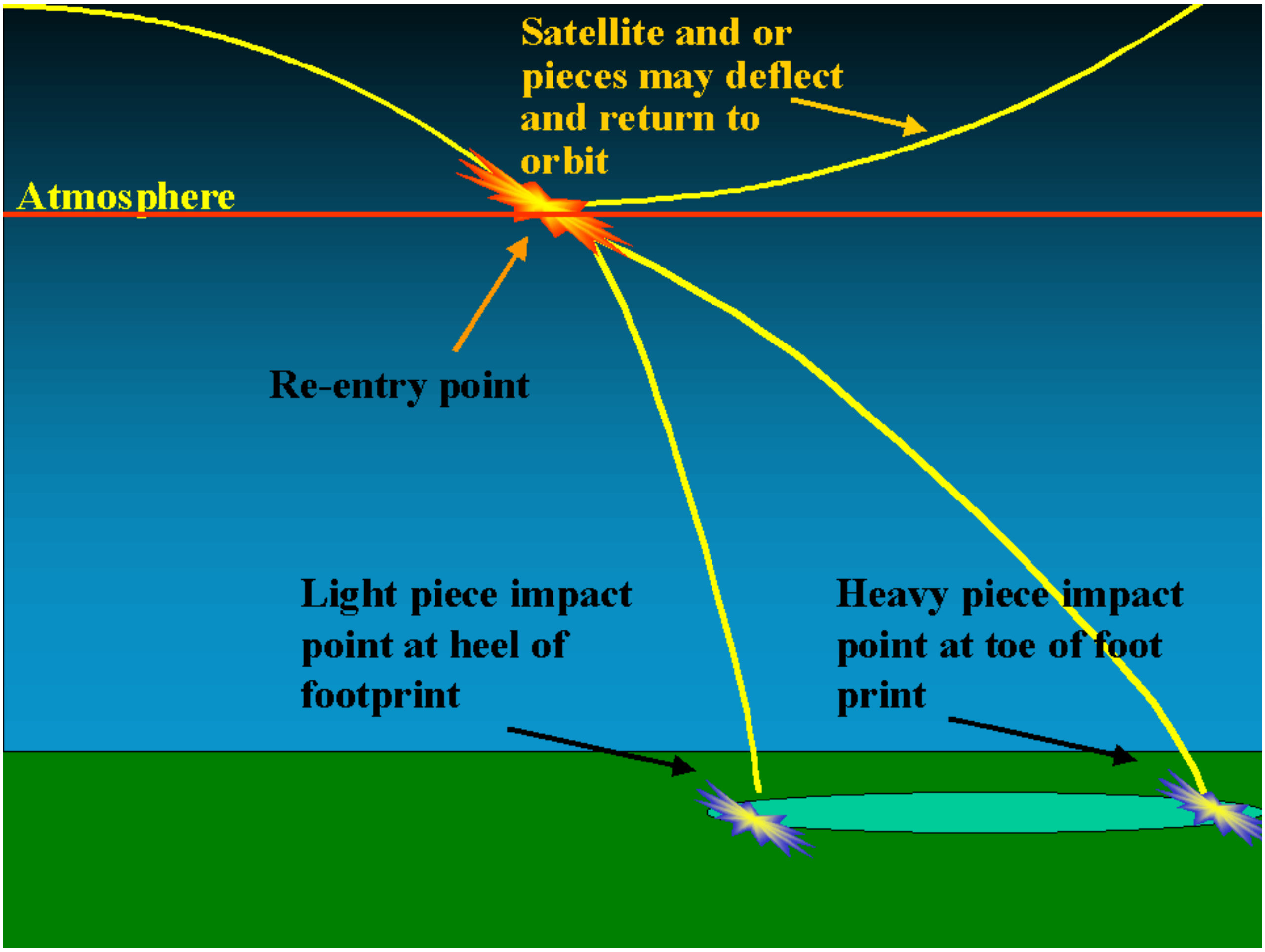
Objects are tracked throughout their orbit life, with the results posted in the Space Catalog. When an object appears to be re-entering within seven days, orbital analysts in Cheyenne Mountain's Space Control Center (SCC) will increase sensor tasking (monitoring) and begin to project a specific re-entry time and location. At the four-day point, a monitor run is accomplished once a shift or three times a day. Messages indicating the calculated re-entry time and location are transmitted to forward users and customers at the four-, three-, two- and one-day points. Starting at the 24-hour point, the object is monitored at the highest level of scrutiny, with processing at the 12, six and two-hour points. Again, ground traces and messages are transmitted. The object is monitored throughout re-entry.



The graphic above depicts the reentry of a typical satellite in a Low-Earth orbit. Figures may change depending on the orbital characteristics of space vehicles.

Re-entry Assessment is an "inexact science." It is virtually impossible to precisely predict where and when space debris will impact. This is due to limitations in the tracking system as well as environmental factors that impact on the debris. Most of USSTRATCOM's satellite tracking radar are located in the Northern Hemisphere, making continuous orbit coverage impossible. Consequently, a returning satellite could be outside sensor coverage for several hours.

Environmental factors acting on an object's orbit could include variations in the gravitational field of the land mass and ocean areas, solar radiation pressure, and atmospheric drag. (Objects re-entering may skip off the Earth's atmosphere, much as a stone skipped across a pond, causing it to impact much further away than originally forecast.) Consequently, USSTRATCOM does not give warning to civilian populations on point of impact for re-entering objects.



USSTRATCOM will verify that an object has re-entered by three "No Show" sensor reports verifying the object is no longer in orbit. Once it is determined not to be in orbit, sensor tasking ends and the object is deleted from the "Active " catalog. The object remains in the inactive catalog for historical purposes.

The chances of someone being struck by a re-entering object are slight. The great majority of objects that re-enter disintegrate due to the intense heat created by re-entry into the Earth's atmosphere. Only a small percentage of objects ever re-enter over land since water comprises 75 percent of the Earth's surface. Only about 25 percent of the Earth's landmass is actually inhabited.

Since tracking began with Sputnik, more than 17,000 man-made objects the Department of Defense tracked have re-entered the Earth's atmosphere. There are more than 8,500 man-made objects currently orbiting the Earth. The Department of Defense has tracked approximately 26,000 objects in its space catalog.

USSTRATCOM does not maintain data on objects once they re-enter the Earth's atmosphere, and have no knowledge of the number of objects that might have survived re-entry. Unless an object is actually found and returned to NASA or any other agency, USSTRATCOM would have no knowledge of whether or not an object survived re-entry. For example, two instances where objects have survived reentry include:

- A small piece of the Lunar Module from Apollo 5. (Catalogue # 3107, International Designator 68-007B). It was launched on Jan. 22, 1968, and recovered in a farmer's field in Colombia on Feb. 12, 1968.
- The second object is a piece of a Soviet Gas Bottle from COSMOS 482. (Catalogue #5921, International Designator 72-036C). It was launched on March 31, 1972, and recovered

April 2, 1972, from a farmer's field in New Zealand. Both objects are on display in the Space Control Center in Cheyenne Mountain.

Space Surveillance

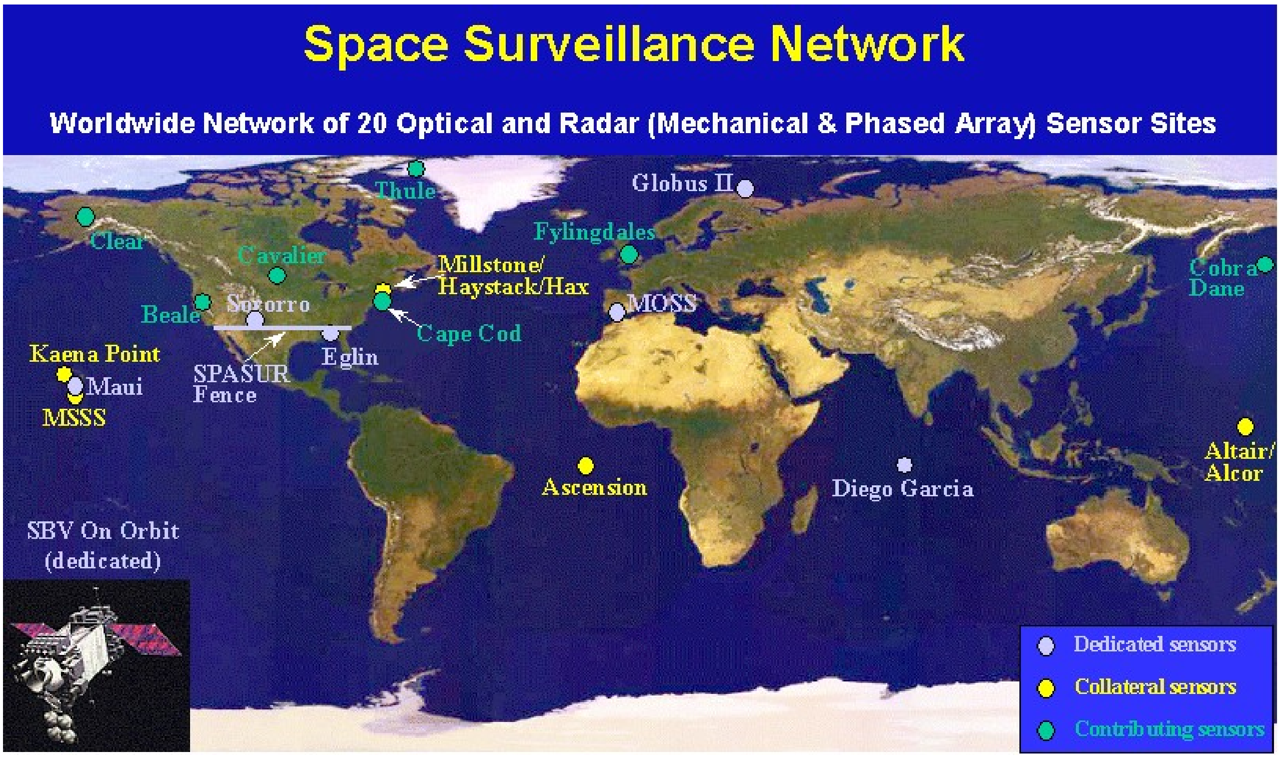
Space surveillance involves detecting, tracking, cataloging and identifying man-made objects orbiting Earth, i.e., active/inactive satellites, spent rocket bodies, debris, and fragments. Space surveillance accomplishes the following:

- Predict when and where a decaying space object will re-enter the Earth's atmosphere;
- Prevent a returning space object, which to radar looks like a missile, from triggering a false alarm in missile-attack warning sensors of the U.S. and other countries;
- Chart the present position of space objects and plot their anticipated orbital paths;
- Detect new man-made objects in space;
- Produce a running catalog of man-made space objects;
- Determine which country owns a re-entering space object;

Inform NASA whether objects may interfere with the orbits of the Space Shuttle and the International Space Station.

Space Surveillance Network

The command accomplishes its space surveillance tasks through its Space Surveillance Network (SSN), a worldwide network of 21 ground-based optical and radar sensors and one space-based sensor.



The SSN has been tracking space objects since 1957 when the Soviets opened the space age with the launch of Sputnik I. Since then, the SSN has tracked more than 26,000 space objects orbiting Earth. The SSN currently tracks more than 8,000 man-made orbiting objects. The rest have re-entered Earth's turbulent atmosphere and disintegrated, or survived re-entry and impacted the Earth. The space objects now orbiting Earth range from satellites weighting several tons to pieces of spent rocket bodies weighing only 10 pounds. About seven percent of the space objects are operational satellites, the rest are debris. USSTRATCOM is primarily interested in the active satellites, but also tracks space debris. The SSN tracks space objects that are 10 centimeters in diameter (baseball size) or larger.

SSN Sensors

The SSN uses a "predictive" technique to monitor space objects, i.e., it spot checks them rather than tracking them continually. This technique is used because of the limits of the SSN (number of sensors, geographic distribution, capability, and availability). Below is a brief description of each type of sensor.

The SSN uses a "predictive" technique to monitor space objects, i.e., it spot checks them rather than tracking them continually. This technique is used because of the limits of the SSN (number of sensors, geographic distribution, capability, and availability). Below is a brief description of each type of sensor.

Phased-array radar can maintain tracks on multiple satellites simultaneously and scan large areas of space in a fraction of a second. These radars have no moving mechanical parts to limit the speed of the radar scan - the radar energy is steered electronically.

Conventional radar use moveable tracking antennas or fixed detection and tracking antennas. A detection antenna transmits radar energy into space in the shape of a large fan. When a satellite intersects the fan, energy is reflected back to the detection antenna, where the location of the satellite is computed. A tracking antenna steers a narrow beam of energy toward a satellite and uses the returned energy to compute the location of the satellite and to follow the satellite's motion to collect more data.

Electro-Optical Sensors consist of telescopes linked to video cameras and computers. The video cameras feed their space pictures into a nearby computer that drives a display scope. The image is transposed into electrical impulses and recorded on magnetic tape. This is the same process used by video cameras. Thus, the image can be recorded and analyzed in real-time.

Midcourse Space Experiment (MSX) satellite is a low-earth orbiting satellite system with a payload containing a variety of sensors, from UV to very-long-wave IR. Originally a platform for Ballistic Missile Defense Organization projects, the MSX was moved to the SSN in 1998.

The SSN sensors are categorized as dedicated (those with the primary mission of performing space surveillance) or contributing and collateral sensors (those with a primary mission other than space surveillance). Combined, these types of sensors make over 100,000 observations each day. This enormous amount of data comes from SSN sites such as Maui, Hawaii; Eglin, Fla.; Thule, Greenland; and Diego Garcia, Indian Ocean. The data is transmitted directly to the Space Control Center (SCC) at Cheyenne Mountain Air Force Station in Colorado Springs, Colo., via satellite, ground wire, microwave and phone. Every available means of communications is used to ensure a backup is readily available if necessary.

Ground-Based Electro-Optical Deep Space Surveillance sites assigned to Air Force Space Command (AFSPC) play a vital role in tracking deep space objects. Over 2,500 objects, including geostationary communications satellites, are in deep space orbits more than 3,000 miles from Earth.

PAVE PAWS is an Air Force Space Command radar system operated by three 21st Space Wing squadrons for missile warning and space surveillance. PAVE PAWS radars are located at Cape Cod Air Force Station, Mass., Beale AFB, Calif., and Clear AFS, Alaska.

Space Control Center

The SCC in Cheyenne Mountain Operations Center is the terminus for the SSN's abundant and steady flow of information. The SCC houses large, powerful computers to process SSN information and accomplish the space surveillance and space control missions. The SCC is staffed by the 1st Space Control Squadron of Air Force Space Command.

The Naval Space Command provides the site and personnel for the Alternate SCC (ASCC). The ASCC would take over all operations in the event the SCC could not function. This capability is exercised frequently.

Orbital Space Debris

USSTRATCOM tracks about 8,500 man-made space objects, baseball-size and larger, orbiting Earth. The space objects consist of active/inactive satellites, spent rocket bodies, or fragmentation. About 7 percent are operational satellites, 15 percent are rocket bodies, and about 78 percent are fragmentation and inactive satellites.

Most debris (about 84 percent) is out approximately 800 kilometers - roughly twice the normal altitude of the space shuttle that orbits at about 300 kilometers. Only a small amount of debris exists where the shuttle orbits.

The likelihood of a significant collision between a piece of debris (10 centimeters or larger) and the shuttle is extremely remote. The statistical estimate is one chance in 10,000 years in the worst case. The probability is higher for objects smaller-than-baseball size, which currently cannot be tracked with available sensors.

Although 8,500 space objects seems like a large number, in the 800-kilometer band there are normally only three or four items in an area roughly equivalent to the airspace over the continental U.S. up to an altitude of 30,000 feet. Therefore, the likelihood of collision between objects is very small.

Through the SSN, the command tracks and catalogs all space objects orbiting Earth that are 10 centimeters or larger. During shuttle missions, the center computes possible close approaches of other orbiting objects with the shuttle's flight path. NASA is also advised of space objects that come within a safety box that measures 10 by 10 by 50 kilometers of the orbiter.

(Current as of March 2004)