Delta 4 and Atlas 5:
Powerful New Expendable American Space Rockets

The Boeing Company's Delta 4 and Lockheed Martin Corporation's Atlas 5 are two powerful new expendable space rockets introduced in the United States in 2002.

Delta 4 and Atlas 5 are direct competitors of a new heavy-lifting variation of the European Space Agency's Ariane 5 rocket.

The Delta 4 has much new technology including many components that have not flown before — while the Atlas 5 shares about 80 percent of its components with the old reliable Atlas 3 rocket.

A much greater proportion of Delta 4 is completely new. For instance, its main RS-68 engine had no previous flight history. Delta 4 is the first new liquid-fuel space rocket to be developed in the U.S. in more than 20 years.

The powerful Atlas and Delta boosters compete for the lucrative U.S. national security market, which requires the launching of big heavy military satellites. The Air Force refers to these new rockets as part of its Evolved Expendable Launch Vehicle (EELV) program.

Delta won the first round of the competition by obtaining 22 of 29 EELV launch contracts awarded by the U.S. Air Force in 1998, but the new Atlas rocket was stiff competition for its rival. The eventual trouble-free launches of Delta 4 and Atlas 5 bolstered industry confidence in the rockets.
Atlas

Lockheed Martin fired the Atlas 5 from Cape Canaveral on its maiden voyage on August 21, 2002, ferrying the Hot Bird 6 telecommunications satellite to orbit for Eutelsat S.A. of France.

Lockheed Martin launched the second Atlas 5 on May 13, 2003, from Cape Canaveral. It carried Hellas Sat 2, an Astrium Eurostar 2000+ satellite, to orbit for the Greek/Cypriot Hellas Sat consortium based in Athens.

Lockheed Martin launched the third Atlas 5 on July 17, 2003, from Cape Canaveral. It carried Rainbow 1, a direct-to-home television broadcast satellite to orbit for Cablevision Systems Corporation, a company serving three million cable TV households in the New York metropolitan area and operating the AMC and IFC cable movie channels. This rocket had a larger fairing covering the satellite and a pair of Aerojet solid rocket boosters that allowed it to leave the pad at twice the speed of the previous Atlas 5. Rainbow 1 can broadcast 24 high-power channels to the U.S. from stationary orbit approximately over Bermuda at 61.5 degrees west longitude.

LOCKHEED MARTIN

Atlas 5 rockets can be launched from Space Launch Complex 41 at Cape Canaveral Air Force Station, Florida, and Space launch Launch Complex 3W at Vandenberg Air Force Base, California.

Atlas rockets have been reliable workhorses since the 1950s when the space boosters were developed from the Atlas intercontinental ballistic missile (ICBM). Atlas rockets were used by Project Mercury to loft the first Americans to orbit. They carried Enos the chimpanzee to space and then the first four orbital flights of Americans from 1961 to 1963. In 1958, the first communication from space was broadcast from an orbiting Atlas with a recorded Christmas message from President Dwight D. Eisenhower.

ATLAS HISTORY

Delta

Among its technological improvements, the Delta 4 was designed to be assembled more quickly than earlier models. Launch pad setup was reduced from 20 to 10 days.

Delta 4 comes in several models built around its new first stage, which is referred to as the Common Booster Core (CBC). Additional boosters can be used to
supplement the first stage. The second stage is an expanded version of the second stage used in the older Delta 3 rocket.

The most powerful version of the rocket involves three CBC's strapped together to form what Boeing calls Delta 4 Heavy – a powerful launcher able to loft a 13-ton payload toward geostationary orbit.

**First flight.** The Delta 4's maiden flight on November 20, 2002, delivered the Eutelsat W5 commercial telecommunications satellite to space for Eutelsat S.A. of France from Space Launch Complex 37 at Cape Canaveral Air Force Station, Florida.

**Second flight.** Boeing launched its second Delta 4 on March 10, 2003, carrying a Defense Satellite Communications System (DSCS) satellite for the U.S. Air Force. The second Delta 4 also blasted off from Space Launch Complex 37B at Cape Canaveral Air Force Station.

**Third flight.** Boeing launched its third Delta 4 from Cape Canaveral on August 29, 2003, carrying the last in the DSCS series. The liquid-fueled Delta 4 Medium made the first daylight launch for a Delta 4.

**Future flights.** A Delta 4 Heavy will fly from Cape Canaveral in Spring 2004, carrying a dummy payload to ensure the rocket works before it blasts off with critical national security satellites.

A Delta 4 Medium will be launched in July 2004 from Vandenberg Air Force Base, California, carrying a classified National Reconnaissance Office (NRO) payload from the abandoned space shuttle pad at Space Launch Complex-6.

**Government focus.** The successful launches of Boeing's new Delta 4 rocket,

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**DSCS Satellites**

Defense Satellite Communications System spacecraft are highly important to the American military establishment. Everyone from the President of the United States to special operation troops in the field relies on them for secure communications.

- The first small 100-lb. DSCS satellite was launched in 1966.
- The second generation of DSCS started in 1971.

Flying 22,300 miles above Earth, the satellites are the backbone of the military network. They use superhigh frequencies for secure, jam-proof voice and data communications among defense officials, battlefield commanders, ground troops, aircraft, ships, the White House and the State Department. They also carry space operations communications and early warning data.

The DSCS 3-B6 spacecraft launched August 29, 2003, was supposed to have been launched by space shuttle in 1986. DSCS 3-B6 and 3-A3 were to have shared the ride to orbit, but the explosion of Challenger changed the plan.

The pair were modified to enhance their capabilities and 3-A3 flew to orbit on the Delta 4 rocket launched March 10, 2003. That made 3-B6 the 65th and last DSCS satellite to launch.

DSCS 3-B6 will replace 3-B7 over the western Atlantic Ocean. The 3-B7 satellite, which was launched back in July 1995 by an Atlas 2A rocket, will be moved to another location.
with its new first stage booster and main engine, were crucial to the company's future in the space satellite launch industry. Boeing would like to sell future commercial launch contracts to telecommunications firms and also obtain launch work from its major government customer, the U.S. Air Force.

However, Boeing said in July 2003 that a shortage of business in the commercial space launch market, even as the costs of Delta 4 missions and launches were growing, caused the company to withdraw from commercial satellite launches and to focus on the growing government and military space market.

The U.S. government originally designed the Delta expendable rocket in response to the Soviet Union's launch of Sputnik, the first ever space satellite, in 1957. Delta was derived from the Thor intermediate range ballistic missile, a weapon developed in the mid-1950s for the Air Force. NASA's first successful Delta launch was the Echo-1A satellite on August 12, 1960.

Ariane

The European Space Agency's Ariane rockets compete with Atlas and Delta for commercial satellite launches. ESA blasts off its Ariane rockets from launch pads at the Kourou spaceport in French Guiana on South America's northeast coast.

The European Space Agency uses its commercial sales arm, Arianespace, to sell launches of its Ariane family of space rockets.

**Ariane 4.** For many years, Ariane 4 was Europe's powerhouse space launcher. Then, Arianespace decided to abandon the successful Ariane 4 in favor of the even more powerful Ariane 5.

The last flight of the venerable Ariane 4 was successful in February 2003. It retired as one of the most successful commercial launchers in history logging 74 consecutive successful missions.

**Ariane 5.** The basic version of the rocket is the Ariane 5G. Its motor is known as Titan 4B.
the Vulcain engine. The more-powerful new rocket is the Ariane 5 ECA. Its is built around the Vulcain 2 modified first-stage engine and brand new cryogenic upper stage,

Ariane 5 ECA is able to lift almost twice the payload of the Ariane 5G version.

First launch of the older Ariane 5G was in 1996. First launch of the new Ariane 5 ECA was in 2002.

**The Ariane 5G version:**

- Unfortunately, a guidance system error caused the first Ariane 5G to twist out of control and blow up 40 seconds into liftoff in June 1996.

- The second Ariane 5G rocket did make it to orbit in October 1997, but it fell short of its target when the first-stage main engine shutdown early.

- Another Ariane 5G test flight was successful followed by six successful commercial Ariane 5G flights.

- Then a commercial Ariane 5G flight failed in July 2001 when its upper-stage engine broke down.

- Three additional Ariane 5G flights were successful.

- The maiden flight of the more powerful Ariane 5 ECA rocket failed in December 2002, putting all Ariane flights on hold. Overall, the December 2002 loss was the fourth Ariane 5 mishap in fourteen flights.

- Launches of the basic Ariane 5G rocket resumed in April 2003 with a successful flight. It was the fifteenth Ariane 5 rocket flight.

- Another successful launch of the basic Ariane 5G rocket occurred in June 2003.

- The next basic Ariane 5G is to launch in August 2003 carrying two communications satellites and ESA's SMART-1 Moon probe.

**The Ariane 5 ECA version:**

- The maiden flight of the Ariane 5 ECA rocket was attempted in December 2002. Unfortunately, it went out of control during liftoff and was exploded over the Atlantic Ocean.

- Arianespace hopes to resume flights of the Ariane 5 ECA in 2004. The first
then will be a test flight carrying a dummy spacecraft.

In the face of stiff competition and fewer commercial spacecraft needing launches, getting the Ariane 5 ECA in service is very important to the commercial company Arianespace.

**HISTORY OF ARIANE ROCKETS**

**Vega.** Europe also is developing a new small space rocket for flights starting in 2006. It will be named Vega after the second brightest star in the skies over the Northern Hemisphere.

Although some satellites seem to be getting bigger, many satellites weighing only 500 to 5,000 lbs. need a small launcher. Such small packages are used for science missions and Earth observation in low equatorial and polar orbits.

Europe hopes Vega will make space access cheap and quick. Some Ariane parts are being adapted for Vega, which will be launched from the Kourou spaceport.

**MORE ABOUT VEGA**

**Titan**

The Titan 4B, also built by Lockheed Martin, is the largest unmanned space booster used by the U.S. Air Force. It can launch shuttle-class payloads. The rocket has a flexible carrying capability because it can be launched with no upper stage or one or two upper stages.

The Titan family was established by the Air Force in 1955 with a contract to build a heavy-duty space system awarded to the former Martin Company, now Lockheed Martin. Titan I was America's first two-stage ICBM (intercontinental ballistic missile), the first ICBM based in an underground silo.

Titan I was developed further into Titan II. Then there was a family of Titan 3 rockets including the powerful Titan 34D. The Titan 4 family evolved from the Titan 3 series.

The last Titan 4A was launched in August 1998. The first Titan 4B flew in...
February 1997. Titan 4B was 25 percent more powerful and had an improved guidance system, flight termination system, and ground checkout system.

The 204-ft.-long rocket weighs 2.2 million pounds at launch. It is built on two solid-fuel motors providing 1.7 million lbs. each at liftoff. The first stage adds a liquid-propellant engine adding 548,000 lbs. of thrust. The second stage uses a liquid-propellant engine adding an average of 105,000 lbs. of thrust. Optional upper stages include the Centaur, which can provide 33,100 lbs., and the inertial upper stage, which can provide up to 41,500 lbs.

- From Cape Canaveral, Titan 4B can carry up to 47,800 lbs. of payload to a low-Earth orbit (LEO) or 12,700 lbs. to a stationary (geosynchronous) orbit when launched.
- From Vandenberg, it can carry up to 38,800 lbs. to a low-Earth polar orbit. Using an inertial upper stage, it can transport up to 5,250 lbs. to geosynchronous orbit.

**Milstar.** In addition to the pair of DSCS satellites described above, a third military communications satellite was launched in 2003. The sixth and final Milstar satellite was ferried to orbit in April by a Titan 4 rocket.

Milstars are the most secure of the various communications satellites. They resist jamming and are hardened against nuclear attack. Milstars can operate in any combat environment with a low probability of detection or interception. In fact, they are used to relay the most sensitive information between the President and the armed forces.

On the other hand, DSCS offers a much larger communication capacity.

The future satellites designed to replace DSCS and Milstar are known as Wideband Gapfiller Satellites. They will have greater bandwidth and communications capacity than DSCS. The first Wideband Gapfiller Satellite will be ferried to orbit from Cape Canaveral by a Delta 4 rocket in 2005.

**Learn more about expendable space rockets and military satellites:**

- The Satellite Wars
- U.S. Air Force Space Rockets
- Lockheed Martin Space Systems
- The Boeing Company
- NASA Space Flight
- European Space Agency
- Arianespace

Information and illustration sources:

http://www.spacetoday.org/Rockets/Delta4_Atlas5.html