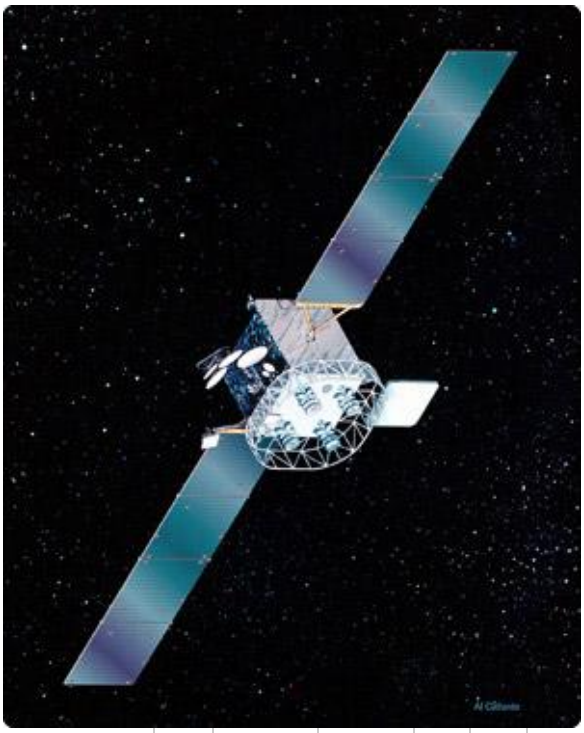
Defense, Space & Security

UHF Follow-On

Evolving, Advanced Military Communications



Spacecraft	Blk	Weight (lbs)*	Power (w)**	L (ft)	W (ft)	Payload
F1 - F3	I	2,600	2,500	60	23	UHF/SHF
F4 - F7	II	3,000	2,800	60	23	UHF/SHF/EHF
F8 - F10	III	3,400	3,800	75	22	UHF/EHF/GBS
F11	IV	3,000	2,800	60	23	UHF/EHF

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The U.S. Navy began replacing and upgrading its ultra-high frequency (UHF) satellite communications network during the 1990s with a constellation of customized satellites built by Hughes Space and Communications Company, which is now Boeing. Known as the UHF Follow-On (UFO) series, these 601 model satellites support the Navy's global communications network, serving ships at sea and a variety of other U.S. military fixed and mobile terminals. They are compatible with ground- and sea-based terminals already in service. The UHF Follow-On satellites replace the Fleet Satellite Communications (FLTSATCOM) and the Hughes-built Leasat spacecraft.

In July 1988, the company won the competition for a fixed-price contract awarded by the Program Executive Office for Space, Communications, and Sensors in Washington, D.C. The initial

agreement called for the company to build and launch one satellite, with options for nine more. Options for spacecraft 2 and 3 were exercised in May 1990; for 4, 5, and 6 in November 1990; and for 7, 8, and 9 in November 1991. In January 1994, the customer extended the contract by ordering a 10th satellite and launch services, bringing the total value to $1.7 billion.

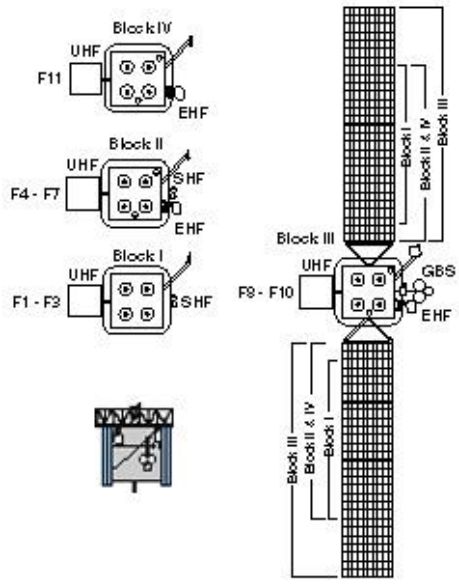
In March 1996, under a contract modification for $150 million, the Navy ordered a high-power, high-speed Global Broadcast Service (GBS) payload to be incorporated onto F8 through F10. This GBS package is revolutionizing communications for the full range of the Defense Department's high-capacity requirements, from intelligence dissemination to quality-of-life programming. The first GBS payload was put into service in 1998, and the final one was launched in November 1999.

In November 1999, the Space and Naval Warfare Systems Command's Communications Satellite Program Office added an 11th satellite to the contract. In January 2001, Boeing was authorized to begin production on that 11th spacecraft, which is scheduled to launch in 2003. This will help sustain the constellation into the latter part of the decade.

The UFO spacecraft has proven to be a very flexible platform for the evolution of critical advanced DOD communications services. The satellites are versions of the body-stabilized, three-axis Boeing 601 model. The spacecraft was introduced in 1987 to meet anticipated requirements for high-power, multiple-payload satellites for such applications as UFO, direct television broadcasting to very small terminals, private business networks, and mobile communications.

The Boeing 601 satellite comprises two main modules. The bus module houses the bus electronics, propulsion subsystem, and battery packs. The payload module contains the communications equipment and antennas.

The UFO satellites are manufactured in El Segundo, California. Using a building-block approach, Boeing and the Navy enhanced the constellation's capabilities in stages. Satellites F1 through F3 carry UHF and SHF (super-high frequency) payloads to provide mobile communications and fleet broadcast services. Starting with F4, an additional EHF (extremely high frequency) payload was added to provide protected communications. F7 introduced an enhancement to the EHF package that essentially doubles capacity. The SHF payload is replaced by the high data rate GBS package on F8 through F10. F11 carries the enhanced EHF package and an upgraded UHF payload as well.



Height stowed: 11 ft
Width stowed: 10.5 x 11.1 ft

The UFO satellites offer increased communications channel capacity over the same frequency spectrum used by previous systems. Each spacecraft has 11 solid-state UHF amplifiers and 39 UHF channels with a total 555 kHz bandwidth. The UHF payload comprises 21 narrowband channels at 5 kHz each and 17 relay channels at 25 kHz. In comparison, FLTSATCOM offers 22 channels. The F1 through F7 spacecraft include an SHF subsystem, which provides command and ranging capabilities when the satellite is on station as well as the secure uplink for Fleet Broadcast service, which is downlinked at UHF.

The Navy added an extremely high frequency communications package beginning with the fourth spacecraft. This addition includes 11 EHF channels distributed between an earth coverage beam and

a steerable 5° spot beam and is compatible with Milstar ground terminals. The EHF subsystem provides enhanced antijam telemetry, command, broadcast, and fleet interconnectivity communications, using advanced signal processing techniques. The EHF Fleet Broadcast capability supersedes the need for the SHF fleet uplink. Beginning with UFO F7, the EHF package was enhanced to provide 20 channels through the use of advanced digital integrated circuit technology.

The GBS payload replaced the SHF payload on spacecraft F8, 9, and 10. This new package includes four 130-watt, 24 megabits-per-second (Mbps) military Ka-band (30/20 GHz) transponders with three steerable downlink spot beam antennas (2 at 500 nmi and 1 at 2,000 nmi) as well as one steerable and one fixed uplink antenna. This modification resulted in a 96 Mbps capability per satellite. Three spacecraft give the DOD near-global coverage.

F11 will be most similar to F7, providing UHF and enhanced EHF communications. The UHF payload incorporates a new UHF digital receiver, providing two additional UHF channels and greater flexibility in configuring communication services.

The first seven satellites and F11 measure more than 60 feet long from the tip of one three-panel solar array wing to the tip of the other. Spacecraft F8 through F10 each have four solar panels on a side, making the spacecraft 75 feet tip to tip. These arrays generate a combined 2,500 watts of electrical power on the first three satellites, 2,800 watts for F4 through F7 and F11, and 3,800 watts for F8 through F10 with GBS.

The arrays are folded against the spacecraft bus for launch, forming a cube roughly 11 feet per side. The satellites weigh an average of 2,600 pounds with the UHF payload, 3,000 pounds with the additional EHF payload, and 3,400 pounds with the GBS payload.

The Atlas rocket series was chosen to provide the launches from Cape Canaveral, Fla. The Atlas I rocket was used for the F1 through F3 satellites. The Atlas II was chosen for F4 through F8 and Atlas IIA for F9 and F10. An Atlas III will launch F11.

UHF F2 was the first in the series to go into service, after its successful launch Sept. 3, 1993. UHF F3 was launched June 24, 1994. Three UHF spacecraft were orbited in 1995: F4 on Jan. 28, F5 on May 31, and F6 on Oct. 22. F7 was launched July 25, 1996. F8 was launched March 16, 1998, and F9 on Oct. 20, 1998. F10 was launched Nov. 22, 1999 and F11 was launched Dec. 17, 2003.

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