NORTHROP GRUMMAN FACTS

Milstar Flight 1 Low Data Rate Payload

When the first Milstar satellite was launched in February 1994, military leaders around the world marked the beginning of a new era in the history of military space communications.

The satellite's low data rate (LDR) communications payload, designed and built by TRW Space & Electronics Group (now Northrop Grumman), offered members of the armed services something never before available: an assured means of communicating with each other day or night, anywhere in the world, under any level of military conflict.

A Critical Warfighting Tool in the Information Age

The LDR payload, a sophisticated "switchboard in space," is the operational heart of the Milstar satellite communications network. It is responsible not only for setting up and managing all voice and data communication networks required by Milstar users, but also for ensuring that connections are made accurately, that message traffic is routed properly, and that all communications operations are carried out securely. It uses its own onboard processing systems hardware and resource management software to make all processing and traffic management decisions autonomously, without help from ground controllers.

The LDR payload guaranteed that any Milstar user would be able to communicate securely, accurately and seamlessly with any other Milstar user worldwide. It made Milstar not only the most secure, most sophisticated satellite communication system ever deployed, but also the satellite system most technologically adaptable to the needs of its users.

In addition to its autonomous processing, routing and network management capabilities, the LDR payload offered military users several other important "firsts:"

- It was the first satellite payload to allow members of all the armed services to communicate with each other on the same network. It uses a single, uniform communications format for its message traffic, which enables geographically dispersed users on board ships, submarines, aircraft and on the ground to carry out well-coordinated, multi-service operations.

- It was the first satellite payload to offer its users secure, jam-proof communications, even under the most rigorous jamming scenarios. It operates at extremely high frequencies (EHF) using unique, frequency-hopped communications and narrow beam antennas.

- It was the first satellite payload to provide instant, in-theater communications infrastructure for mobile users. Unlike Operation Desert Storm, which required months to set up communications and logistics infrastructure, Milstar's communications resources are always available to provide communications support among any in-theater or out-of-theater military users. Its geostationary orbit made the Milstar network virtually invulnerable to disruption by hostile ground-based forces.

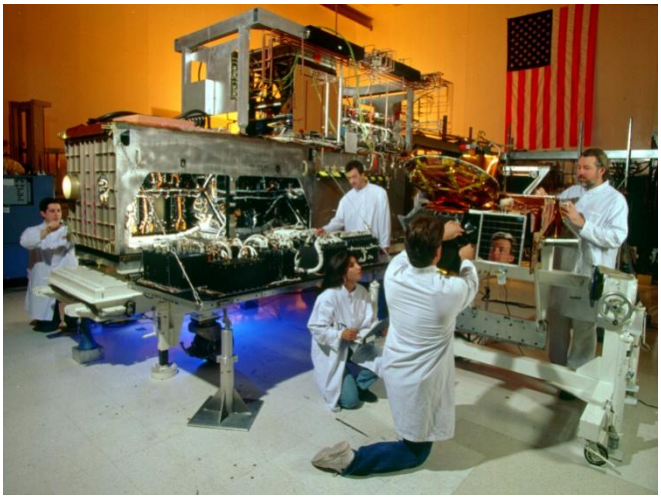
- It was the first payload to support direct communication satellite-to-satellite crosslinks. It allows users within view of any Milstar satellite to talk to each other with the ease of making a phone call, without the assistance of costly or potentially vulnerable ground stations. Users needed only know each others' Milstar "phone numbers" in order to communicate.

LDR Payload Supports Tactical and Strategic Missions

The LDR payload provides assured voice and data communications for tactical and strategic users. During the Cold War, tactical networks made up about two-thirds of the LDR capability. Today, all but 11 percent of the LDR networks are dedicated to the warfighting Commanders in Chief (CINCs) supporting tactical missions. Current LDR missions include:

- Joint task force command and control
- Army Corps/Division command and control
- Real-time battlefield condition reports
- Special operations communications
- Marine task force command and control
- Tactical Intelligence Coordination
- Navy battle group command
- Submarine information exchange
- Targeting data broadcast
- Strategic command and control

Flexible, Reliable Communications -- On Demand



Conventional communications satellite payloads operate strictly as relay stations in space: incoming signals are received, amplified, and then retransmitted. Any noise or distortions that exist in the incoming signal due to jamming or poor transmission remain in the outgoing signal. These "bent-pipe" payloads also rely on ground station operators to allocate satellite resources among users, often on a dedicated basis.

The Milstar LDR payload, by contrast, manages all satellite communication resources and message traffic autonomously from on board the satellite. It is responsible for setting up, maintaining and reconfiguring communication networks in real time and adding and removing channels in response to user-transmitted requests. Resources are made available to the users in seconds. Milstar users can make a point-to-point call; set up or join a conference call; request a new allocation of satellite resources; broadcast data to many users simultaneously; or request information about networks, satellites or other users. The payload can use its 192 channels to connect up to 212 independent circuits to satellite managed networks simultaneously.

The Milstar LDR payload provides data rates from 75 bits per second (bps) to 2400 bps -- which permits secure voice, data, fax and laptop computer communications. When channels are fully loaded, the payload can send an equivalent of 50,000 pages of text in one hour!

The payload's onboard processors also enhance the clarity and accuracy of communications traffic flowing through the satellite. When signals enter the payload, they are converted into digital form, filtered for unwanted noise, corrected for any errors, then retransmitted to the next user, eliminating much of the signal degradation that occurs in conventional satellite networks.

LDR Payload Subsystems

The LDR payload is built around a rectangular, box-like structure called the wing. Its major electronic subsystems are contained on four hinged panels which fold into this structure. The payload includes five major subsystems:

The EHF Uplink Subsystem is the "front end" for user signals received by the satellite. It decodes incoming signals from nine uplink antennas and prepares them for processing by the "brains" of the LDR payload.

The Payload Management System is the "nerve center" for the LDR payload's "switchboard in space." It extracts digital messages from the incoming analog signals, allocates communication resources to handle message traffic, and makes all switching and routing decisions to ensure that every incoming channel is matched with the proper outgoing channel.

The SHF Downlink Subsystem prepares and transmits outgoing messages to the Earth using one of five downlink antenna.

The UHF Transponder Subsystem manages the receiving, processing and transmitting of low data rate (75 bits per second) and fleet broadcast (1,200 bits per second) communications to Department of Defense users with UHF communication terminals.

The Timing and Frequency Reference Subsystem (TFRS) serves as the "pulse," or primary timing reference, for the entire payload. Since all user terminals synchronize their timing to that of the satellite, the TFRS defines, in effect, the "beat" to which all LDR mission communication actions "march."

The payload also includes 13 assorted extremely high frequency (EHF), super high frequency (SHF), and ultra-high frequency (UHF) antennas which enable the flow of information between user terminals and the satellite.

LDR Payload Technical Specifications

Data Rates: 75 to 2,400 bits per second (bps)

Operational Frequencies

- EHF Uplink (44.5 GHz, 2 GHz bandwidth)
- SHF Downlink (20.7 GHz, 1 GHz bandwidth)

Interoperability: Common modulation modes and protocols

Channel Capacity: 192 (108 available for general communication)

EHF/SHF Antennas

Uplink Antennas	Downlink Antennas
5 EHF Agile Beams	1 SHF Agile Beam
1 EHF Earth Coverage	1 SHF Earth Coverage
2 Narrow Spots	2 Narrow Spots
1 Wide Spot	1 Wide Spot

UHF Services

- 4 AFSATCOM IIR channels (earth coverage; 75 bps, transmit and receive)
- 1 Fleet Broadcast channel (earth coverage; 1,200 bps, transmit only)

Crossbanding Capabilities

- Uplink EHF to Downlink SHF (Standard operations for Milstar terminals)
- Uplink UHF to Downlink UHF (AFSATCOM Terminals)
- Uplink EHF to Downlink UHF (Fleet Broadcast Mode)

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