# GAMBIT

## **HIGH RESOLUTION SATELLITE PROGRAM**

The Eye of the Eagle

## GAMBIT

- GAMBIT was the Cold War era strategic high-resolution satellite reconnaissance program that imaged high value targets identified by broad area search satellites (CORONA from 1960-72 and HEXAGON from 1971-84)
- The GAMBIT program had two baseline design configurations GAMBIT 1 & GAMBIT 3
- GAMBT 1 (1963-67) 77-inch focal length, 24-inch resolution from 95 nm
- GAMBIT 3 (1966-84) 160 & 175-inch focal length, with better than 12-inch resolution from 95 nm
- GAMBIT 3 incorporated several design improvements during development & operation
  - Vehicles 1-22 (1967-69) had a single film recovery vehicle
  - Vehicles 23-54 (1969-84) had two film recovery vehicles
  - Vehicles 32-47 (1971-84) had 175-inch focal length optics
  - Vehicles 48-54 (1977-84) had two parallel camera systems (9"& 5" film)

	1960	1961	1962	2963	1964	1965	2000	1967	1968	1969	1970	1971	1972	197B	1974	1975	1070	19Th	197B	1979	1980	1981	1982	1983 1983	60 80
CORONA																									
HEXAGON																							1		
GAMBIT 1				y.								-													10
GAMBIT 3				_			-																		

## **GAMBIT BASIC DESIGN**

All GAMBIT satellites had these features

- •A lens assembly parallel to ground along the axis of the vehicle
- •A flat stereo mirror that reflected the ground image into the primary mirror assembly
  - •The stereo mirror, nominally pointed at nadir, could pivot 15<sup>o</sup> fore and aft for stereo imagery •Rotation of line-of-sight 45<sup>o</sup> either side of flight path for imaging off nadir
  - •Color corrector & field flattening lens focused image onto a cylindrical platen in a strip camera that controlled the film movement past imaging slit at speeds matching the motion of ground scene
  - •A supply/take up looper compensated for strip camera film movement without supply and take up motor running to reduce vibration in image
  - •Exposed film was transferred on to a take up spool in the reentry vehicle
  - •Reentry vehicle deorbit over Pacific area for aerial recovery

## **GAMBIT 1 & 3 CONFIGURATIONS**

#### Kodak GAMBIT 1 Camera Optics Assembly

#### **3-foot diameter**

77-inch focal length, f/4 lens; 19.5 clear aperture 34-inch stereo mirror; 28-inch primary mirror 3,000 feet of 9-inch-wide film

#### Kodak GAMBIT 3 (single SRV) Photographic Payload Section (PPS) 5-foot diameter

160-inch focal length, f/4 lens; 44-inch clear aperture 46 by 56-inch stereo mirror; 44-inch primary mirror 5,000 feet of 9-inch-wide film



#### Kodak GAMBIT 3 (dual SRV) Photographic Payload Section (PPS) 5-foot diameter

175-inch focal length, f/4 lens; 44-inch clear aperture 44 by xx-inch stereo mirror; 44-inch primary mirror 10,000 feet of 9-inch-wide film



### **GAMBIT CAMERA SYSTEM OVERVIEW**

	GAMBIT 1								
User Name	KH 7 KH 8								
Vehicles	Jan-38	1-22	23-31	32-47	48-54				
Launch Vehicle	Atlas Agena D Titan IIIB Agena D								
First Launch	12-Jul-63	29 July 1966	23 August 1968	12 August 1971	13 March 1977				
Focal Length	77-inch f/4	160-in	ich f/4	175-inch f/4					
Strip Camer Film	9" Wide 3,000' Long	9" Wide 5,000' Long	9" Wide 10	0,000' Long	9" Wide 10,000' Long 5" Wide 3,800' Long				
Off Axis Imaging	45° left & right								
Ground Resolution	2 to 3 Feet Less than 12 Inches								
Longest Mission	8 Days	8 Days	25 Days	57 Days	123 Days				
Recovery Aircraft	JC-130								

#### **GAMBIT Mission Firsts**

- First high-resolution photography from space
- First to photograph people from space
- First use of color film in space
- •First high-resolution night photography from space

#### **OPERATIONAL IMAGE WIDTHS**



FIGURE 5. TYPICAL EXAMPLES OF CONTINUUS STRIP AND LATERAL PAIR FRAME COVERAGE AT NOMINAL 95 NM ALTITUDE.

FIGURE 5. TYPICAL EXAMPLES OF CONTINUUS STRIP AND LATERAL PAIR FRAME COVERAGE AT NOMINAL 95 NM ALTITUDE.

#### Less Than 12-Inch Resolution

2-to-3 Foot Resolution

Less Than 12-Inch Resolution

### **GAMBIT IMAGING MODES**





#### **GAMBIT OPERATIONAL MODES**



LATERAL TRIPLET



LATERAL PAIR



MONOSCOPIC STRIP



STEREO STRIP

## **GAMBIT 1 SATELLITE**





The GAMBIT 1 Satellite separated from the Agana and operated on its own

The GE Orbital Control Vehicle (OCV), outlined in white, provides power, command & control, attitude control, pointing, & orbit adjust
The Kodak Camera Optics Assembly is mounted within the OCV

## **GAMBIT 1**

A Kodak GAMBIT 1 Camera Optics Assembly (COA) is currently displayed at NRO Headquarters & In public display at the Rochester Museum and Science Center in Rochester, New York



## **GAMBIT 1 SATELLITE**





- The Kodak Camera Optics Assembly (COA) was completely contained within GE Orbital Control Vehicle (OCV)
- OCV viewport door opened to expose COA



Reentry Vehicle



GE Orbital Control Vehicle (OCV)

Aft end of OCV

### **GAMBIT 1 INTEGRATION & LAUNCH**





#### **GAMBIT 3 BASIC SATELLITE CONFIGURATION**



#### **GAMBIT 3 SINGLE BUCKET SATELLITE**





Photographic Payload Section (Kodak)

Roll Joint (Lockheed)

Agena D Satellite Control Section (SCS) (Lockheed)





### **AGENA-D SERVICE BUS**

The AGENA-D bipropellant system took it into final orbit then became a "tripod" for payload COA mission operations.

- The roll joint enabled cross track pointing agility
- The Agena bus provided basic satellite support functions
  - Attitude control
  - Telemetry & Command interface
  - Orbit maintenance
  - Electric power (Vehicles 53 & 54 added solar arrays for longer mission duration)



## **GAMBIT 3 ROLL JOINT**



- The Roll Joint was attached to the Forward Rack of the Agena
- The Photographic Payload Section (PPS) bolted to the Roll Joint
- The Roll Joint had a unique gearing arrangement that allowed the Agena to roll the PPS 45° left and right of nadir while cancelling the reacting momentum force on the Agena in the opposite direction

## **TYPICAL GAMBIT-3 PAYLOAD**



#### **GAMBIT-3 CAMERA OPTICS ASSEMBLY**



## **GAMBIT 3 CAMERA PAYLOAD DESIGN EVOLUTION**

GAMBIT 3 (Flights 1-22) Single Bucket Astro Position Terrain Camera

GAMBIT 3 (Flights 23-47) Dual Bucket Astro Position Terrain Camera

GAMBIT 3 (Flights 48-54) Dual Bucket 9 x 5 Camera (Replaced Astro Position Terrain Camera)



### **GAMBIT 3 ASSEMBLY & TEST**

Integrated Supply Electronics Module and Camera Optics Module







Integrated Photographic Payload Section (PPS)







Recovery Vehicle & Adapter Integration



Thermal Vacuum Testing



Pack for Shipping

#### **GAMBIT 3 FINAL ASSEMBLY**



## **GAMBIT 3 FACTORY TO PAD INTEGRATION**



at Space Launch Complex 4 West

Lockheed Agena (including Roll Joint) Sunnyvale, CA

#### **GAMBIT 3 TRANSPORT**



Kodak to Griffiss AFB, NY

Airlifted from Griffiss AFB, NY to Vandenberg AFB, CA



Loading on to C-5 at Griffiss AFB, NY





Hoisted into Tower



Mated to Titan IIIB Agena for Launch

#### **GAMBIT-3 MISSION PROFILE**

Mission operations were planned & commanded at the Satellite Control Center, Sunnyvale CA & relayed to the satellite through the satellite control network. GAMBIT command operation had to be precise due to the small imaging footprint and critical flight parameters. This task was made more challenging considering the state of computer technology at the time.



### **GAMBIT-3 INTEGRATED SYSTEM FLIGHT OPERATION**



## **MISSION OPERATIONS**





**IMAGE OPERATIONS** 

LAUNCH

## **RECOVERY OPERATIONS**

LIRECTION OF FLIGHT





Film was returned in reentry vehicle (buckets) weighing 200-pounds which were captured in midair by specially equipped JC-130 aircraft. The film was then taken to Kodak for processing.



## EXPLOITED GAMBIT IMAGERY (Sample)



SPACE BORIS TER

#### GAMBIT-1 & GAMBIT-3 AT THE MUSEUM OF THE AIR FORCE

[GAMBIT 1 & 3 are currently in storage - not on public display.]



The GAMBIT satellite program imaged high resolution critical targets. GAMBIT-1 (38 missions) from 1963 to 1967, and GAMBIT-3 (54 missions) from 1966 to 1984.