



# Falcon Overview

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**Aerospace in the News  
Symposium**

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DARPA/TTO  
Falcon PM**



# Program Genesis



## Program Goal

***Develop and Validate, In-flight, Technologies  
that will Enable a Prompt Global Reach  
Capability while at the Same Time,  
Demonstrating Affordable and Responsive  
Space Lift***

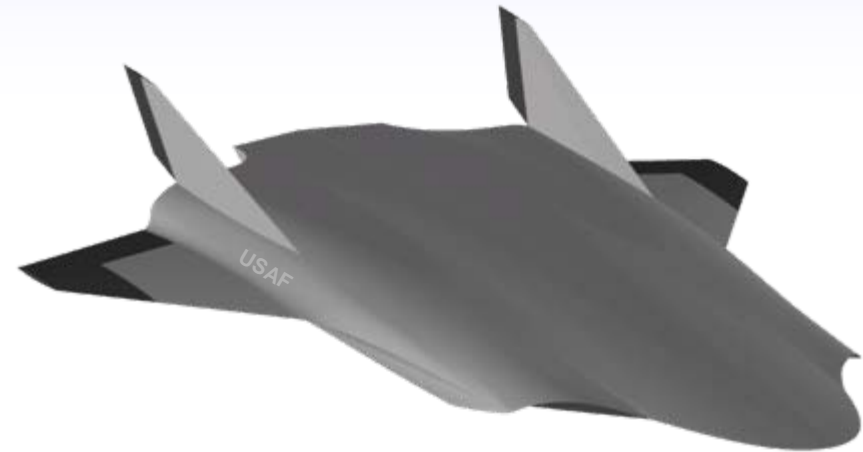
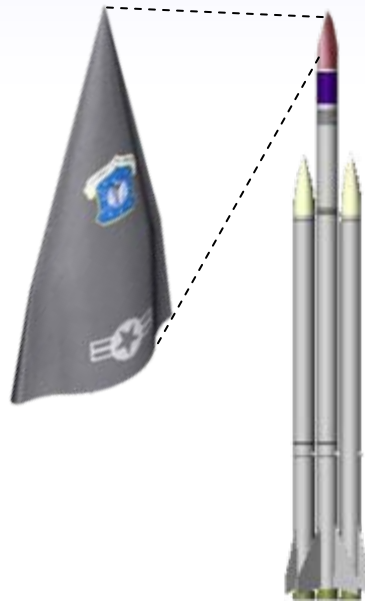
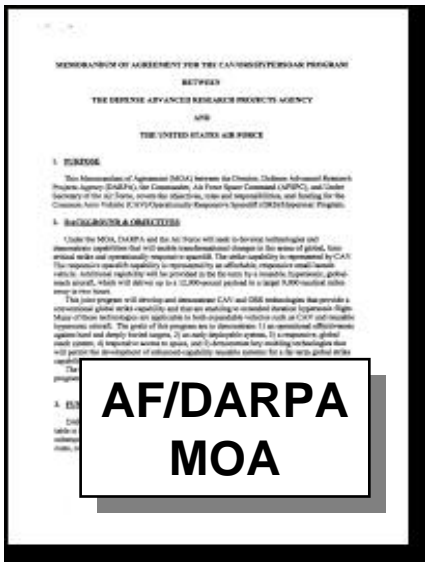
***FALCON is a joint DARPA/AF technology demonstration program***



# Program Genesis



## Program Components



### MOA Signed June 2003

- DARPA Director Tony Tether
- AFSPC Commander Gen. Lance Lord
- USECAF Pete Teets

### Near Term (Expendable) Hypersonic Technology Vehicle (HTV) and Small Launch Vehicle (SLV)

### Far Term (Reusable) Hypersonic Cruise Vehicle (HCV)



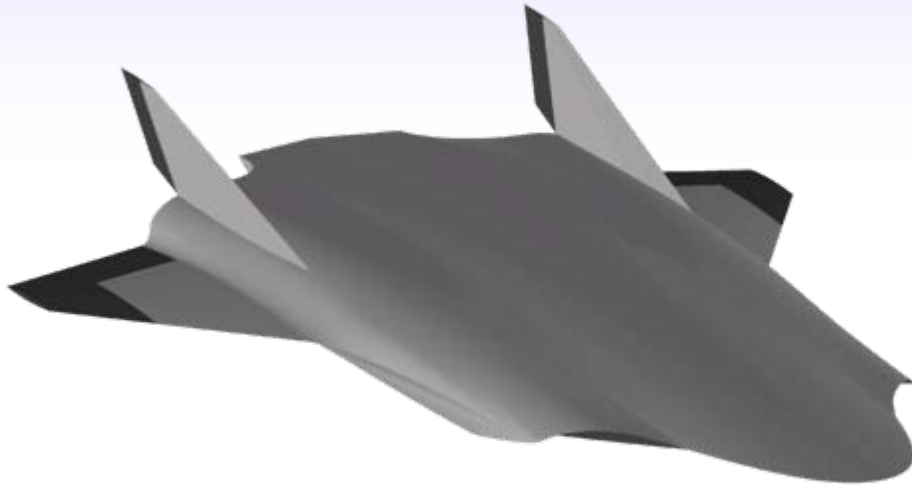
# SLV Operational System



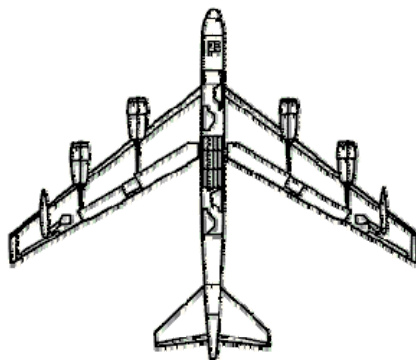
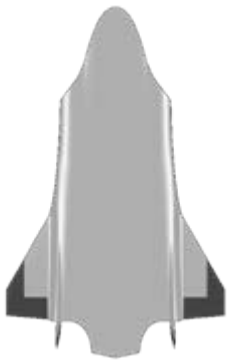
- **Small Payloads to LEO**
  - 1000 lb payload to 28.5°, circular, 100 nm altitude (baseline orbit for concept comparison)
  - Technologies support payload growth options
  
- **Low Recurring Launch Cost (< \$5M)**
  
- **New Launch Operations**
  - Reach alert status within 24 hrs
  - Launch within 24 hrs



# HCV Operational System



- Prompt (Time-Sensitive)
- Global Reach from CONUS
- Anti-Access Capability
- Multiple Payloads
- Aircraft-Like Operations
  - *Launch on demand*
  - *Reusable*
  - *Recallable*



**B-52 Size and Weight Class**



# HTV, SLV, and HCV Vehicles



## HTV (Hypersonic Technology Vehicle)

**HTV-1**  
2200 lb  
11.3 ft



- *Quantify Flight Environments*
- *Advanced 1 Piece Carbon-Carbon Aeroshell*
- *GFE rocket launched in 2007*

**HTV-2**  
2200 lb  
13.3 ft



- *Improved L/D*
- *Sharp Carbon-Carbon Aeroshell*
- *Advanced Multi-Layer Insulation*
- *Demonstrate SatCom and Talk Through Plasma*
- *SLV launched in 2008*

**HTV-3**  
1800 lb  
14.2 ft



- *HCV Waverider Aerodynamics, S&C*
- *Reusable Airframe – Recovered and Flown Again*
- *SLV launched in 2008*

**FaCET**



- *Falcon Combined-cycle Engine Technology*
- *Develop & ground demo prototype TBCC*
  - *Ground Tests in August 2008*

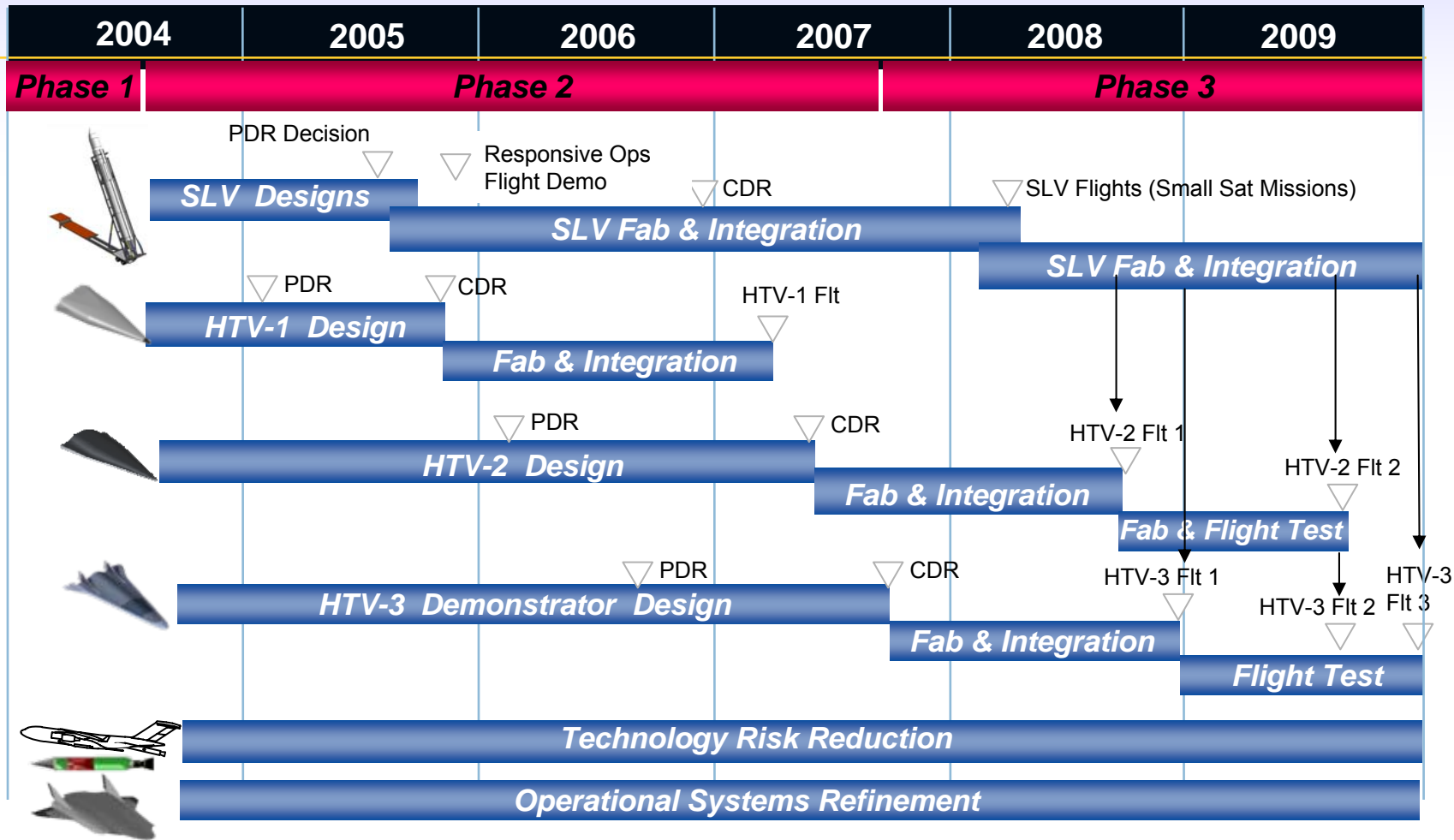
**HCV**



**Hypersonic Cruise Vehicle**



# FALCON Program Schedule



**SLV and HTV Demonstrators Will Focus Technology Development**

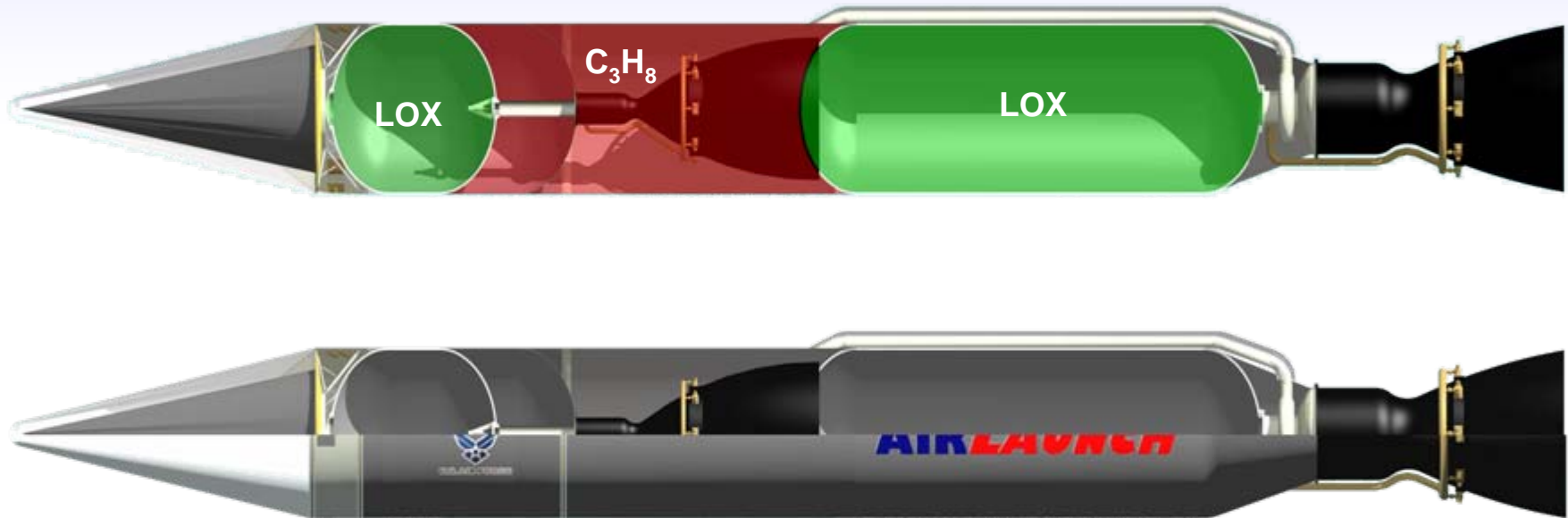


# Small Launch Vehicles





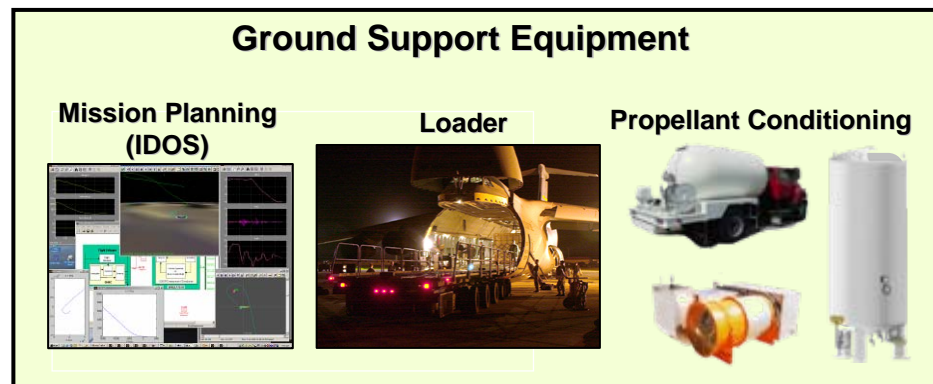
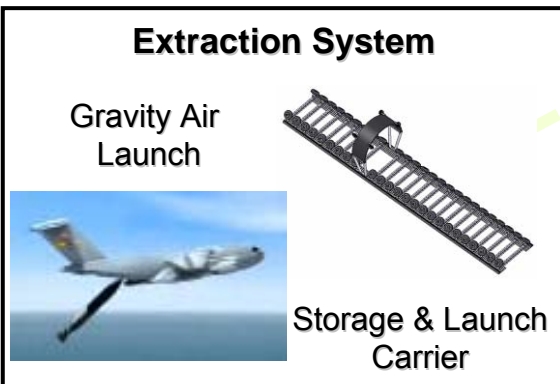
# AirLaunch QuickReach Small Launch Vehicle



***Air-launched, containerized, self-pressurizing liquid two-stage rocket with less than 24 hour response for less than \$5M/flight.***



# AirLaunch Architectural Elements





# AirLaunch CONOPS



## Launch

T=0 sec  
Alt = 24,900 ft  
Velr = 330 fps  
Range = 0 nmi



## Optional In-flight Refueling



## Staging

T = 110 sec  
Alt = 161,000 ft  
Velr = 7,765 fps



## Ground Hold

Takeoff within 60 minutes of call-up



## Orbit Insertion

T=366 sec  
Alt = 608,000 ft  
Veli = 25,580 fps  
Range = 620 nmi

## 1<sup>st</sup> Stage Impact

T = 390 sec  
Range = 350 nmi





# AirLaunch CONOPS Video



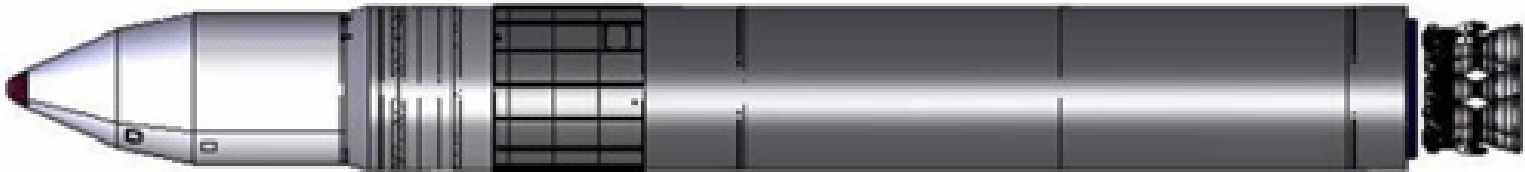
# C-17 Drop Test Video



# Space X – GFE Booster Demonstration Overview



- Responsiveness demonstration of a Falcon I launch vehicle resulting in payload injection to orbit
- A demonstration of firsts: LV system, Launch Site, & Launch Range
- Falconsat-2 payload selected in February 2005; total payload mass 87 lbs (43 lbs plus adapter hardware 44 lbs).



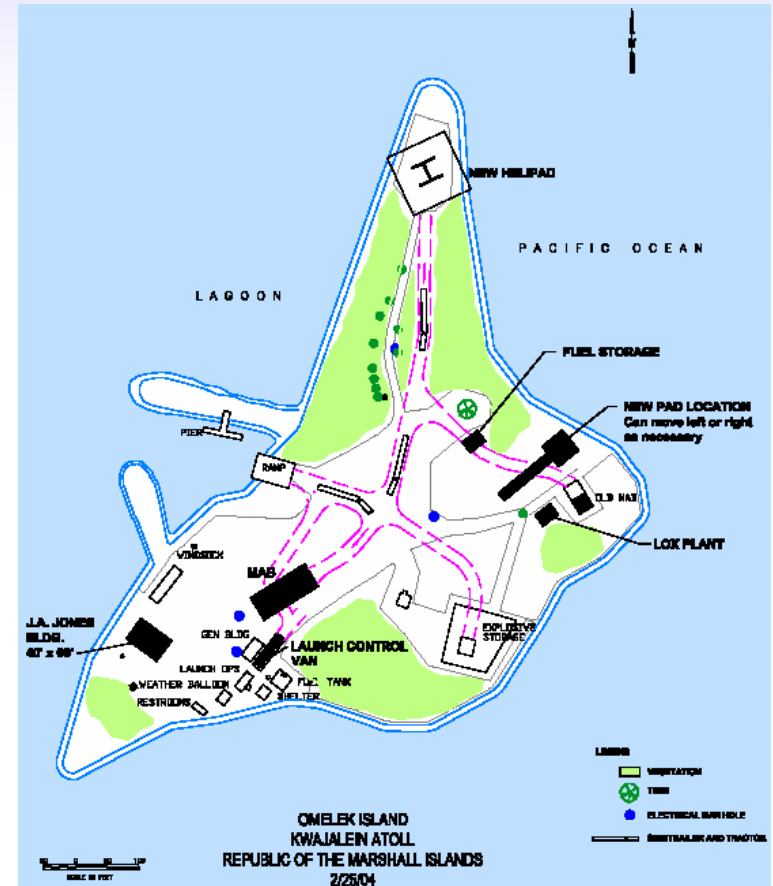




# Space X – GFE Booster Omelek Launch Site



- Construction completed in Oct 2005
- Assembly Building
- LOX Tanks
- Helium Tanks
- Office Building
- Storage
- Launch Pad
- Umbilical Tower
- Water Deluge System





# Space X – GFE Booster Launch Status



- First launch attempt (11/26)
- Second launch attempt (12/19)
- Third launch attempt (2/9/2006)
- Fourth launch attempt (3/20/2006)







# SpaceX Static Fire Video

## 2/12/2006



# Hypersonic Cruise Vehicle



# HTV-1,2,3 Flight Demos



**Continuous improvement in flight performance**

Low Risk, Ready  
For Design

Revise Aero Shell,  
Thermal Insulation, and  
GN&C Subsystems

Revise Aero Shell, Internal  
Structure, Reusable Thermal  
Protection Systems



HTV-1  
SLV  
Launched



HTV-2  
SLV  
Launched



HTV-3  
SLV  
Launched

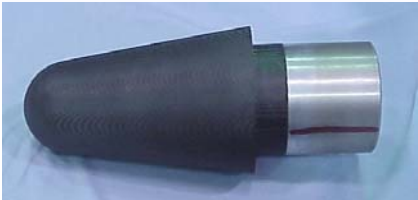
**FALCON's evolutionary, spiral development flight demonstrator approach reduces technology validation cost and risk**



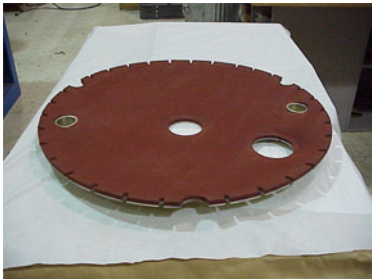
# HTV-1 Demonstration System



*HTV-1 uses state-of-the-art materials and components to reduce overall program risk and flight demonstrate today's hypersonic technology capability*



Nosetip



Aft Cover



IR&D Aeroshell



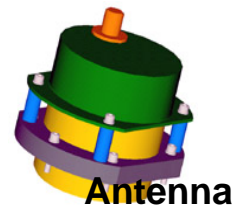
Antenna Window



Carbon-carbon samples



ESIGI



Antenna



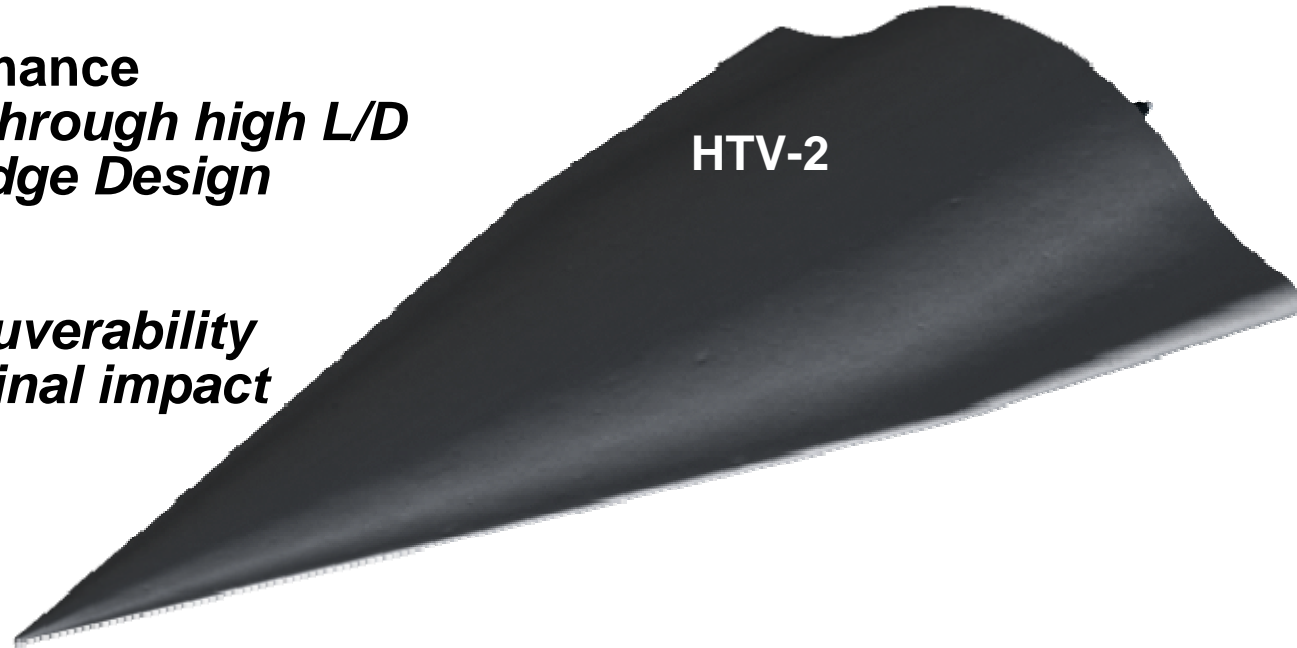
Encoder



# HTV-2 Demonstration System



- **Thermal protection**
  - *Low recession carbon-carbon aeroshell*
  - *Advanced Multi-Layer Insulation for long duration reentry flight*
- **Aerodynamic performance**
  - *Extended range through high L/D*
  - *Sharp Leading Edge Design*
- **NG&C performance**
  - *Significant maneuverability required for terminal impact*
- **Communications**
  - *Maintain up/downlink throughout long-range flight*



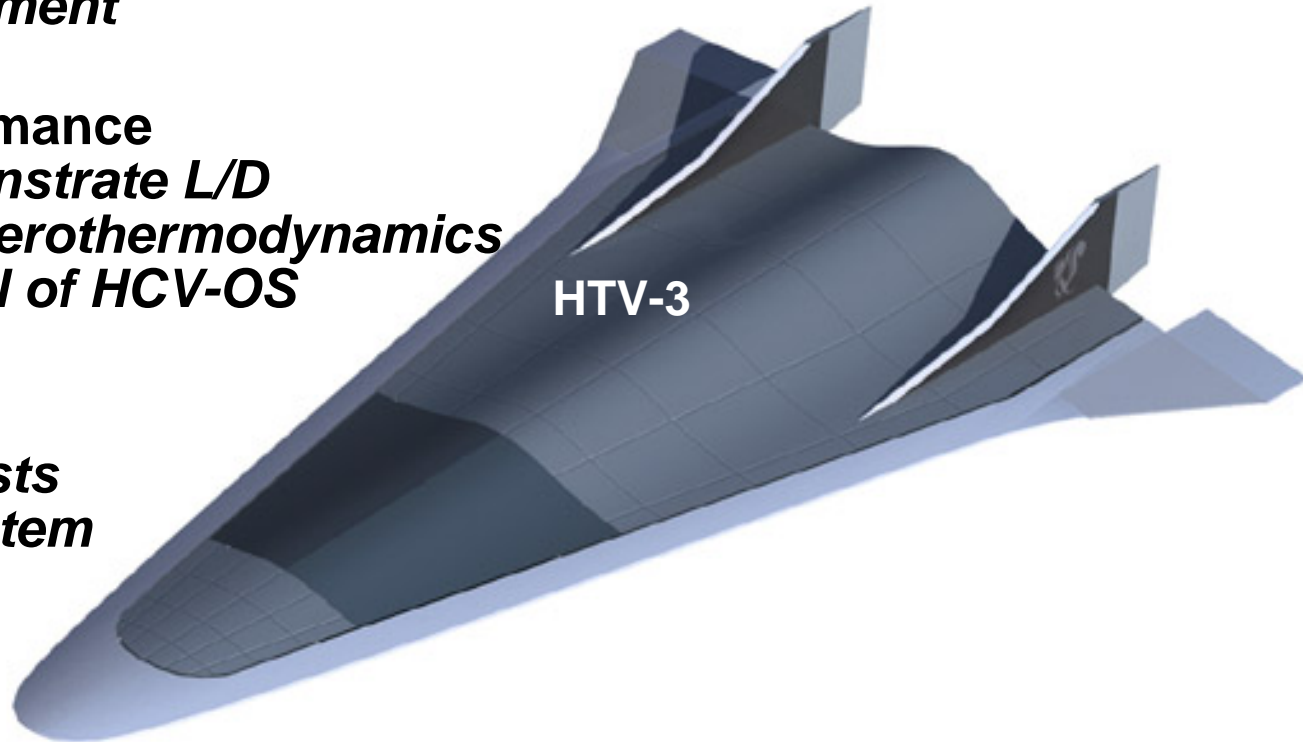
**HTV-2 Demonstrates Enabling Hypersonic Technologies for future Operational Systems**



# HTV-3 Demonstration System



- **Thermal Protection System (TPS)**
  - *TPS/Structure demonstrate capability for HCV-OS environment*
- **Aerodynamic performance**
  - *Shaped to demonstrate L/D aerodynamics, aerothermodynamics and flight control of HCV-OS*
- **Maximize Reuse**
  - *Multiple flight tests demonstrate system reusability/TPS refurbishment*
- **Built upon HTV-1 and HTV-2 technology basis**
  - *Technology risks managed to maximize gain*



**HTV-3 Demonstrates Enabling Hypersonic Technologies for future Hypersonic Cruise Vehicle Operational System**





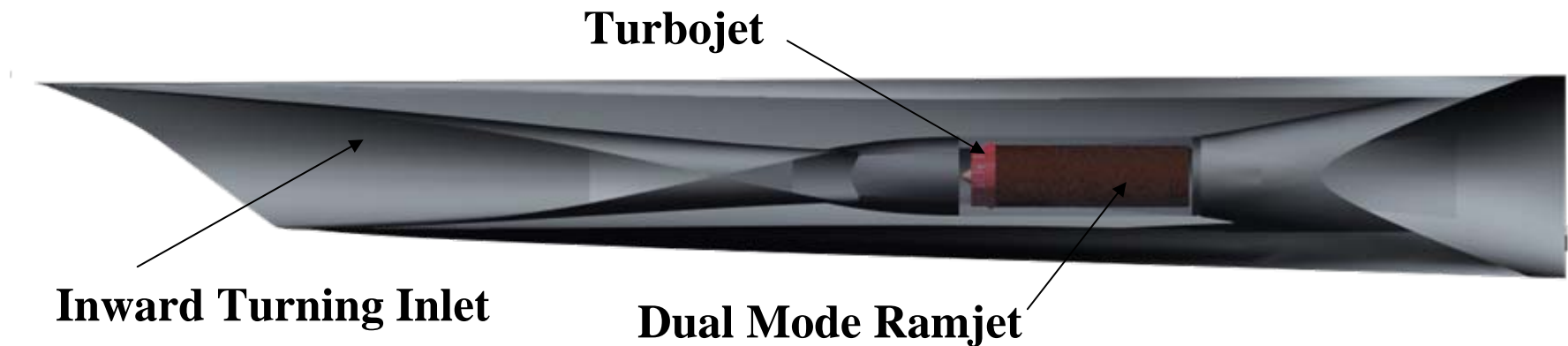
# FaCET

## HCV Propulsion Ground Demo



FaCET – Falcon Combined-cycle Engine Technology:

Mature and integrate technologies for a combined cycle (turbine + scramjet) engine using a new inward turning inlet.





# HCV Vision Video