



# Upper Stage Evolution

**Mark Wilkins**

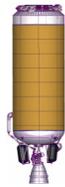
**Atlas Product Line VP  
United Launch Alliance**



# EELV Sustainment Through 2030 ULA's Evolution Strategy

## EELV Configurations

- (3) Upper Stages
- (2) Avionics Systems
- (2) GC3 Systems
- (2) Upper Stage Engines



Existing Intermediate Market



Common Subsystems



Existing Heavy Market



Future Heavy & Growth Markets



Atlas

ULA Consolidation Phase

Fleet Optimization Phase 1

Common Upper Stage Phase 2

Booster & GSE Optimization Phase 3

Next Generation System Development

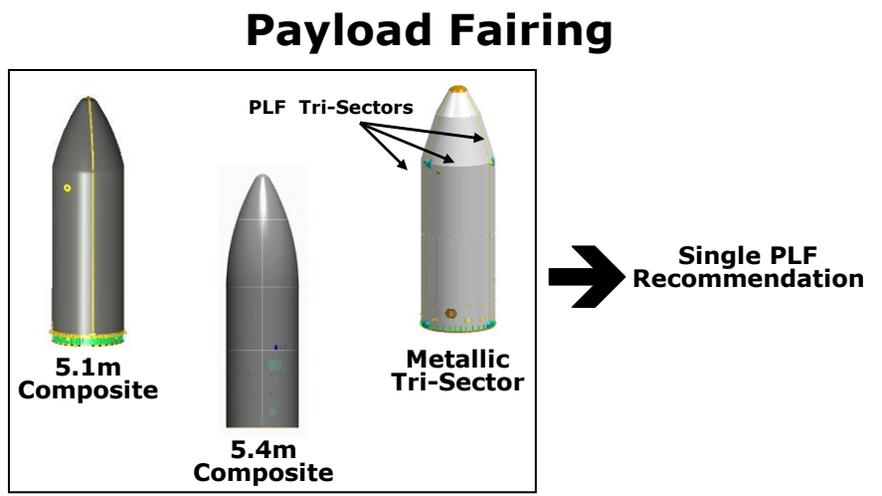
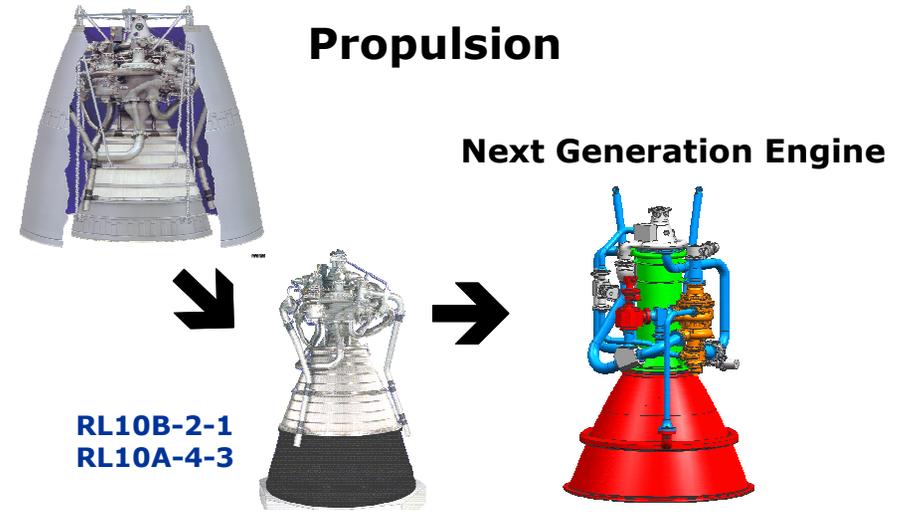
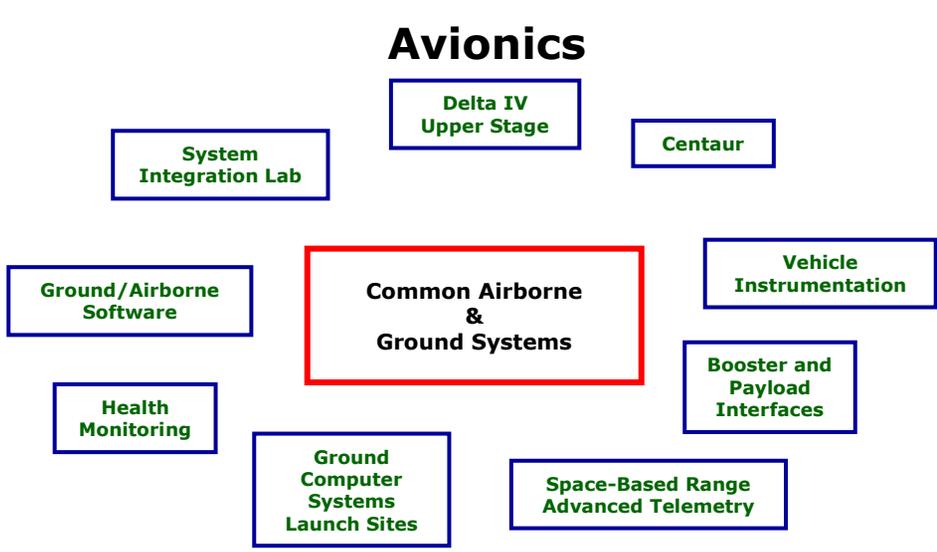


Delta

Fleet Evolution



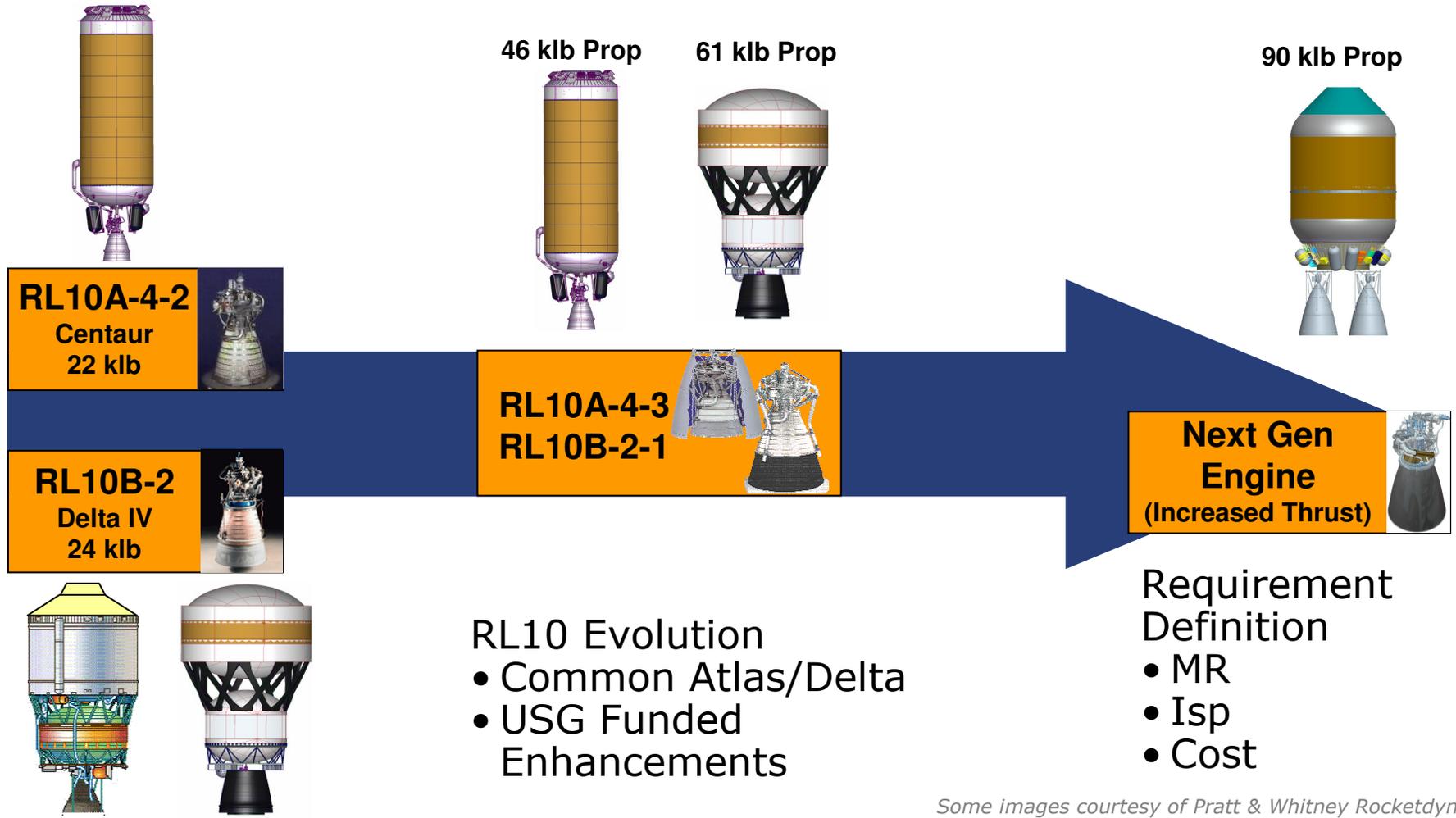
# Common Upper Stage Enables Robust Industrial Base



- **Supplier Viability Through Consolidations & Rate**
- **Assured Access Through Reliability, Resiliency & Rate**
- **Industrial Base Health Through Sustained P3I**
- **Reduced Obsolescence Costs**

Some images courtesy of Pratt & Whitney Rocketdyne

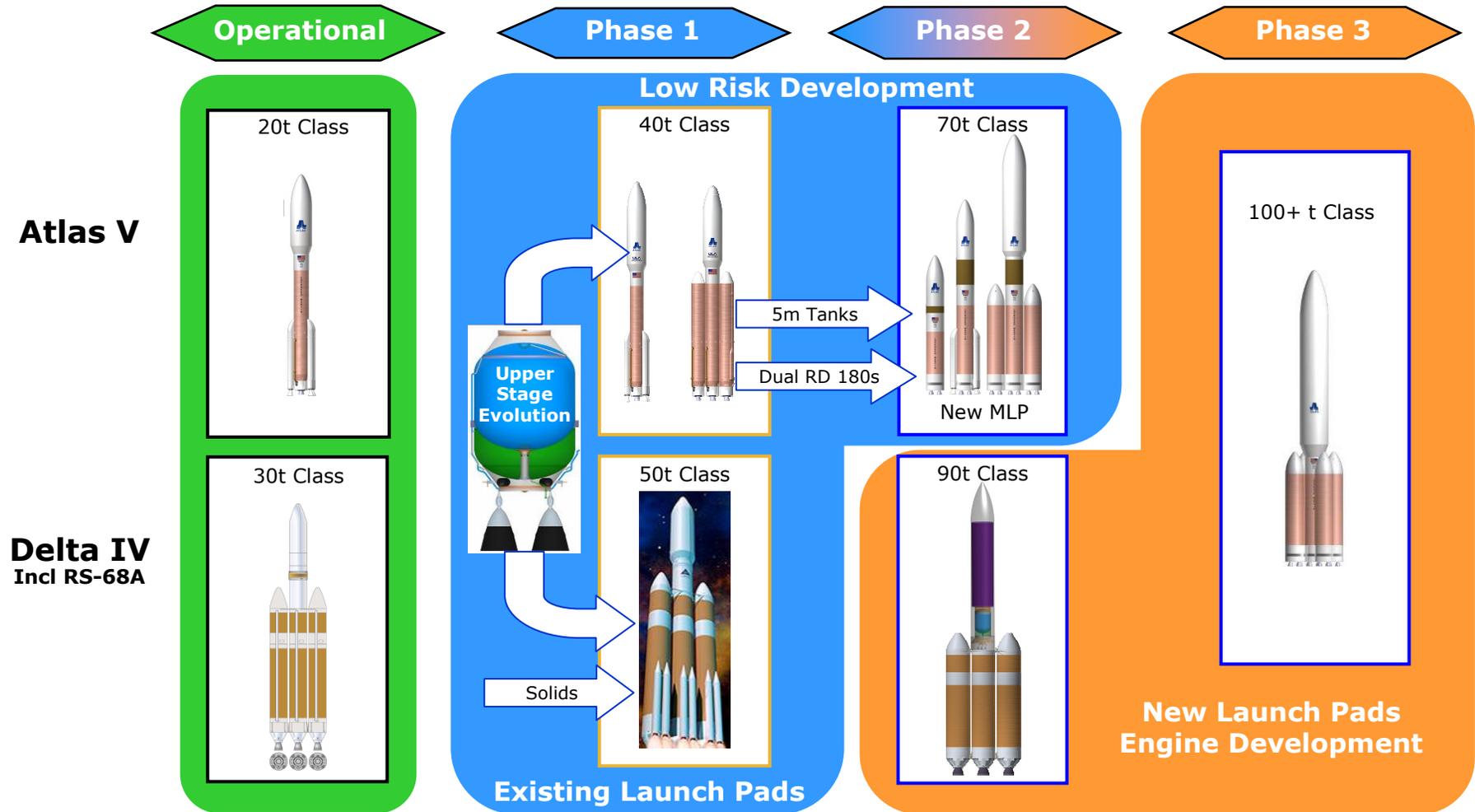
# Upper Stage Engine Roadmap



*Some images courtesy of Pratt & Whitney Rocketdyne*

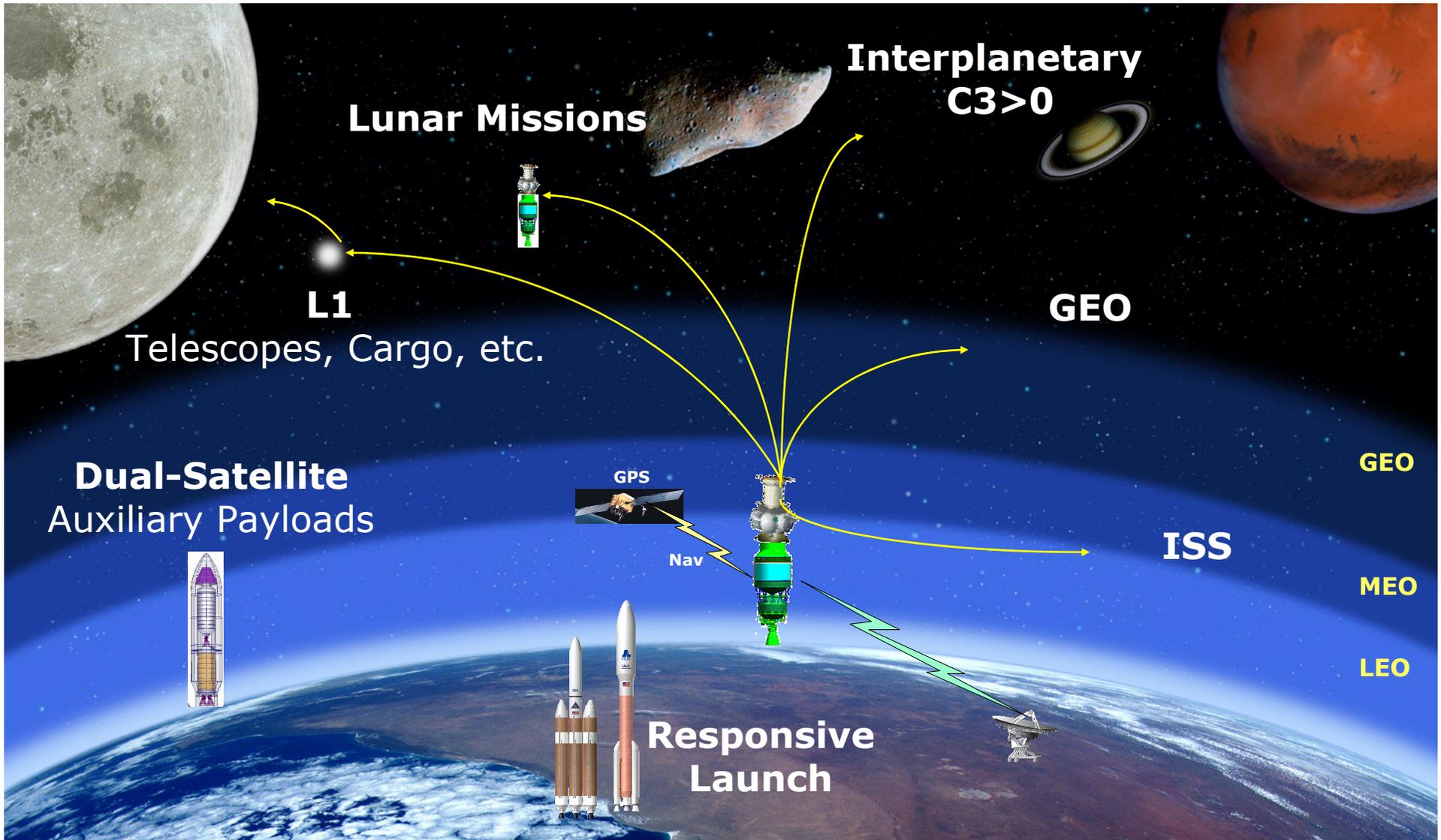
**Early Fielding with Existing Product Lines**

# EELV Evolution Flexible Mission Architectures

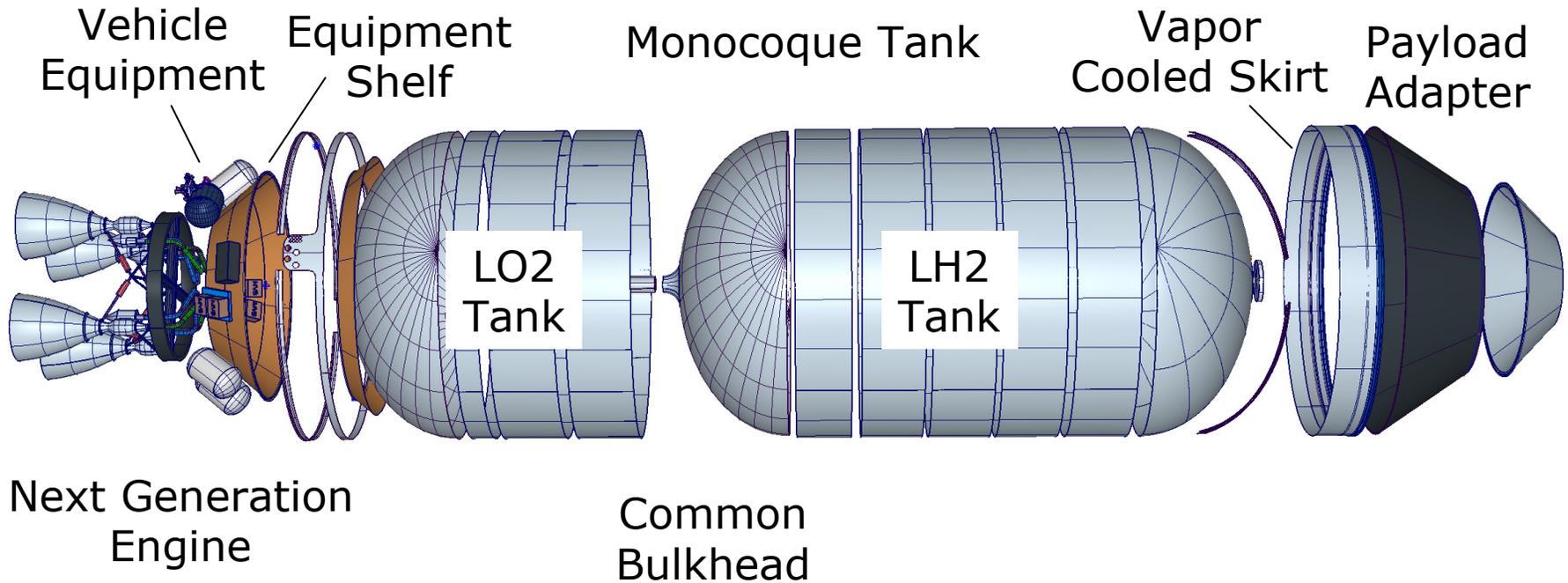


***First Step: Upper Stage Consolidation/Evolution***

# Mission Needs Drive ULA's Evolution Strategy



# Advanced Common Evolved Stage Key Elements



***Combine Best of Atlas & Delta Characteristics***

# Long Duration Innovation

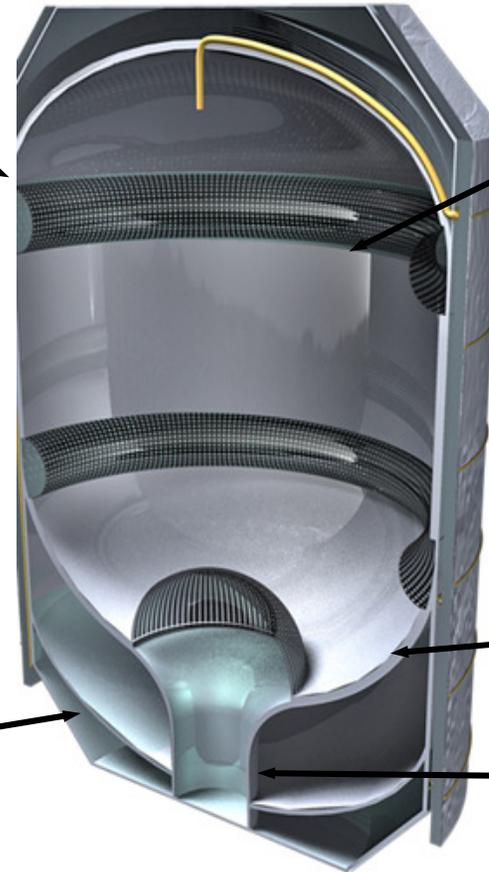


**Guided by  
Flight  
Experience**

- Monocoque Tank
- Thermal Management
- Mass Fraction >0.9

Reduced  
LH2  
Surface  
Area

Minimal  
Penetrations



LH2 Tank  
Sized for  
Substantial  
Boil-Off

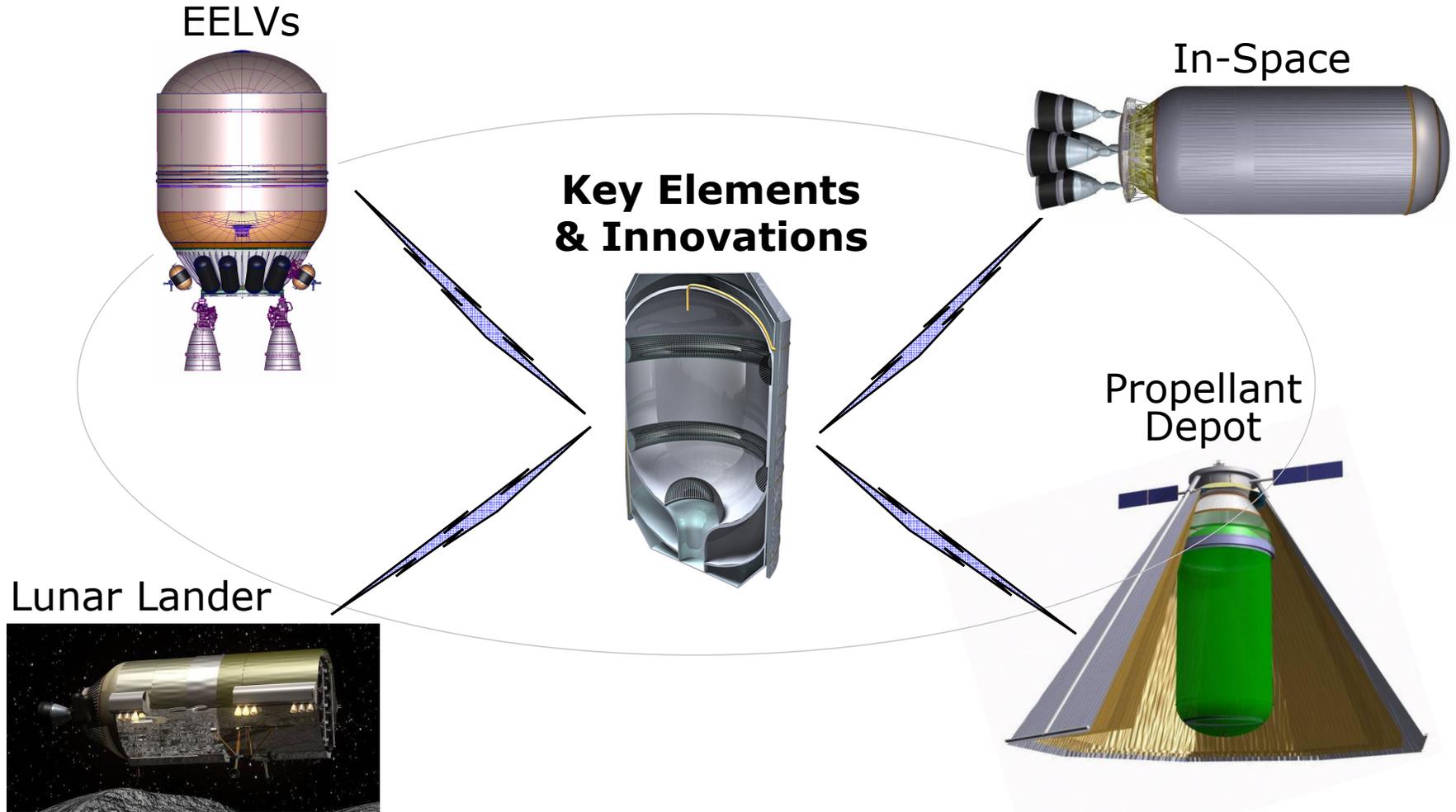
MLI &  
Sun Shield

Enhanced IB  
Insulation

Internal  
Sump

***Supporting Enhanced Mission Requirements***

# Advanced Common Evolved Stage Extensibility



***Providing Efficient High-Energy Propulsion Core***



# Ride Share Opportunities Upper Stage Extensibility

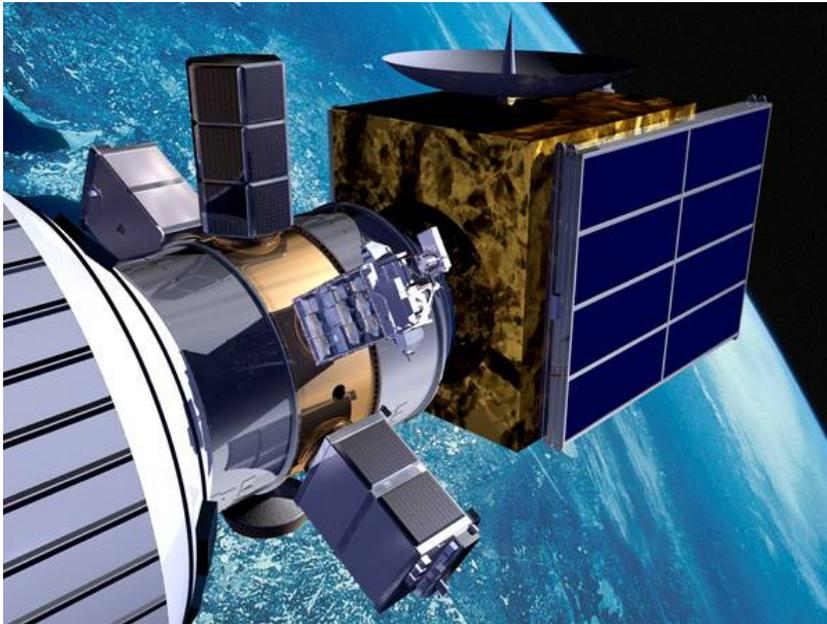


Image courtesy of STP Program Office

**Upper Stage Framework  
Provides Innovations in  
Accommodating a Variety  
of Rideshare & Science  
Missions**

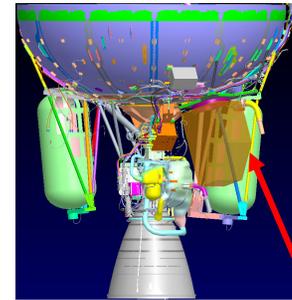


Image courtesy of Cal-Poly

**P-Pod**

Poly PicoSat Orbital  
Deployer

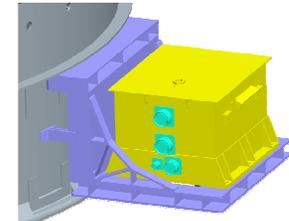
**10 kg**



**ABC**

Aft Bulkhead Carrier

**80 kg**



**CAP+**

C-Adapter Platform+

**100 kg**

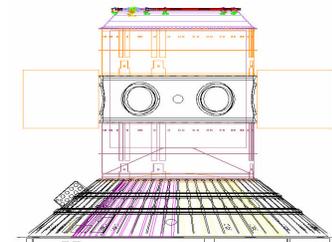


Image courtesy of STP Program Office

**ESPA**

EELV Secondary P/L Adapter

**200 kg/ea**



**IPC**

Integrated Payload Carrier

**500+kg**



# Summary

- ❑ Atlas V & Delta IV Upper Stages Evolved from Over 100 Years & 1,300 Launches Combined to Achieve the Reliability & Agility Necessary to Serve Today's Broad Launch Needs
- ❑ Active Flight Learning Produces System Knowledge & Reliability for Evolution & Innovation
- ❑ Common System Elements Establish a Framework for Supplier & Industrial Base Health
- ❑ Tank Design Innovations Currently Underway Establish a Framework for Future Missions (Growth & Extensibility)
- ❑ Future Mission Models Benefit from Early Fielding on Current Vehicles & Evolutionary Approaches

***Strong Systems Engineering Heritage of Disciplined Evolution Provides Capability & Reliability Necessary to Meet Tomorrow's Space Goals***