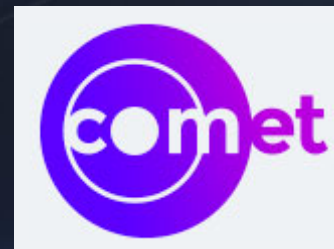


# VECTOR

//////////////////////////////////// REVOLUTIONARY SPACE ACCESS //////////////////////////////////////

## Low Cost Launcher Services & Their Impact



VECTOR LAUNCH FOR PUBLIC DISTRIBUTION

# Who and What is Vector

## ▶ Vector's Mission

- ▶ Vector is on a mission to transform the space economy through an anywhere, anytime launch system and a space-grade cloud-computing platform, significantly lowering the barriers to entry for space.

## ▶ About Vector

- ▶ Vector is *the* space access company. Vector's unique remote/mobile launch platform/technology (TEL) gives complete launch site freedom to its customers with the aim of disrupting the status quo of launch frequency from fewer than 20 launches per year to hundreds. In addition, Vector's patented software-defined satellite technology enables innovators to easily and effectively deploy their space application technology in space.



WHO IS VECTOR

## Vector Management Team



**Jim Cantrell**  
Co-Founder and CEO



**John Garvey**  
Co-Founder and President,  
Launch Services



**Dr. Eric Besnard**  
Co-Founder and CTO



**Shaun B. Coleman**  
Co-Founder, Chief Sales and Marketing  
Officer & SVP/GM GalacticSky



**Dr. Darren Garber**  
Vice President of Satellite Systems & Chief  
Scientist



**Robert R. Cleave**  
Chief Revenue Officer



WHO IS VECTOR

## Key Investors

SEQUOIA 

 Lightspeed



Kodem  
Growth  
Partners

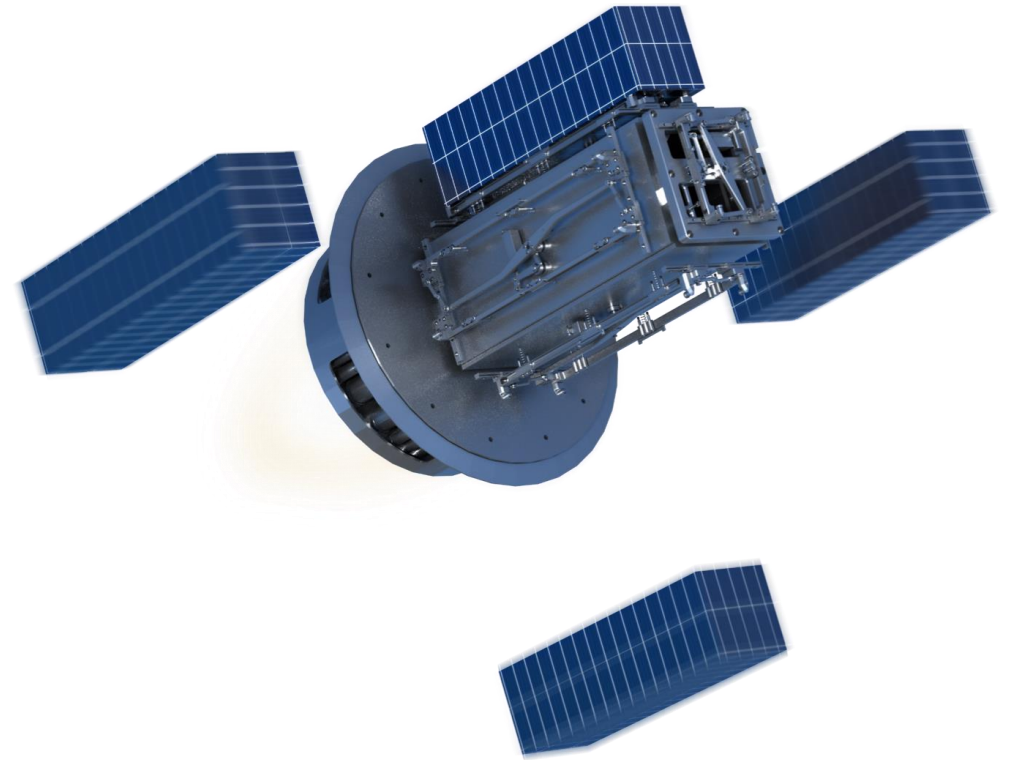
Morgan Stanley

  
SPACE ANGELS



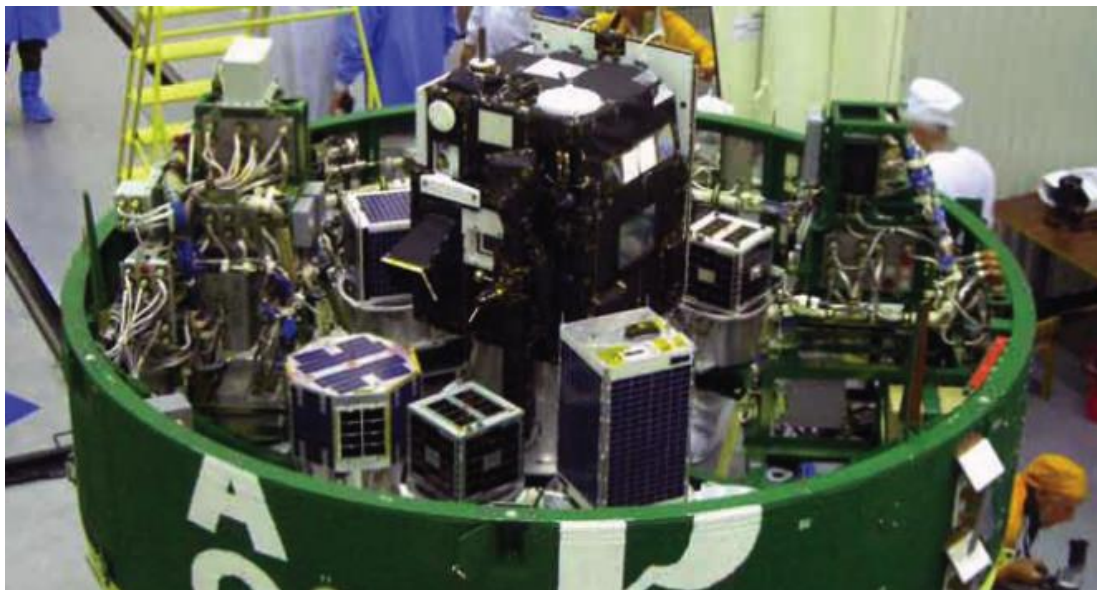
# What Will Vector Provide

- ▶ **On demand launch services**
  - ▶ Dedicated launches to desired orbit and inclination
- ▶ **Revenue and mission-certainty**
  - ▶ Launch when you want, to where you want
- ▶ **Value delivery**
  - ▶ Service-focused team to ensure on time satellite delivery
  - ▶ Launch site flexibility to minimize logistics
- ▶ **Start-up program mentoring to reduce space procurement complexities**
  - ▶ US company that supports FCC & FAA requirements
- ▶ **Low cost dedicated service**
  - ▶ Value price point to meet customers financial objectives



# Today's Ride Share Environment

## Payload congestion



### GeekWire

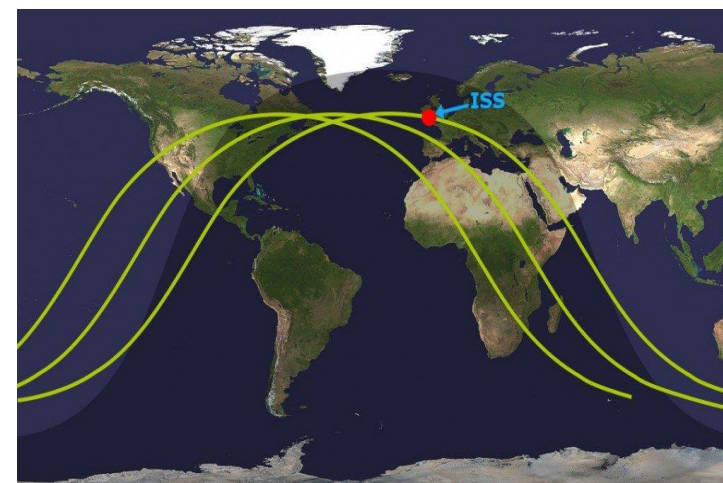
Citing schedule slips, Spaceflight rebooks 89 satellites on SpaceX's launch list

### SPACE NEWS

Soyuz satellites feared lost in launch failure

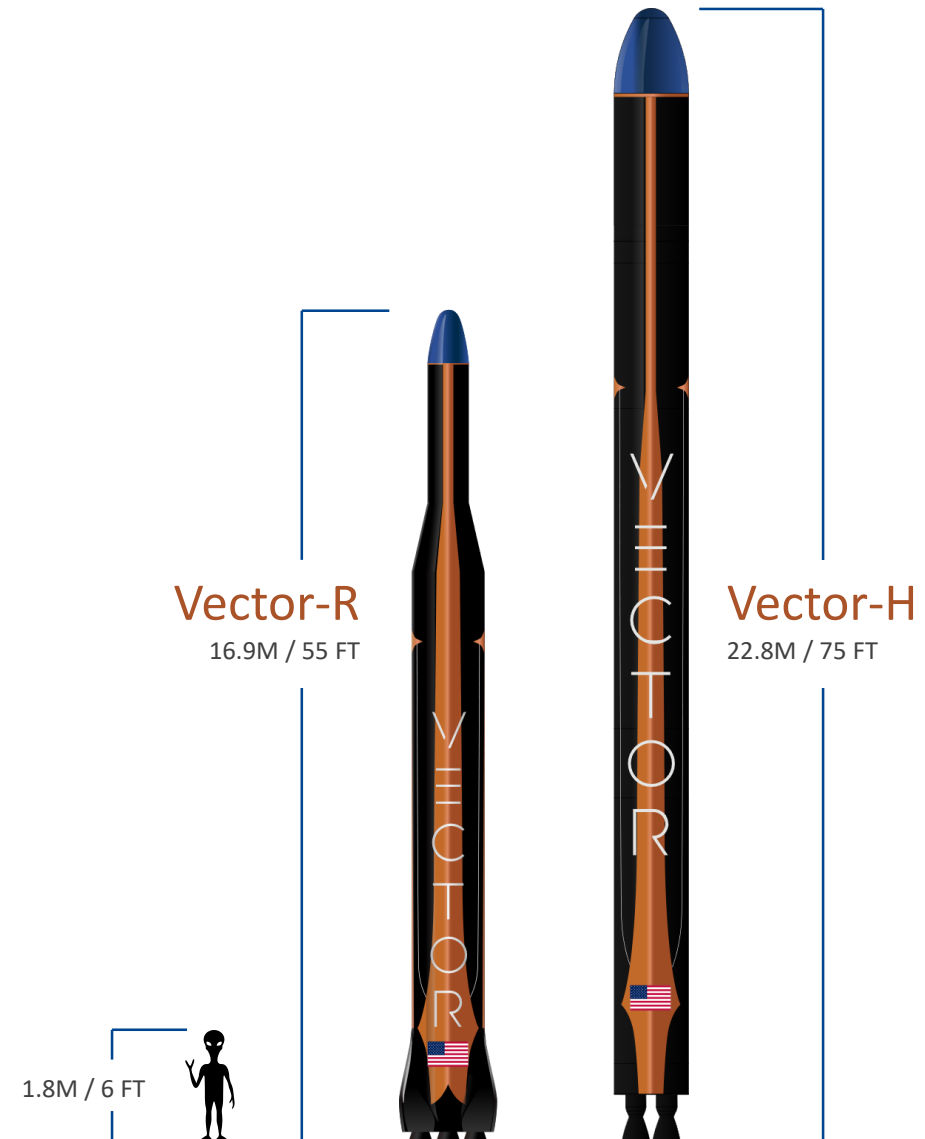
by Jeff Foust — November 29, 2017

## Orbital Congestion



## Cost Effective Approach

- ▶ **Strong heritage**
  - ▶ Baseline design includes over 20 suborbital launches (Garvey Space)
- ▶ **Pyrotechnic-free & pressure vessel free**
  - ▶ Eliminates shock environment and safety risk
- ▶ **High availability**
  - ▶ Robust automotive-like production line methodology that builds reliable vehicles at rate



## Cost Effective Approach (Continued)

- ▶ **Production simplicity**
  - ▶ Parts count approximately  $\frac{1}{4}$  of current rockets on the market

**Cell phone**



**300 parts**

**Vector-R**



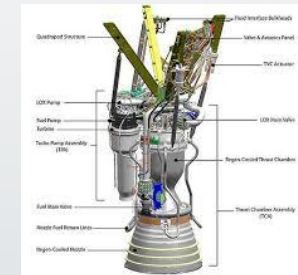
**900 parts**

**Automobile**



**1,800 parts**

**F9 Merlin**

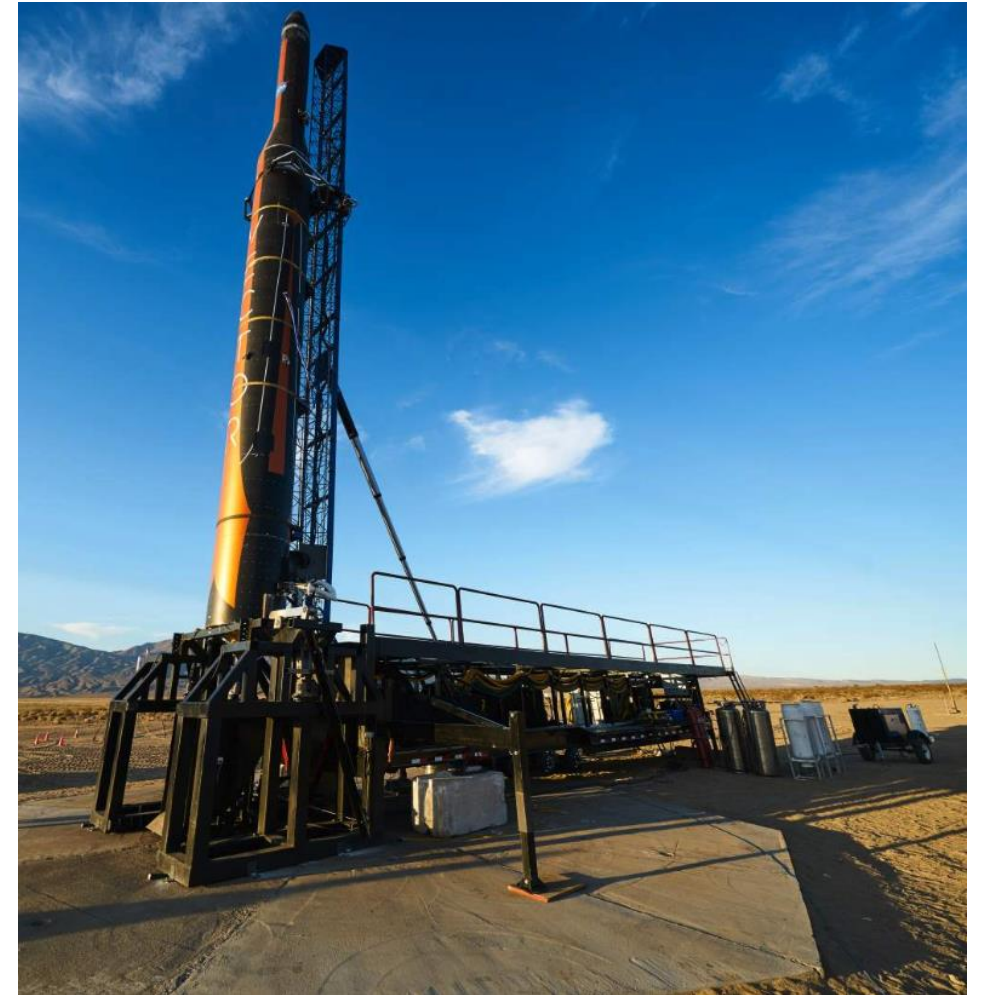


**2,100 parts**



## Cost Effective Approach (Continued)

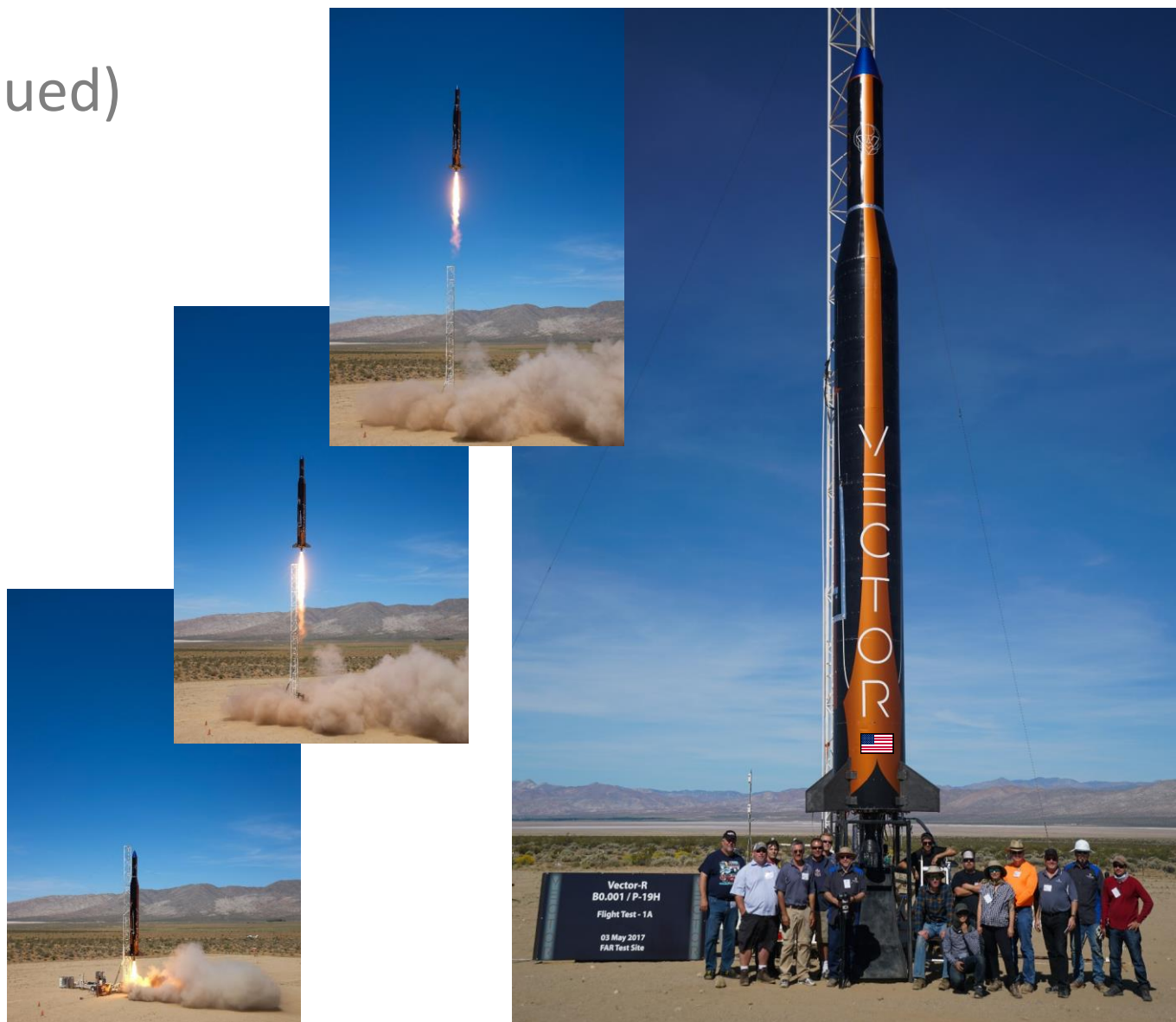
- ▶ **Demonstrated simplified ground operations**
- ▶ **Transporter-Erector-Launcher (TEL) for simplified operations**
  - ▶ Launch site flexibility
  - ▶ Minimal infrastructure investment
  - ▶ Single Mission Ops Center (MOC)
- ▶ **2-stage launch vehicle (3 engine configuration on 1st stage)**
  - ▶ LOX/propylene propellants
  - ▶ Densified / chilled propylene provides higher Isp
  - ▶ Soft cryogenic propellants are environmentally benign



## KEY SYSTEM FEATURES

## Cost Effective Approach (Continued)

- ▶ Two sub orbital launches as Vector
- ▶ Block 0 development flights 2017
- ▶ Vehicle qualification tests 2019
- ▶ Block 1 orbital flight 2019



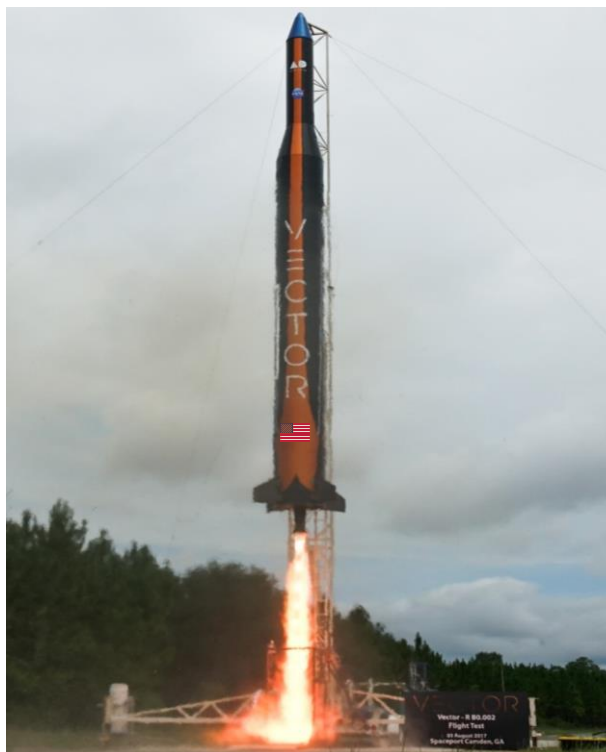


# Vector Milestones- Launches and Continued Test Operations

**First Sub-orbital Test**  
May 2017



**Second Sub-orbital Test August 2017**



**Ongoing Engine tests in Arizona**



## Vector Milestones- Pathfinder Operations Streamline Systems

**Vandenberg Airforce Base, SLC-8**  
(Nov 2017)

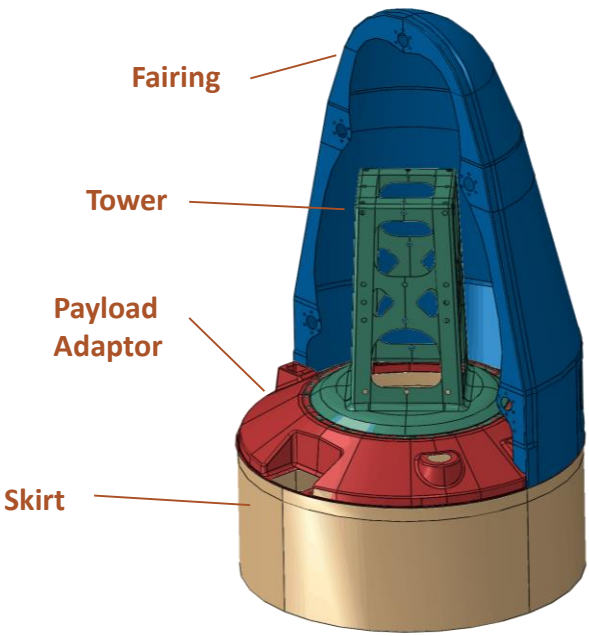


**Transporter-Erector-Launcher (TEL)**  
**@ Kodiak after delivery**  
(July 2018)

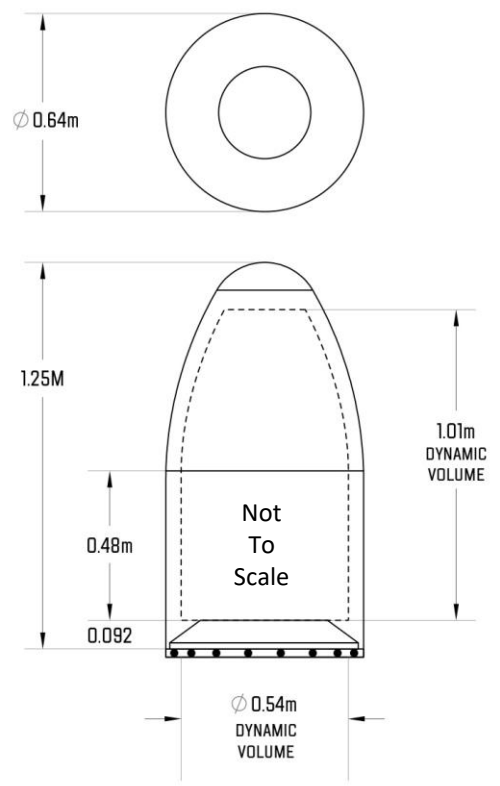




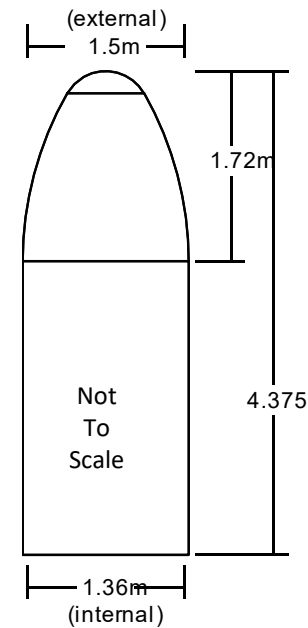
# Payload Adapter and Fairing



## Vector-R Payload Volume

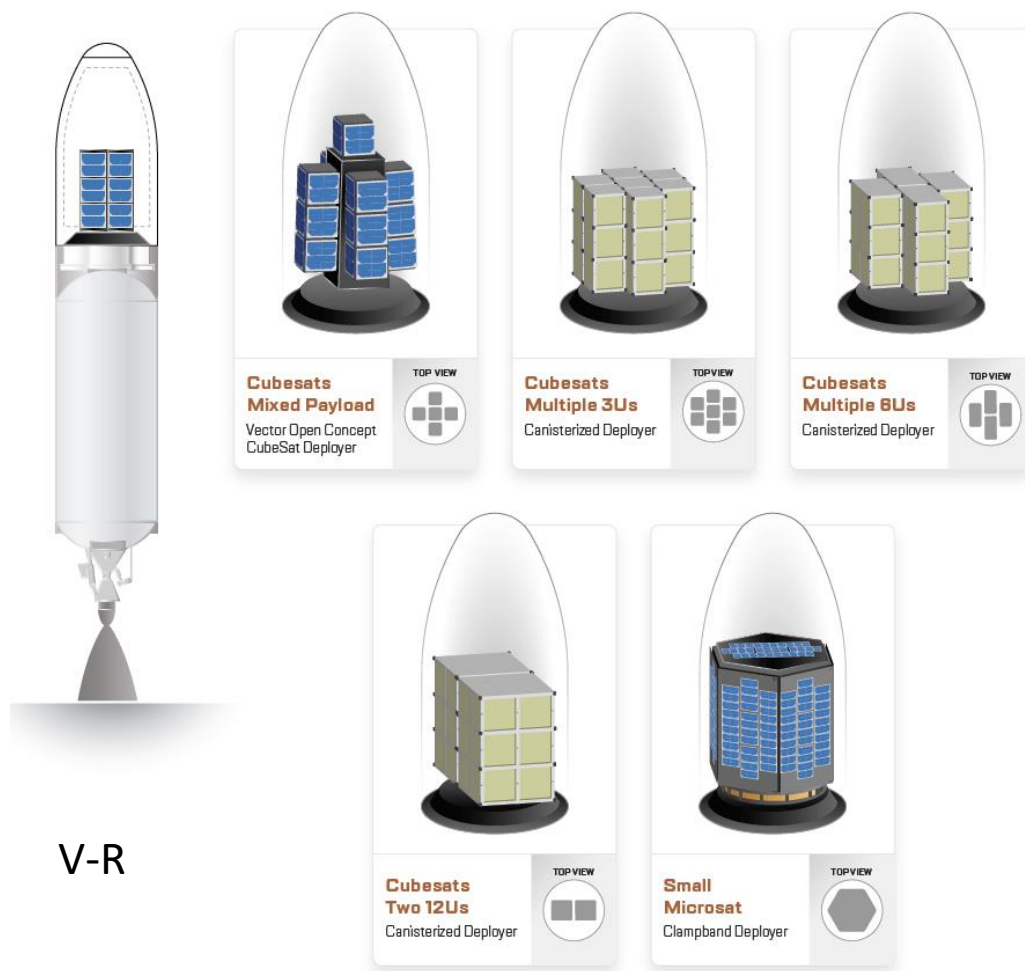


## Vector-H Payload Volume

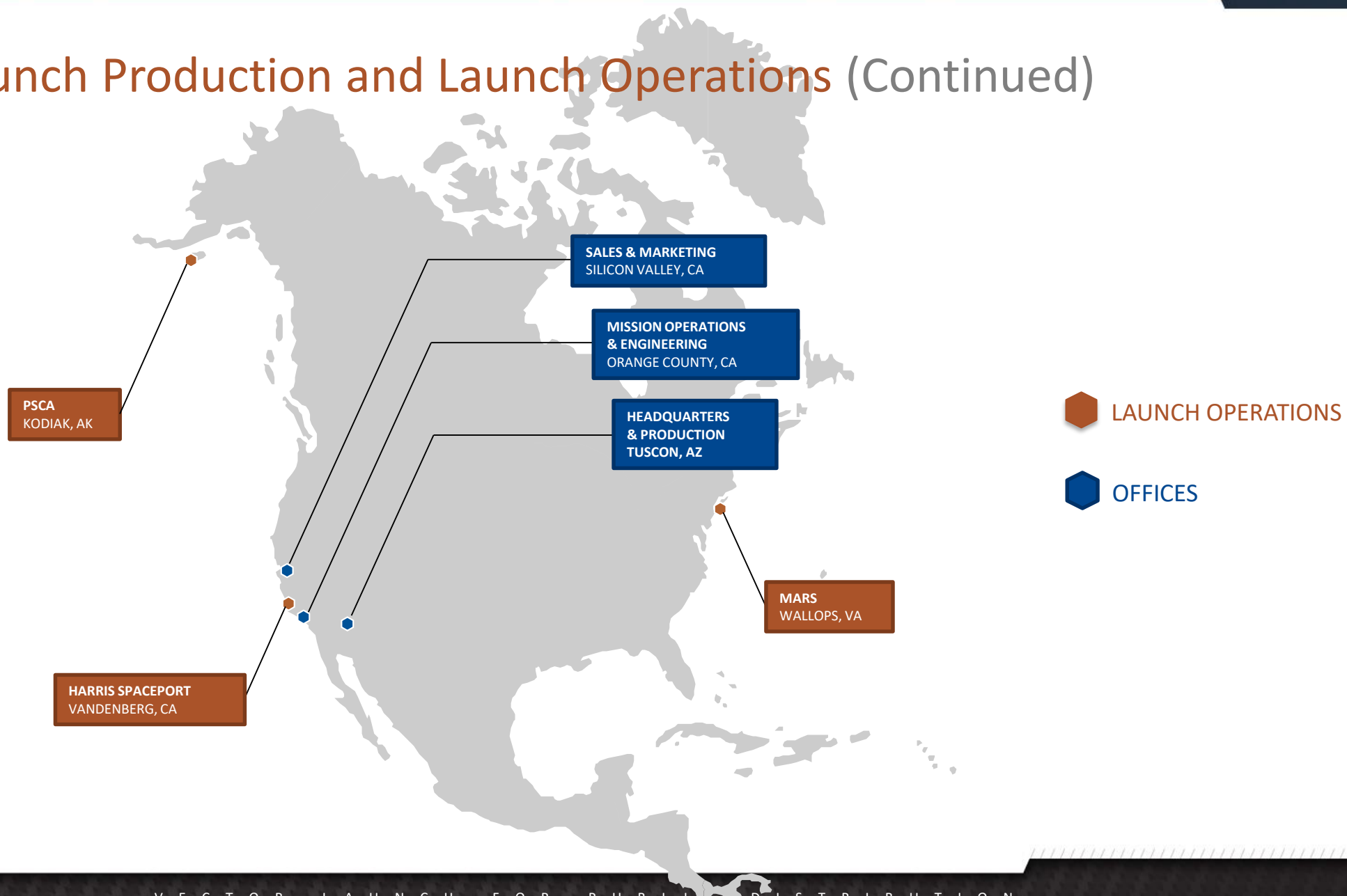


## PAYLOAD CONFIGURATIONS

## Payload Configurations – Vector-R and Vector-H



# Vector Launch Production and Launch Operations (Continued)

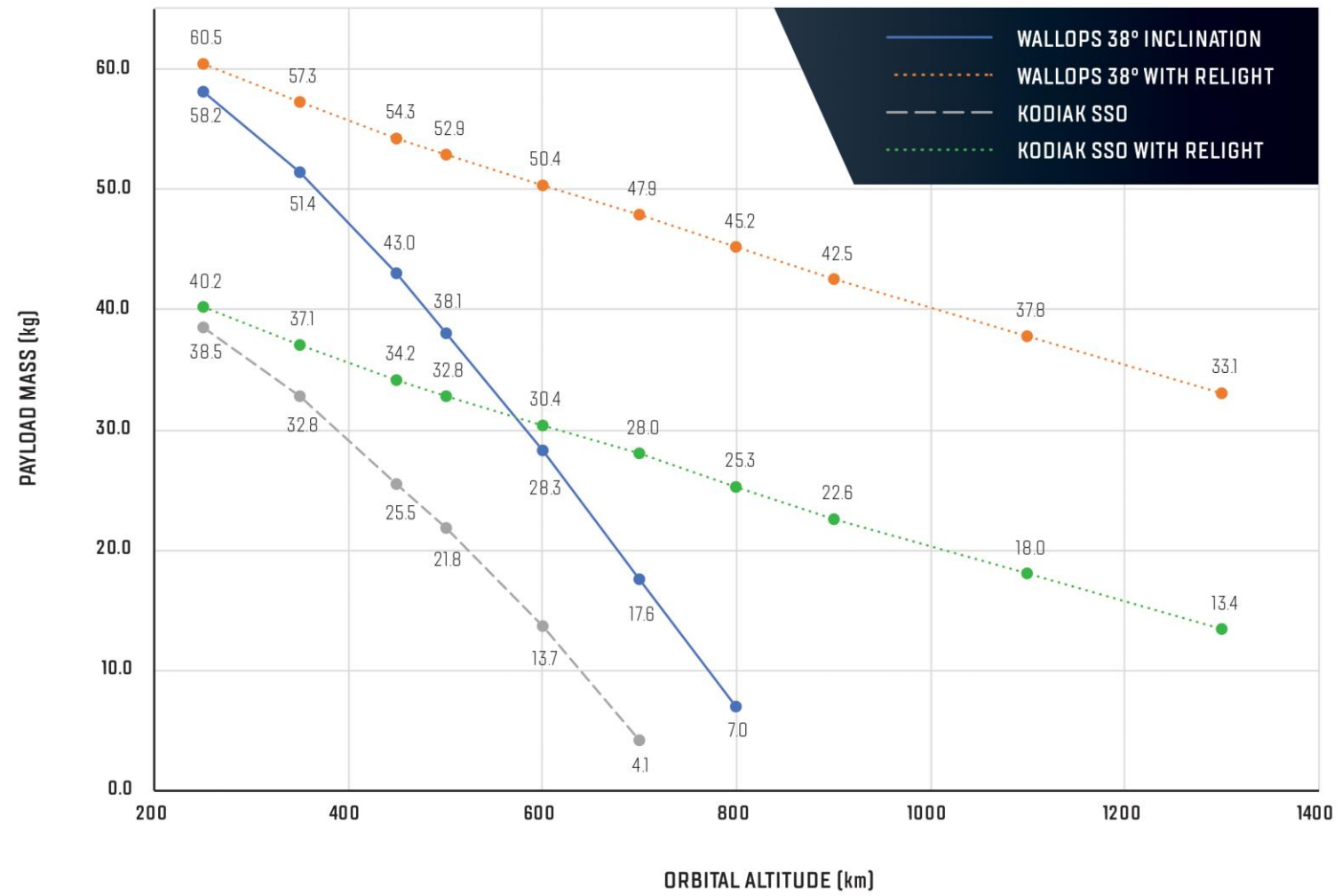


# Vector Launch Production and Launch Operations (Continued)

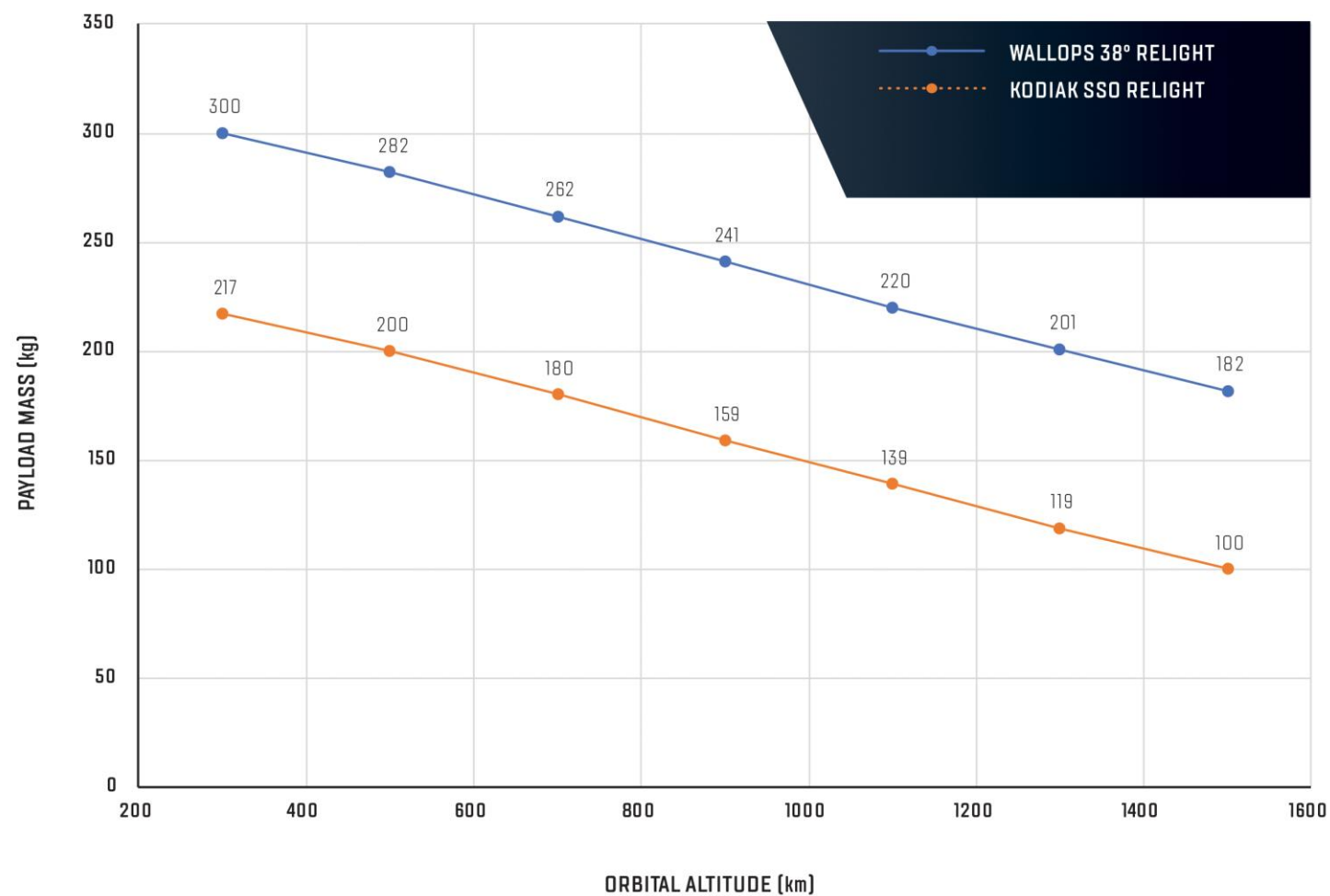




# Vector R Performance Data



## Vector H Performance Data



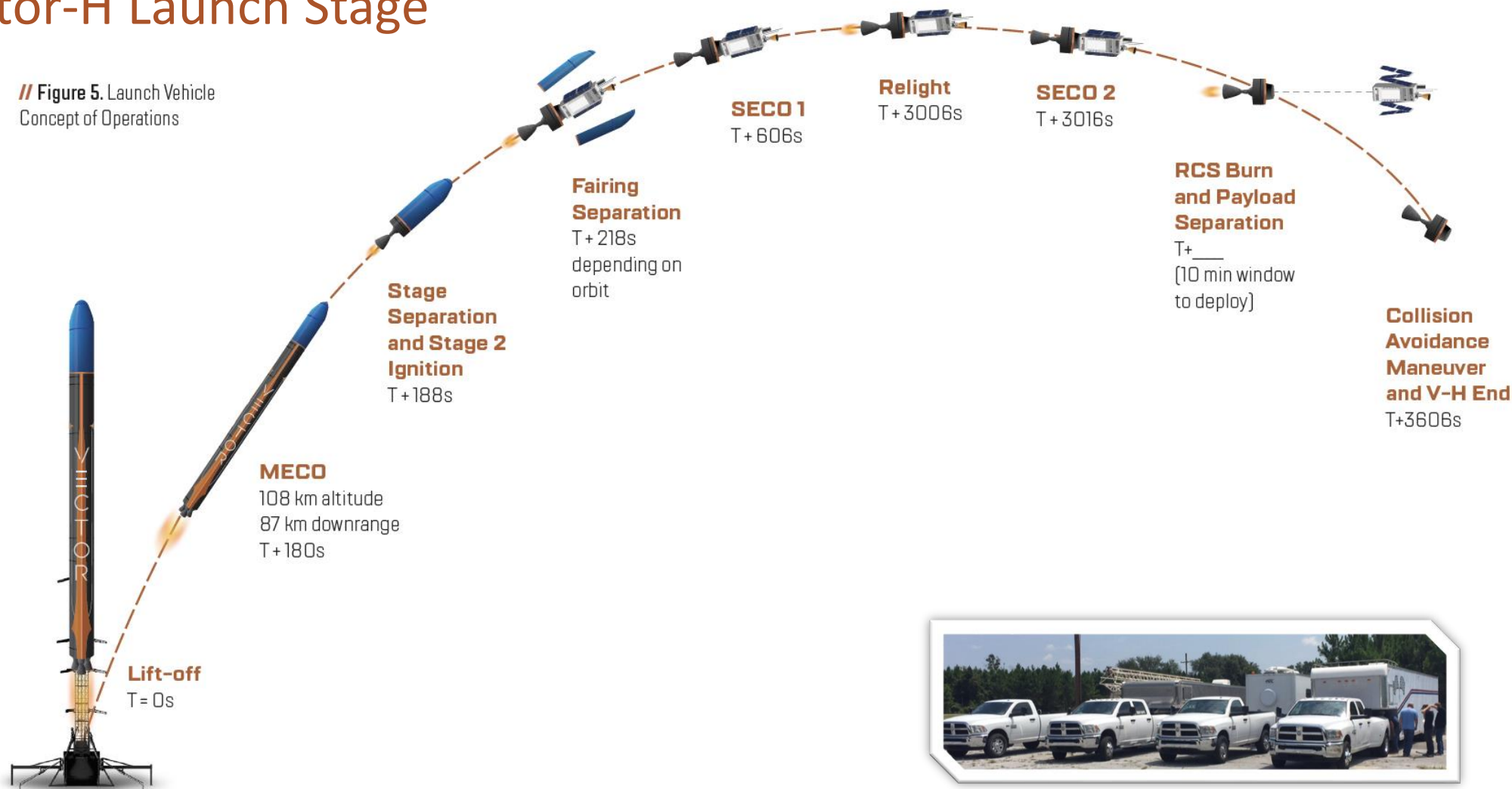
PAYLOAD CONFIGURATION DETAILS

# Payload CONOPS and Launch Stage



# Vector-H Launch Stage

// Figure 5. Launch Vehicle  
Concept of Operations





# Software-Defined Satellites



## The Current State of Space (Comm)

- ▶ Satellites are built with limited flexibility
- ▶ Hardware is still handcrafted using multiple standards
- ▶ Flight software and mission software custom coded
- ▶ Majority of all processing is done on the ground
- ▶ Limited ability to adapt to competing customer requirements



# GALACTICKY

GalacticSky™ offers the next generation of satellite technology adding a smart cloud-computing layer to satellites, creating a truly software-defined satellite. GalacticSky-enabled satellites can dynamically change missions, thus providing the most relevant capability to users — saving time, bandwidth, and money.

## “Beyond the Cloud” Computing with GalacticSky





# “Beyond the Cloud” Computing with GalacticSky



## Faster, More Actionable Data

Save time and resources with on-orbit processing – sending only the most relevant data to the ground



## On-orbit Mission and Operational Modifications

Dynamically add or change the satellite's mission - extending its useful life and increasing revenue potential



## Flexible, Reliable and Secure

Self-healing state monitoring and recovery across satellites provides protection for your valuable assets



## Realize the Potential of Space

Enables space entrepreneurs to focus on their business without having to be a space expert



## Improve Operational Efficiency and Flexibility

Smart, automated infrastructure provides scalability on a single satellite or across multiple satellites



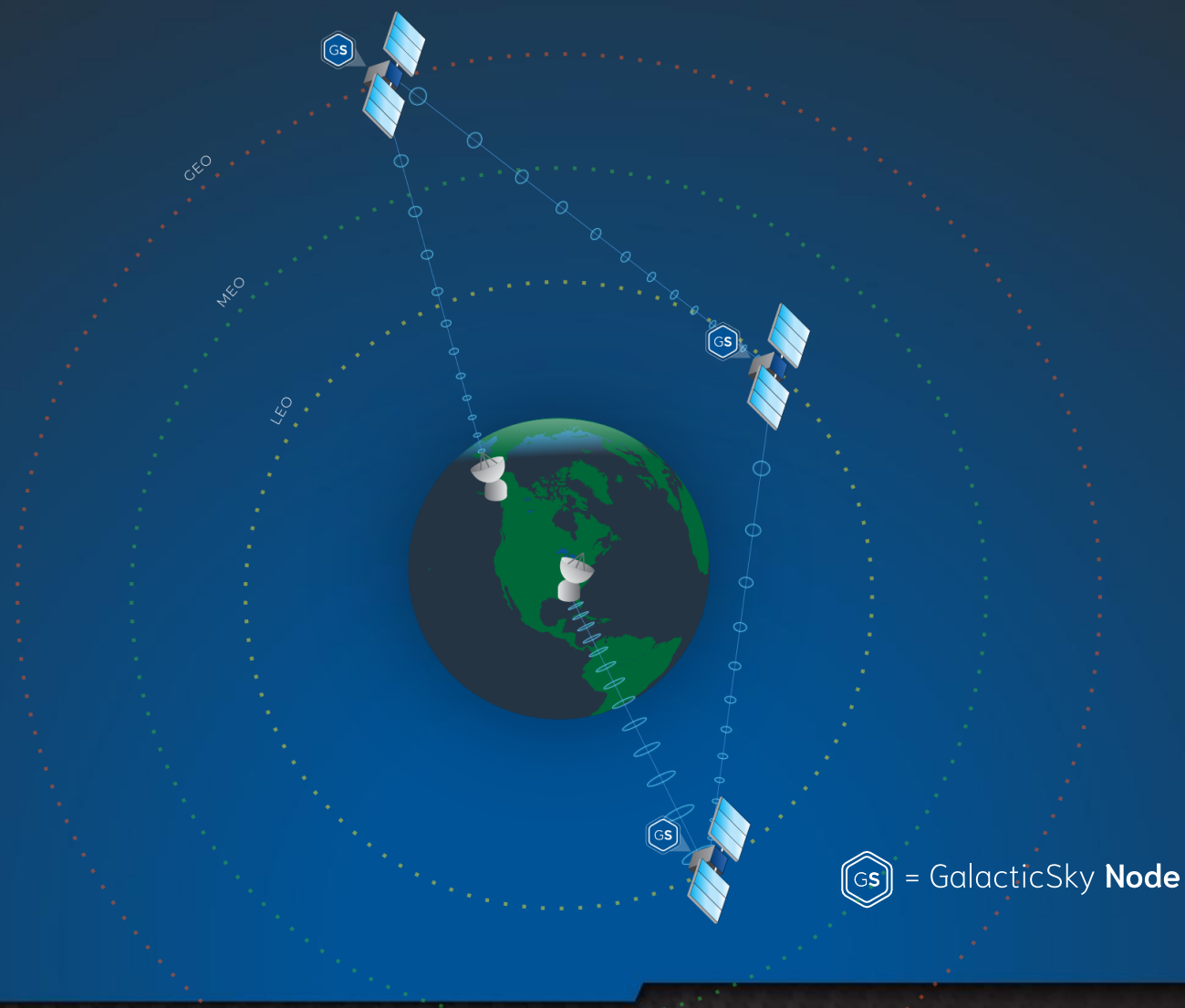
## Common Infrastructure

Integrated solution between LEO to GEO and air to space

# New Market Opportunity- Internet of Things everywhere on Earth

- ▶ Reduce latency by factor of five thru data transfer to LEO's
- ▶ Increase data transfer rates and volume by factor of ten
- ▶ Use GEO-LEO connections to obtain global reach (GEO = WAN; LEO = LAN)
- ▶ GEO>LEO>GROUND>GEO
- ▶ GROUND>GEO>LEO>LEO>GROUND
- ▶ GROUND>LEO>LEO>GEO>GROUND
- ▶ LEO>GEO>GROUND>LEO
- ▶ Provide Internet of Things Connectivity, leveraging existing technology

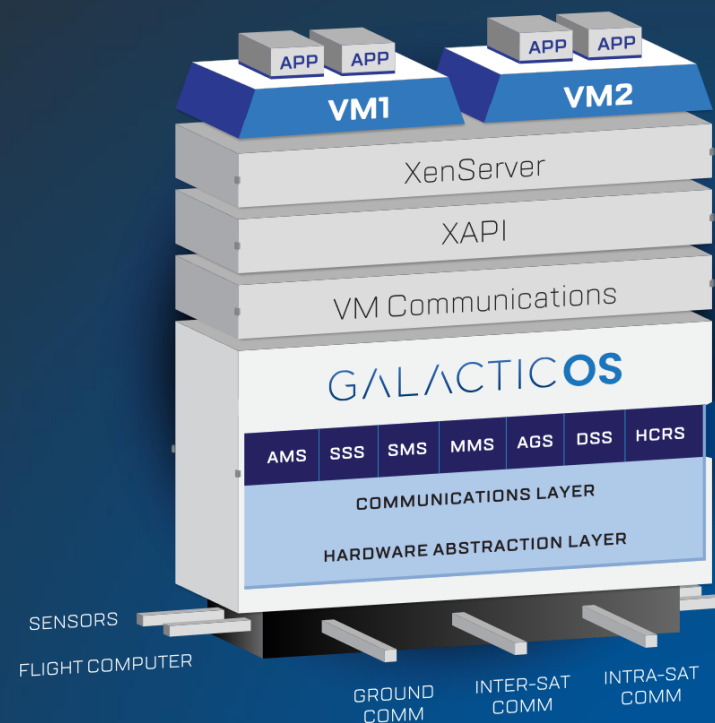
## GALACTICSKY



# Cloud in the Satellite

## ► Dynamically:

- Add new applications from ground to satellite
  - Comprehensive infrastructure as a service analytic platform
  - Secure multi-tenancy embraces multiple customers
  - IOT processing and connectivity
  - Cybersecurity in space
  - Event/Log management
  - Smart learning/machine learning algorithm
- Enhance existing applications, components, bus
- Add new applications from ground to satellite



## GALACTICKOS

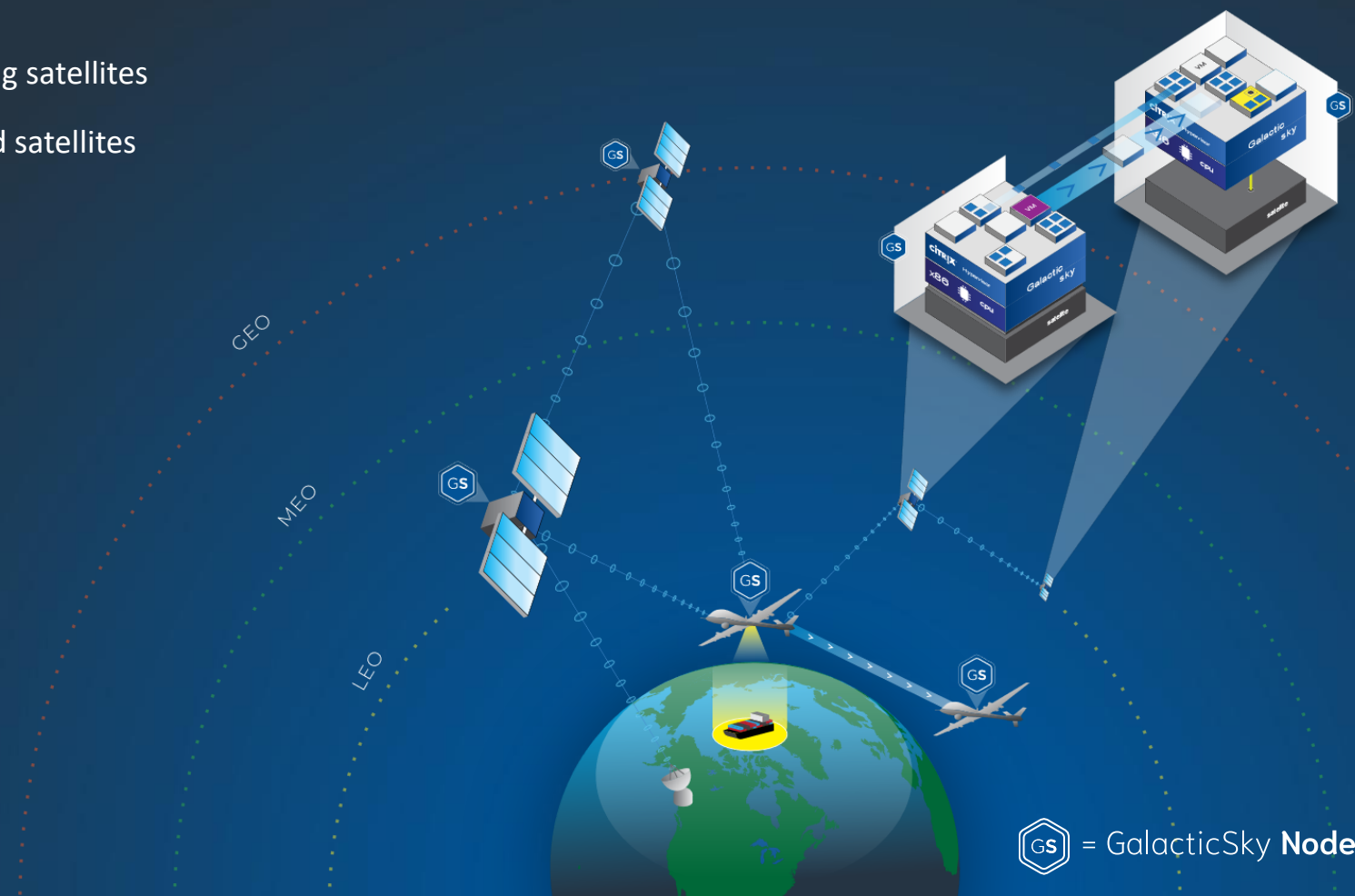
### Services Layer

- AMS Application Management Service
- SSS System Scheduling Service
- SMS State Manager Service
- MMS Metric Monitoring Service
- AGS Alert Generation Service
- DSS Data Streaming Service
- HCRS Hyper-converged Resource Service

# Software-defined Satellite

- ▶ Dynamic, real time communication between/among satellites
- ▶ Seamless transition from cloud to software-defined satellites
- ▶ Includes software-defined networks
- ▶ Software-defined storage
- ▶ Compute virtualization (VM/Container technology)
- ▶ Software-defined micro-services

## GALACTICSKY



GS = GalacticSky Node



Thank You