



# Marshall Space Flight Center

## MSFC's Role and Vision for Small Launch Vehicles

### 17<sup>th</sup> Space and Missile Defense Symposium

#### August 12, 2014

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**marshall**

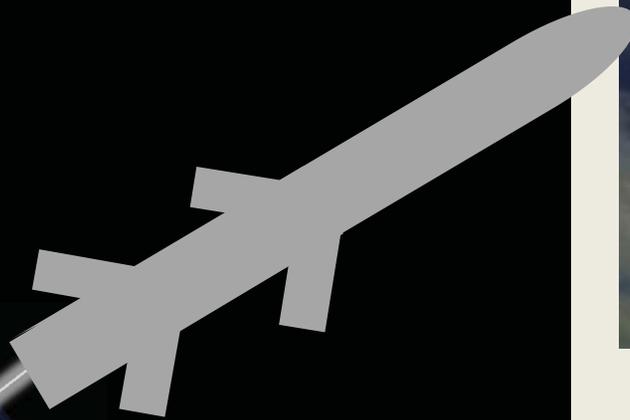
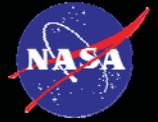


# NLP

NanoLaunch Project

## Goals and Objectives

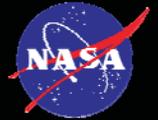
National Aeronautics and  
Space Administration



2014 Nanolaunch Flight Test







## Balancing Risk and Innovation Through Training and Collaboration

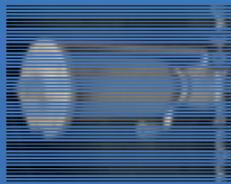
### Low Cost Solid Rocket Motors



### Innovative Hybrid Approaches



### "Printed" Liquid Engines



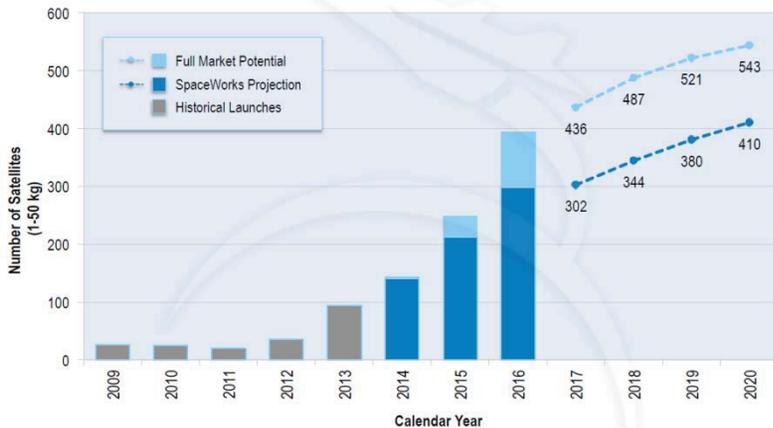
### Novell Components and COTS Utilization





### Nano/Microsatellite Launch History and Projection (1 - 50 kg)

Projections based on announced and future plans of developers and programs indicate between 2,000 and 2,750 nano/microsatellites will require a launch from 2014 through 2020



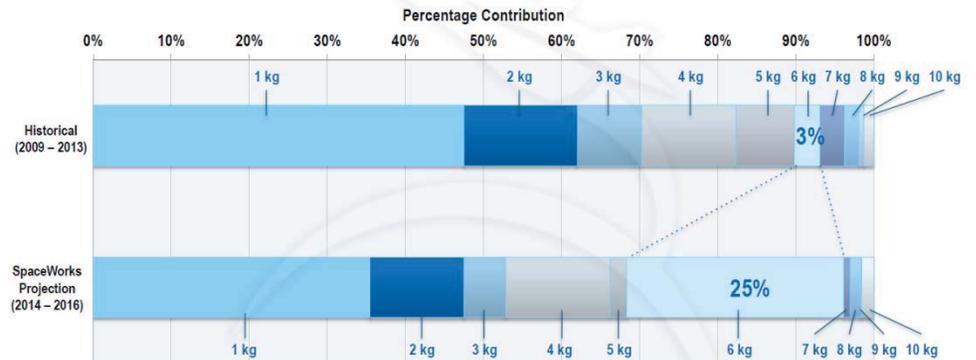
The Full Market Potential dataset is a combination of publically announced launch intentions, market research, and qualitative/quantitative assessments to account for future activities and programs. The SpaceWorks Projection dataset reflects SpaceWorks' expert value judgment on the likely market outcome.

Please see End Notes 1, 2, 4, 5, and 6.

**Significant growth in both the quantity and quality of cubesat missions.**

### Nanosatellite Size Trends (1 - 10 kg)

1U (1 kg) CubeSats, while still immensely popular, will comprise less of the market in the future (35% of future nanosatellites compared to 47% from 2009 to 2013)



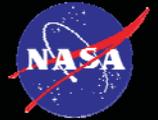
25% of future nanosatellites (1-10 kg) are in the increasingly popular 6 kg mass class (compared to only 3% from 2009 to 2013)

\* Please see End Notes 2, 6, 7, and 9.

Picture from the surface of the earth with optics that will fit within a 3U cubesat.  
Ved Chirayath, Stanford University



Figure 9 – Lunar detail (Copernicus Crater. 93 km diameter)



Best solution is “out there,”  
so fly early and often:

- Initial orbital capability: MSFC developed stages atop sounding rocket - 5 kg to ~200 km circular
- Validate candidate technologies with affordable sub-orbital flights
- Plan and pursue eventual stage upgrades enabling affordable orbital capability

“Co-opetition” and maturing  
technology spinoff

- Off-the-shelf Avionics: Ames CNAT vs. MSFC vs. KSC vs. ?
- Each development step contains technologies for a launch services provider to exploit

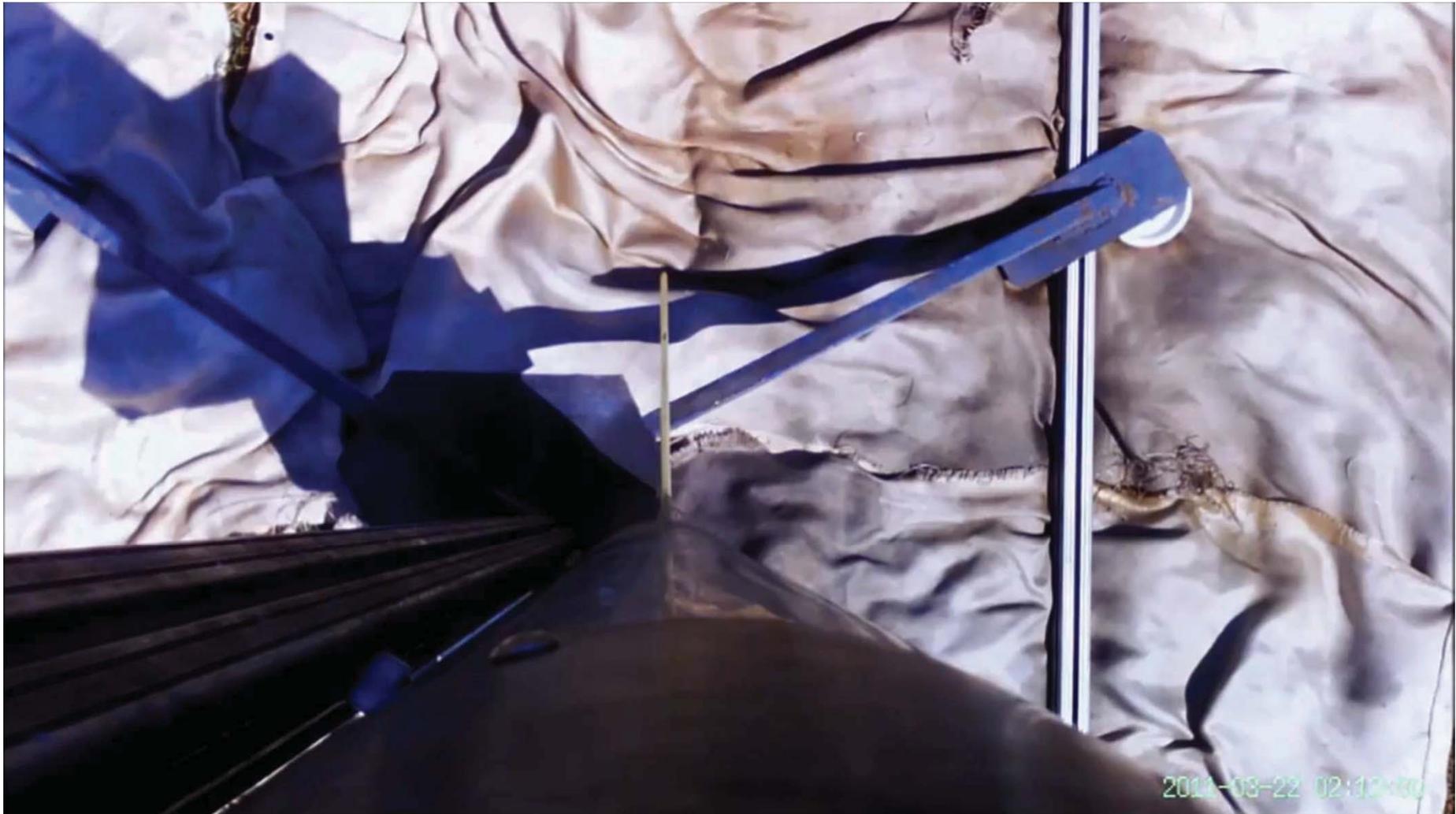
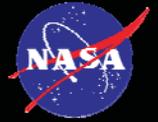


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## Flight Test

National Aeronautics and  
Space Administration

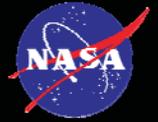


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# Schedule

National Aeronautics and  
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FY14

FY15

FY16

Orbital Capability



NL2A:  
Feb '15



25,000ft  
*Component test*

50,000ft  
*Subsystem test*

Sub-Orbital

Orbital

