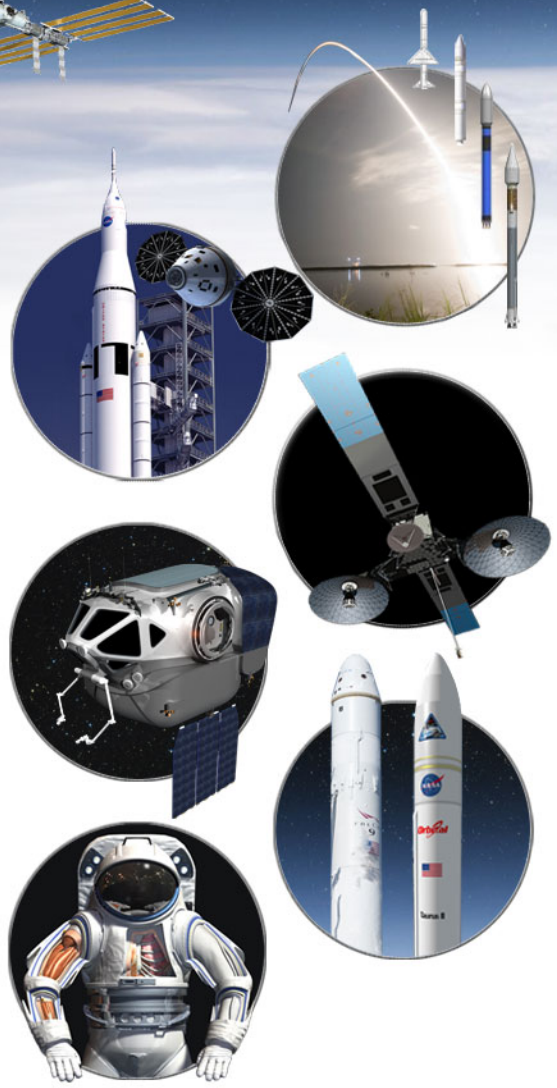
National Aeronautics and Space Administration



Launch Update for the NRC Space Studies Board

6 March 2013

Jim Norman
Director, Launch Services
Human Exploration & Operations
Mission Directorate / NASA HQ

Launch Services Program -- FY12 & FY13 Launch Highlights

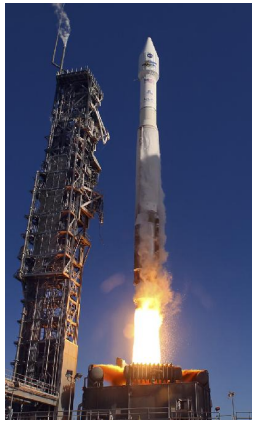
October 28, 2011

November 26, 2011

June 13, 2012

August 30, 2012

January 30, 2013



February 11, 2013

Next Launch

June 23, 2013
(protecting for May 18, 2013)
Pegasus XL, VAFB, CA

Launch Services Program – Recent Programmatic Activity

- **FY 2012**
  - Oct 2011 Signed New Entrant Launch Vehicle Certification Strategy
  - "On-Ramped" Falcon 9 v1.1 May 2012 and Antares 12X & 13X Jun 2012
  - Awarded 2 Intermediate & 4 Medium-class LSTOs
- **FY 2013**
  - February 22, 2013 awarded medium-class LSTO for *Ice, Cloud, and land Elevation Satellite-2* (**ICESat-2**) mission to ULA for a Delta II 7420 Launch Service for $96.7M
  - Proposals under evaluation for intermediate-class launch service for *Origins Spectral Interpretation Resource Identification Security-Regolith Explorer* (**OSIRIS-REx**) mission
  - 3 Draft Requests for Launch Service proposals have been released to NLS II providers asking for information and/or comments for the following missions:
    - Small-class *Cyclone Global Navigation Satellite System* (**CYGNSS**) mission
    - Intermediate-class *Solar Orbiter Collaboration* (**SOC**) mission
    - Intermediate-class *Interior Exploration Using Seismic Investigations, Geodesy, and Heat Transport* (**InSight**) mission

NASA Launch Services Manifest

FPB Approved 10/23/2012 Release 1/1/2013	FY13				FY14				FY15				FY16				FY17				FY18				FY19			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Small Class Athena Ic Falcon 1 / 1e Pegasus XL (P-XL) Taurus XL (T-XL)			IRIS (P-XL) 4/28/13																									
Medium Class Antares Athena IIc Delta (D) II 73XX / 79XX Falcon 9v1.0 (F9v1.0)							OCO-2 (DII-7320) 7/1/14		SMAP (DII-7320) 10/31/14		JASON-3 (F9v1.0) 3/1/15						JPSS-1 (DII-7920) 11/15/16											
Intermediate / Heavy Class Atlas V (AV) 4XX / 5XX Falcon 9v1.1 (F9v1.1)		TDRS-K (AV-401) 1/29/13	LDCM (AV-401) 2/11/13		MAVEN (AV-401) 11/18/13		TDRS-L (AV-401) 1/2014		MMS (AV-421) 10/15/14				GOES-R (AV-541) 10/2015					GOES-S (AV-541) 2/2017										
LSP ADVISORY ROLE	SpX-1 (F9) 10/7/12	Orb-2 (A) 8/6/13 (UR)	SpX-2 (F9) 3/1/13	Orb-1 (A) 4/8/13 (UR)	SpX-3 (F9) 10/15/13	LADEE (Minotaur) 8/12/13	GPM Core (H-IIA) 2/2014		EFT-1 (DIV-H) 9/2014										GRACE FO 8/2017				JWST (Ariane) 10/2018					
NASA COTS (Info only) (Managed by JSC)		Demo C-1 (A) 12/20/12																										
Vehicle Unassigned													InSight 3/2016	ICESat-2 7/2016	OSIRIS-REx 9/2016		Solar Orbiter CY 2017					Solar Probe Plus 7/2018					

For NASA Planning Purposes Only

* * * *

△ = SCIENCE

□ = HUMAN EXPLORATION AND OPERATIONS

◇ = DOD REIMBURSABLE

C = CubeSat

K = KWAJALEIN

V = Vandenberg Air Force Base

W = Wallops

* = MISSION UNSUCCESSFUL

UR = UNDER REVIEW

* * * *

NASA Launch Services (NLS) II Contract Fleet

Certified

Vehicles On NLS II Contract

Pegasus XL

Taurus XL

Delta II
VAFB only

Atlas V
4xx, 5xx

Not Yet Certified

Vehicles On NLS II Contract

Falcon 1
1, 1E

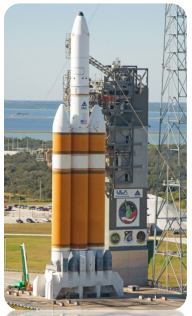
Falcon 9
v1.0, v 1.1

Athena Ic

Athena IIc

Antares
12x, 13x

Potential/Emerging Vehicles



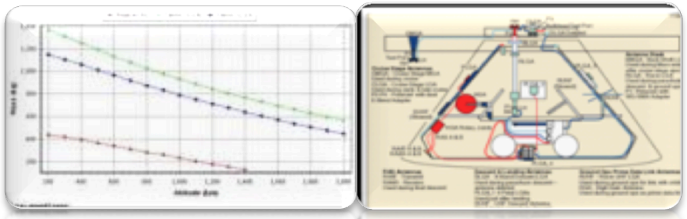
Delta IV
4m, 5m, H

- Athena III
- Falcon Heavy
- Stratolauncher
- Virgin Galactic Launcher One
- Other

Launch Services Program Overview

Acquire launch services

Verify and validate mission engineering and analysis



Insight and approval of production, integration, testing and processing

Provide technical, operational, contractual, budget and business knowledge and expertise to future missions

Certify launch systems for NASA use

Establish strategic partnerships and make investments to satisfy Agency launch service needs

Manage launch vehicle to spacecraft integration

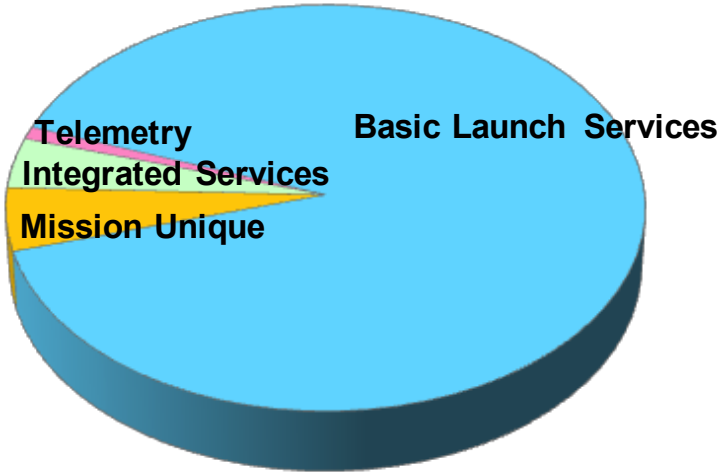
Who Pays for LSP Launch Services?

HEO Funds
Program Infrastructure, Fleet Related Work, Labor & Travel costs

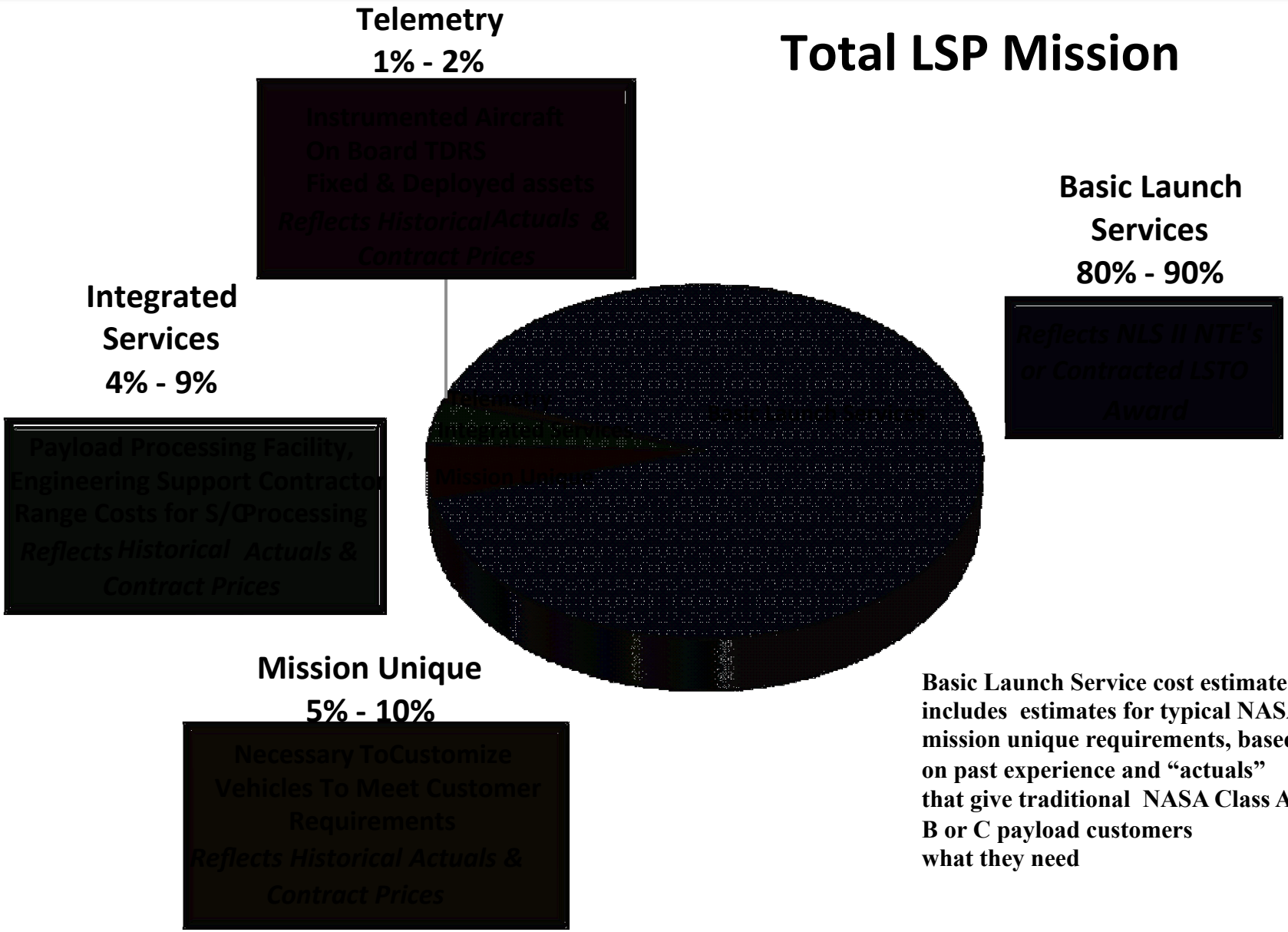
Stable Experienced Work Force

- *20 years avg. in LV industry for Civil Service*
  - *–Engineering & Program Mgmt functions*
  - *–Mission Management*
  - *–Mission Assurance*
  - *–Fleet technical issue resolution*
  - *–Launch Management*

Customer Funds
Launch Services



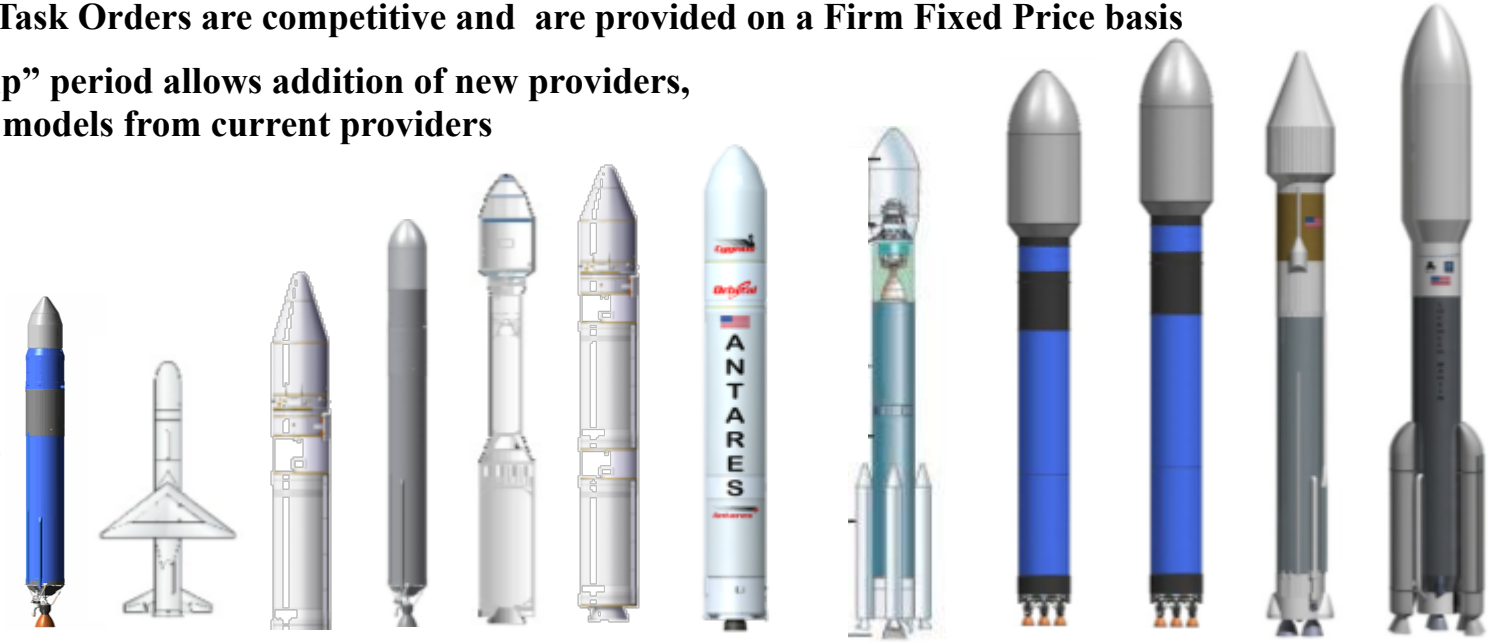
Customer Funded Mission Budget Elements



Basic Launch Service cost estimates includes estimates for typical NASA mission unique requirements, based on past experience and "actuals" that give traditional NASA Class A, B or C payload customers what they need

LVs & Providers on NLS II Contract

- **NLS II is an IDIQ contract with negotiated Not To Exceed (NTE) prices**
- **Launch Service Task Orders are competitive and are provided on a Firm Fixed Price basis**
- **Annual "on-ramp" period allows addition of new providers, or new vehicles or models from current providers**



Performance shown below rounded down to nearest 50kg in the Small class and nearest 100 kg in the Medium and Intermediate classes. For detailed performance data see http://elvperf.ksc.nasa.gov

Vehicle Class	Small					Medium				Intermediate		
Launch Vehicle	Falcon 1	Pegasus XL	Athena Ic	Falcon 1e	Taurus XL	Athena IIc	Antares 120/130	Delta II 7320/7920	Falcon 9 v1.0	Falcon 9 v1.1	Atlas V 401	Atlas V 551
Offeror	SpaceX	OSC	LMSSC	SpaceX	OSC	LMSSC	OSC	ULS	SpaceX	SpaceX	ULS	ULS
Perf @ 600 km Sun Synch	150kg	200kg	300kg	500kg	800kg	1100kg	1400/*2500kg	1500/2900kg	6400 kg	12200 kg	6600 kg	14200 kg
Perf @ C3 of 10	n/a	n/a	n/a	n/a	n/a	n/a	*600 / n/a	n/a	1300 kg	2600 kg	2400 kg	5000 kg
Certification Cat	n/a	Cat 3	n/a	n/a	Cat 2	n/a	n/a	Cat 3	n/a	n/a	Cat 3	Cat 3
Launch Sites	RTS	CCAFS WFF RTS VAFB	CCAFS KLC WFF	RTS	CCAFS WFF VAFB	CCAFS KLC	WFF	VAFB	CCAFS VAFB	CCAFS VAFB	CCAFS VAFB	CCAFS VAFB

*Antares 120 performance @ C3 of 10 is not available. Data shown is for Antares 122 performance @ C3 of 10 // Antares 130 performance to sun synch not available. Data shown is for Antares 131 performance to 600km sun synch. NOTE: Delta IV is not currently offered on NLS II

NASA ELV Cost Comparison

Total Mission Cost Comparison

1999-2010 (NLS I)

Small	$30M-$75M
Medium	$50M-$80M
Intermediate	$100M-$125M

*Based upon Actual Prices Awarded

-NLS I costs based on historical actuals

2010-2015 (NLS II)

Small	$32M -$114M
Medium	$102M -$136M
Intermediate	$117M -$334M

*Based upon contract Not-to-Exceed (NTE) prices

-NLS II costs are projected costs using contract NTEs
-Price varies depending on performance/orbit/order year

Recent NLS II Awards:

Intermediate-Class LSTO Awards:
-MAVEN (AV 401): $187M
-GOES R & S (AV 541): $446M*
(*Average price ~$223M)

Medium-Class LSTO Awards:
-SMAP (DII 7320), OCO-2(DII 7320), JPSS-1 (DII 7920): $412M*
-ICESat-2 (DII 7420): $96.7M*
(*Average DII price ~$127M)

-JASON-3 (F9 1.0): $82M

Comparison of "Internet Price" vs NLS II Contract

Full LSP Managed Launch Service Suitable for Class A, B & C payloads		Internet Price Commercial Launch Vehicle (May be appropriate for Class D missions)	
Basic launch service w/ items for typical NASA customers		**A basic launch vehicle suited to less complex spacecraft**	
	Payload adapter and separation system		**Not Included:** *"SpaceX can supply the payload adapter and separation system as a non-standard service."*
	Range, NASA style mission integration process, 3 analysis cycles, (LSP-led launch mission assurance instead of liability insurance)		*"Pricing includes range, standard payload integration and third party liability insurance… Standard prices assumes standard services (see User Guide) ."*
	Up to **33 month integration cycle** (priced options)		**24 month integration cycle**
	10 milestone payments (customization on request)		***"payment in full** within the noted calendar period"*
	Payload grace days		**Not included: No grace days**
	25% launch failure penalty		**Not included: No failure penalty**
Budget for mission unique modifications & analyses		**Not included**	
Downrange mission specific telemetry assets		**Not included**	
Payload Processing Facility & commodities		**Not included -- PPF for non-hazardous operations**	
LSP launch management & "GO" for launch		**Not included**	
97%+ Reliability	Implementation of NPD 8610.7, 23, & 24. Provisions for NASA non recurring certification, technical oversight and "GO" for launch	Limited or no core launch vehicle insight	
	LSP mission management services		
	LSP technical assessment and risk management		
	LSP expertise in negotiating & managing risk inherent with firm fixed launch service price contracts		

Key Messages

- **There is no LSP tax on launch services for NASA payloads**
  - HEOMD funds LSP labor and fleet work
  - Customer pays for costs directly attributed to their mission's launch service
- **LSP launch service budget estimates provided to missions include items traditionally required by the Agency and customer that are above and beyond what a typical commercial launch service price includes**
  - Even commercial prices for medium-class are well above $60M when rudimentary things like payload processing, vehicle modifications, payment milestones are included
- **Intermediate-class launch service costs have increased from NLS I to NLS II**
  - Atlas V price increases were due to market forces
  - AF "Block Buy" should stabilize Atlas V prices and may decrease them some, but key to intermediate-class price reduction will be competition
- **Medium-class launch service costs are either in-line with, or below "normal" escalation projection**
  - Competition currently exists and is key to maintaining favorable pricing
- **Small-class launch service situation is under review**

Summary

- **LSO & LSP are committed to partnering with our customers to provide effective launch solutions**
  - NASA will continue to coordinate with DoD on intermediate-class (i.e. EELV) launch service plans and acquisitions
  - LSO & LSP will continue to work closely with SMD in an effort to mitigate cost risks and react to changes as they occur
  - Current market conditions have delivered a new medium-class vehicle with 5 initial successes with a price point below historical Delta II prices (when escalation & inflation is taken into account)
    - Certification still to be completed
    - LSP realized price with "typical" NASA management of the launch service is marginally higher than a commercial "internet price" without government management and mission assurance
  - More work required in intermediate-class but headed in right direction due to the potential for competition

The NASA Launch Service Program is committed to mission success