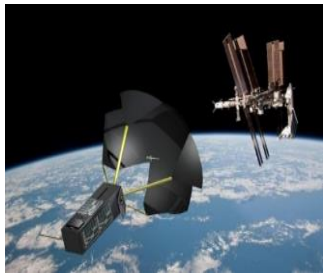
TechEdSat 5 / PhoneSat 5 (T5/P5)

SmallSat Presentation 2016

TechEdSat-1

TechEdSat-2



TechEdSat-3

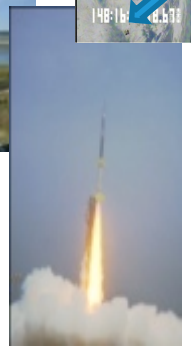
TechEdSat-4

SOAREX-8

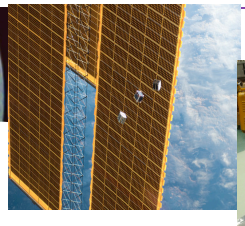
M.Murbach, R. Alena, A. Guarneros Luna
C. Priscal, R. Shimmin J. Wheless, F. Tanner, R. Morrison, K. Oyadomari
P. Papadopoulos/SJSU, D. Atkinson/UofIdaho
TES/PSAT-Team
NASA Ames Research Center

Relevant Flight Experiments TES-N

SOAREX-6
2008

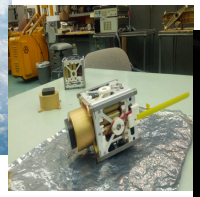


SOAREX-7
2009



TES-1
Oct 4, 2012

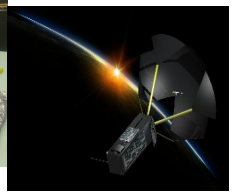
First US Nanosat deployed off ISS
PSRP process mastered
Rad-tolerant processor demo



TES-2
Iridium test
Aug 21, 2013

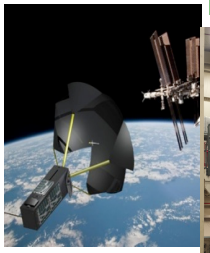
First Iridium in-space COM demonstration

First US 3U Nanosat deployed off ISS First Exo-Brake test



TES-3
Aug 3, 2013
(6 wk deorbit)

Evolution of TES-3 Iridium modem
Uplink/via email demonstrated
Exo-Brake II



TES-4
Mar 3, 2015
(4 wk deorbit)

WSM1, AIM Camera
X-Band, ISM-Band, P5 alpha, ISM-Camera and Full ExoBrake

SOAREX-8 During test (WFF)
July 7, 2015

WSM2, AIM Camera
ISM-Band, P5 alpha, ISM-Camera

SOAREX -9 (WFF)
March 3, 2016

Modulated Exo-Brake
Improved positional/ target accuracy
Improved Targeting, WSM2, ISM Band

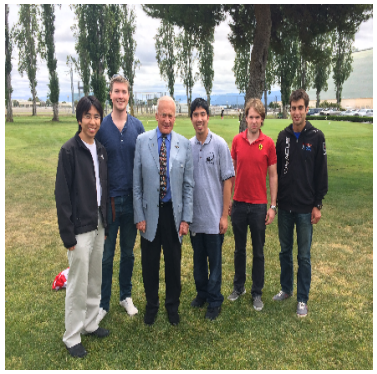
TechEdSat5/ PhoneSat5
Coming up this year!!

Recent Years of Flight Experiments (2008-2015):
6 Flights +1(SOAREX8) +PhoneSats 1-4

…here before

SOAREX/TechEdSat-N Team

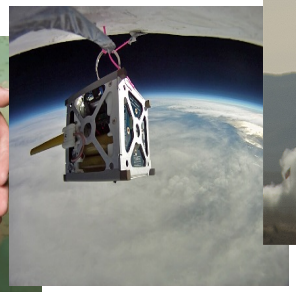
Relevant Flight Experiments PhoneSat



Recent Years of Flight Experiments (2009-2015)

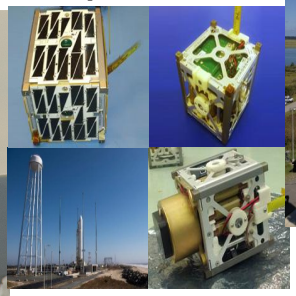
Intimidator-5
July 29, 2010

Balloon
June 9, 2011



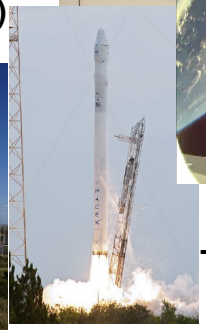
SpaceLoft-6
Apr 5, 2012

PhoneSat 1a, 1b, 2.0
Antares A-ONE
Apr 21, 2013

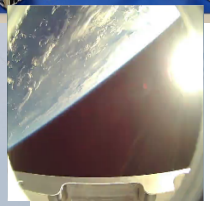


PhoneSat 2.4
ORS-3 Minotaur 1
Nov 20, 2013
(still in orbit)

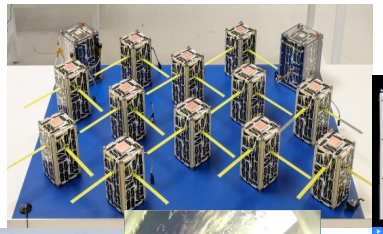
PhoneSat 2.5
CRS-3 Falcon 9
Apr 18, 2014



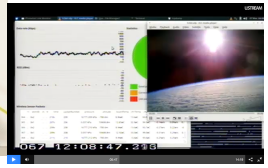
SOAREX-8
Terrier/Black Brant
July 7, 2015



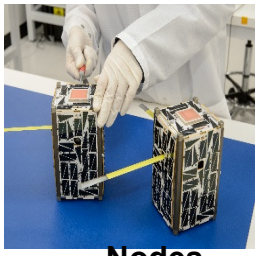
EDSN
Super Strypi
Oct 29, 2015



SOAREX-9
(WFF)
March 3, 2016



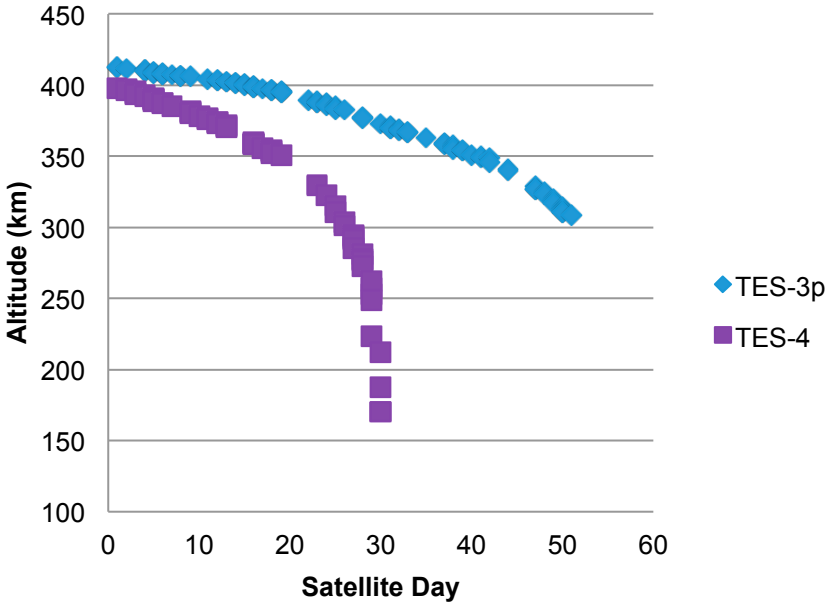
Nodes
Orb-4 Atlas V
Dec 3, 2015

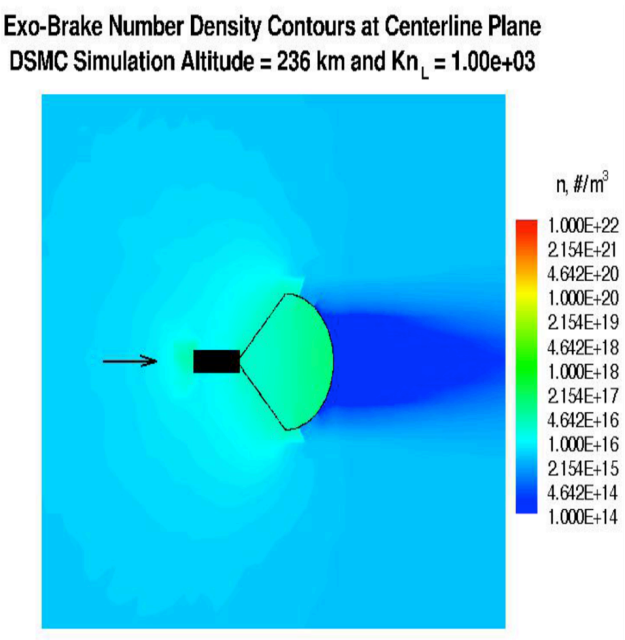


PhoneSat Team

Status of Analysis TES-3 and TES-4

TES-3/TES-4 Flight Test Data

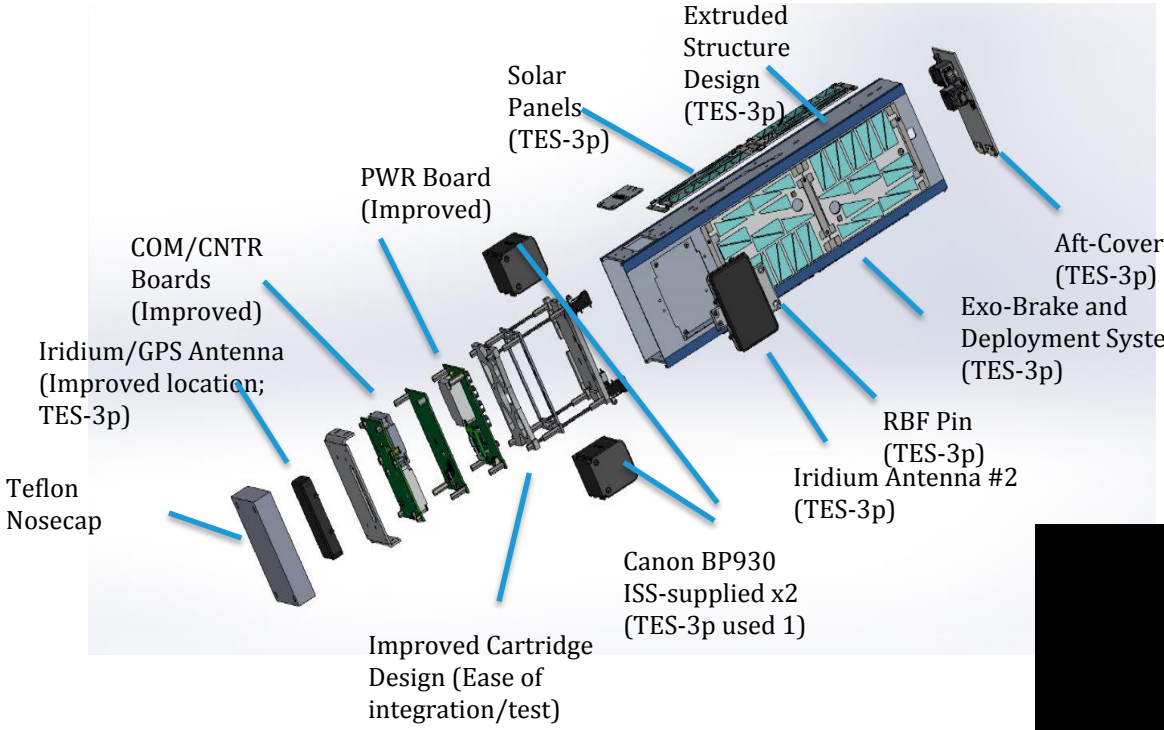




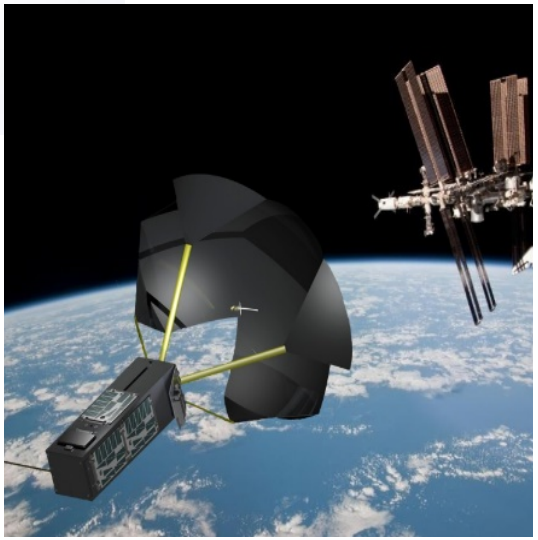
C.Glass/LaRC [DAC/DSMC]

***Active work in progress to refine models based on flight data – including uncertainty analyses (F10.7; geometric variables)**

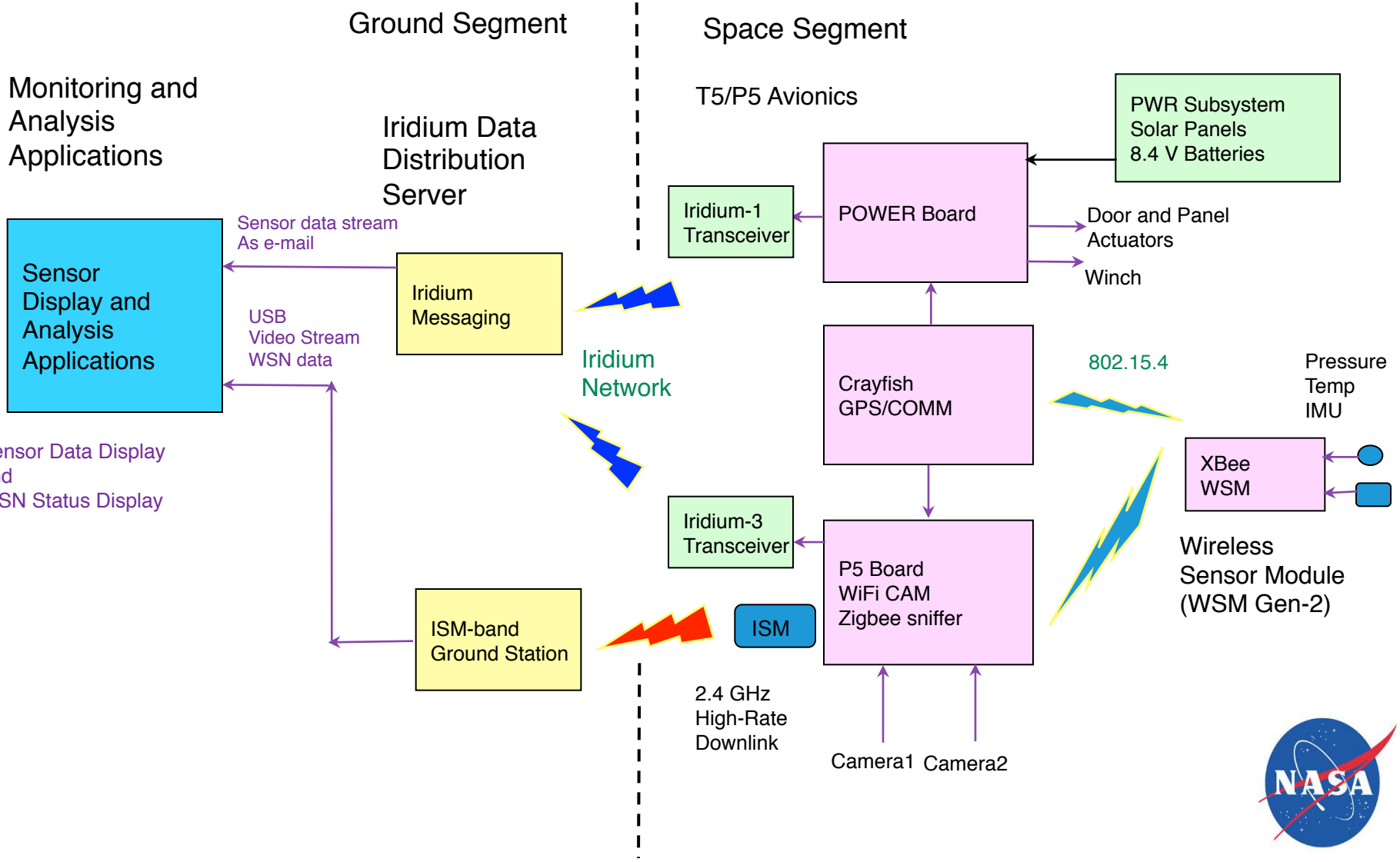
TechEdSat-4



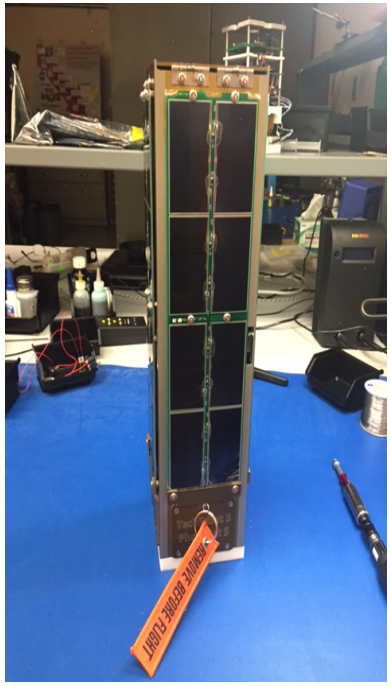
- 1st NASA NanoSatellite 3U Jettisoned from the NRCSD (July 2014)
- Exo-Brake Demonstration
  - β=8kg/m^2
- Advanced Manufacturing
- COM Experiment III + GPS
- Two-tier Architecture



T5/P5 Flight System Architecture and Dataflow



TES-5 Science/Mission Objectives



TES-5/P-5 Flight Unit
(READY to Integrate)

-Establish improved uncertainty analysis for eventual controlled flight through the Thermosphere (perform detailed comparison to the TES-3 and TES-4 with respect to key Thermosphere variable uncertainty).

-Improve prediction of re-entry location.

-Provide the base technology for sample return technology from orbital platforms.

-Provide the eventual testing of independent TDRV-based planetary missions

-Provide engineering data for an On-Orbit Tracking Device that could improve the prediction of jettisoned material from the ISS (per discussions with the TOPO group).

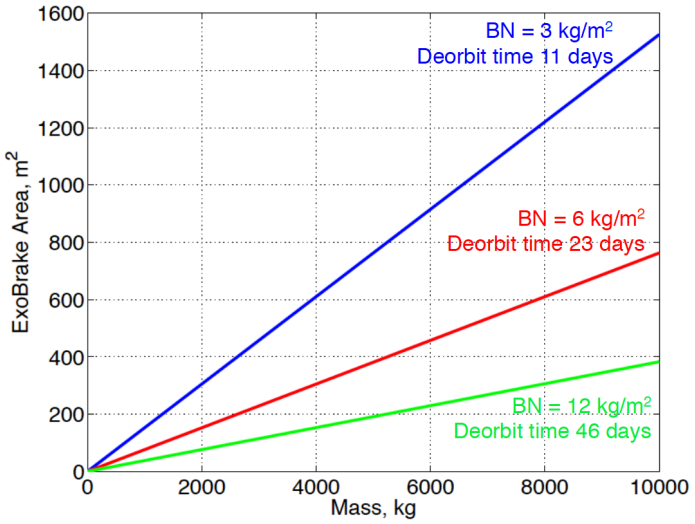
Frequency Coordination

	TES-1	TES-2	TES-3p	TES-4	SOARE X-8	SOARE X-9	TES-5
Iridium	N/A	1616-1626.5 MHz	1616-1626.5 MHz	1616-1616.5 MHz	1616-1626.5 MHz	1616-1626.5 MHz	1616-1626.5 MHz
StenSat	437.465 MHz	N/A	437.465 MHz	N/A	N/A	N/A	N/A
ISM	N/A	N/A	N/A	N/A	2457 MHz	2457 MHz	2457 MHz
WSM	N/A	N/A	N/A	N/A	2410 MHz	2410 MHz	2410 MHz

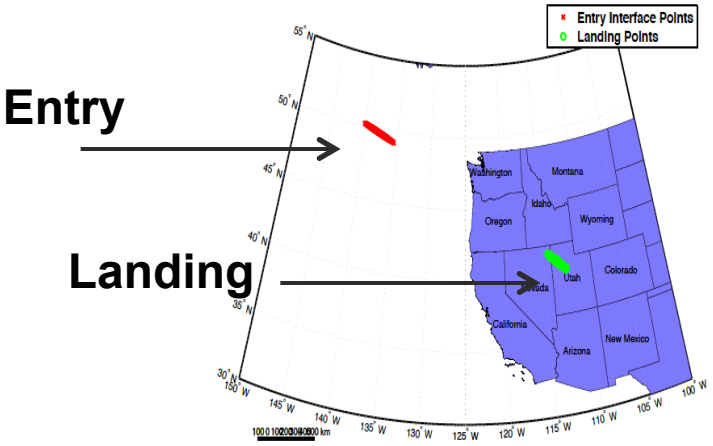
De-Orbit/Targeting Interest…

Results

Exo-Brake



Sample Return/Re-entry Targeting With Modulated Exo-Brale: Validation – it WORKS!



S. Dutta, A. Cianciolo, R. Powell , (LaRC)

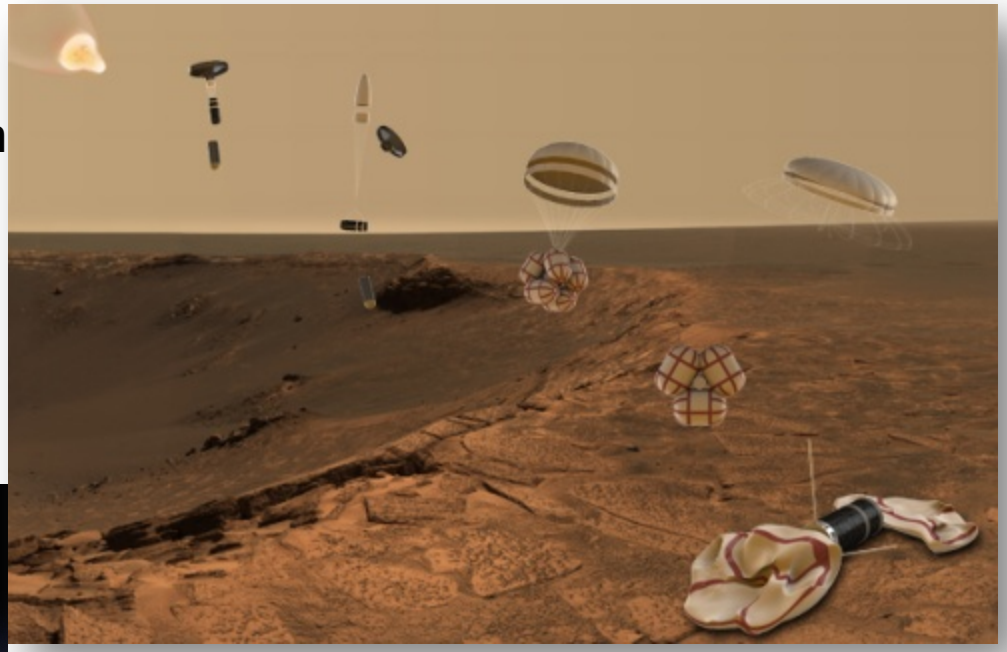
Application to larger payloads

What is Next?

ISS Sample Return

SPQR-Small Payload Quick Return

- 3 stage concept
- On-demand sample return
- COM IV experiment
- EDL test platform



Atromos: Nano-sat Mission to the Surface of Mars

- Mission Attributes –local climatology and surface characterization of areas not accessible to large missions (most of Mars!)
- Self-stabilizing re-entry probe (TDRV-Tube Deployed Re-Entry Vehicle)
- EDL Technique for small probes
- Dual probe demonstration 2018-2020

Summary

- **TES-N/Phone-N series has helped to train ~40 individual now at NASA, SpaceX, Boeing, Lockheed and …Start-ups!**
- **Several 'Firsts' for ISS-deployed experiments**
- **Numerous Technologies Advanced**
  - COM [**LOW** data rate up/downlink – Iridium; **MEDIUM** and **HIGH** data rate]
    - ✓ Commanding the nanosat via EMAIL
  - Fabrication
  - De-Orbit Systems (Exo-Brake – MODULATED!)
  - Evolving 2-tier Architecture
    - ✓ Arduino/Intel-Edison-Linux based platforms
- **Pioneered Safety Processes for ISS Satellite Jettison**
- **Future Work leads to ISS Sample Return, Advance Re-entry Development ….. And Mars!**

Ames Research Center