Focus and Objectives For Effecting Near-Term Investments To Bipropellant Earth Storable Propulsion Systems

Dave Byers - SAIC

Advanced Chemical Technology Description

- Evolutionary near-term improvements in chemical propulsion system performance that directly impact payload mass fraction and cost.
  - Resulting in greater science
  - Producing higher performance than SOA chemical systems
  - Increasing the reliability of propulsion systems

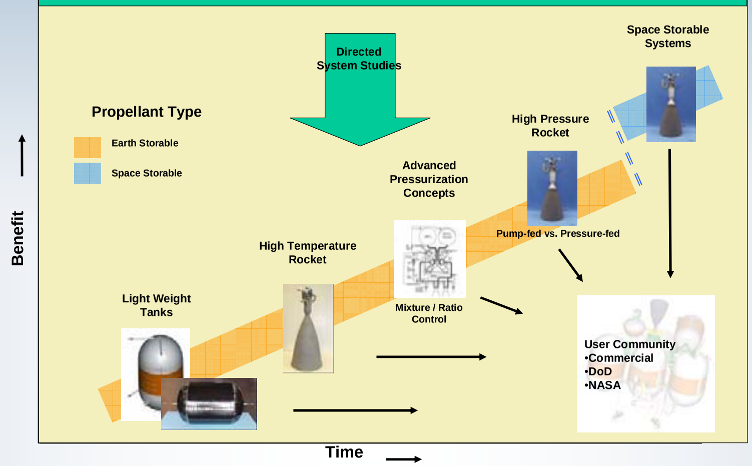
Lightweight/Optimized Components Tasks - component, subsystem, and manufacturing technologies that offer measurable system level benefits

- High Temperature Storable Bipropellant Engines
  - Performance optimization of existing storable bipropellant engine designs and demonstration of increased Isp >335s by leveraging high temperature thrust chamber material potential
- Ultra-lightweight Tank Technology (ULTT)
  - Optimization of COPVs to decrease the mass of propellant and pressurant tanks.
  - Acceptance / margin testing to increase design allowables and reduce risk
- High Temperature Thrust Chamber Assembly (TCA) Materials
  - Investigation of materials and manufacturing processes, e.g. Vacuum Plasma Spray (VPS), to provide high temperature options for TCAs
- Active Pressurization & Mixture Ratio Control
  - Initial laboratory demonstration using non-hazardous fluids to simulate a small, deep space, pressure-fed propulsion system
  - Investigation to determine the accuracy of critical sensor technology in at the component and subsystem level

Advanced Propellants Tasks - evaluation of high-energy storable propellants with enhanced performance for in-space application

- Advanced Ionic Monopropellants
  - Assessment of high performance monoprop potential through laboratory test and simulation

Mission and System Analyses



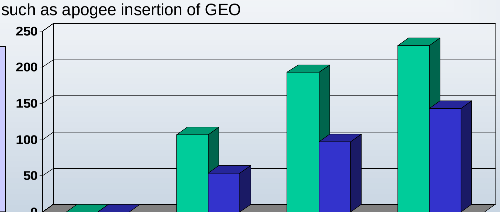
High Temperature Storable Bipropellant Engines

- Provide benefit for applications with medium to high ΔV and high reliability requirements
  - NASA robotic missions
  - Outer planet orbiters
  - Commercial missions such as apogee insertion of GEO COMSATs

Sizing Assumptions:

Europa Orbiter
- 254 lbm (115kg) to Europa Orbit
- ΔV = 18045 ft/s (5500 m/s)

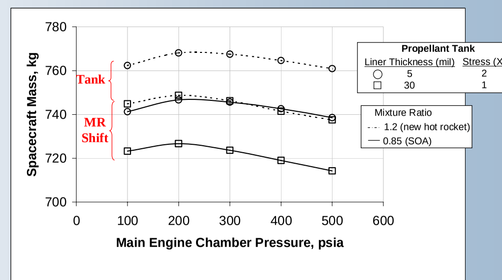
GEO COMSAT
- 4513 lbm (2050 kg) to GEO
- ΔV = 6234 ft/s (1900 m/s)



	SOA Biprop (NTO/MMH)		SOA Dual Mode (NTO/N2H4)		Optimized (NTO/MMH)		Optimized Dual Mode (NTO/N2H4)	
Isp, lbf-sec/lbm	320	320	327	327	330	330	335	335
Total Propellant Mass, lbm	1552	1706	1652	1657	1629	1637	1590	1602
Mass Savins, lbm	0	0	54	49	77	69	116	104
Percent Savings, %	0.0	0.0	3.2	2.8	4.5	4.1	6.8	6.1

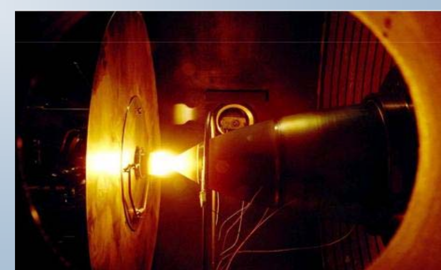
- The Advanced Chemical Technology Area utilized several analytical tools to determine mission benefit, including JPL Team X studies, the ACPS model developed by SAIC, and others. These analyses identified payload weight savings for each technology,which could be used for more scientific instruments, more maneuvering time at the target planet, or increased propellant reserve.
- The selected technologies (high temperature thrusters, ultra lightweight tanks, etc.), can be used individually or collectively to produce greater payload weight savings. The potential savings range from 10 to >100 kg for each.

Mission Evaluation (1) NTO/N_2H_4



- Increasing mixture ratio has a positive effect on spacecraft mass, without tank technology additions
- Combining technologies (mixture ratio & tank) can increase payload significantly

(1) Jupiter Polar Orbiter, VEEGA, 5.84 Trip Time, Mo = 1937.17 kg, ΔV = 2106.63 m/sec



High Temperature Thruster Firing at Aerojet Redmond