Future of Space Transportation

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Abstract

Future of Space Transportation System (STS) in India is going to be governed by the launch vehiclesto be cost competitive through innovative design, recovery and reuse,on-demand launch availability and capability to meet the national needs for the projected spacecrafts for communication, navigation, earth observations and science missions. The future of STS will also be governed by our ability to producein large numbers from Indian industry to meet the national and international spacecraft customers on a commercial basis.

Subsequent to the learning phase of SLV-3 and ASLV,ISRO entered into an operationalphase of PSLV. Today, ISRO is recognized as a prominent launch service provider with the continued success of PSLV which is recognized as one of the reliable launch vehicles of the world. PSLV has carried out variety of missions to Low earth orbits, GTO and interplanetary missions such as Chandrayaan-1 and MOM. The successful missions of GSLV with indigenous cryogenic stage have demonstrated the mastery on the complex cryogenic technology. GSLV is capable of placing 2.2 ton spacecraft to GTO. GSLV is also capable of carrying out different missions including low orbit missions and identified for the Chandrayaan-2 mission. There is also a need to make PSLV more production friendly, cost effective or to identify a low cost configuration for 500 kg class of spacecraft launch to LEO.

The LVM3will achieve a launch capability of 4ton to GTO. This capability is important for ISRO so that large spacecrafts with transponders up to 40 nos can be launched for communication purpose. With the development of the C25 high trust cryogenic engine and stage going through successfully, first developmental flight of LVM3 will take place by the end of 2016.

The planned development program of Semi-cryogenic engine of 200 ton thrust is the key to the enhanced capabilities in the future. The semi-cryogenic stage with 200 ton propellant loading will replace the present earth storable core stage of LVM3 to enhance the payload capability to 6 tons. A heavy lift launch vehicle having8 to 10 ton GTO payload capability based on bigger solid boosters, a semi-cryogenic core stage and clustered cryogenic upper stage is configured and is under detailed study. A clustered semi-cryo booster stage with 4 to 5 engines and with 500 ton propellant loading can be the booster stage of future heavy lift vehicle or a two stage human rated vehicle. Such a semi-cryo booster stage can be recovered and reused as well taking advantage of the throttling capability of the engine

Demonstration of reusable launch vehicle technology with a winged space plane through a flight (RLV-TD) is planned soon. Demonstration of air-breathing propulsion technology through the flight of a scaled model scramjet engine mounted in a sounding rocket system is a long cherished goal. It is required to integrate the air breathing technology with the reusable launch vehicle technology in an operational scale to have a cost effective launcher as the next phase of this development program. The viability of such a proposal is under study.

Advanced Electrical Propulsion Systems (EPS) for spacecraft that will reduce the mass of the spacecraft and launch cost is being developed. The induction of EPS will enable the launches of all out communication satellites up to 4 ton mass in LVM3 with transponder capabilities as much as that of a present six ton spacecraft with conventional propulsion system. It is also interesting that many small/medium satellites could be configured with EPS for station keeping purposes, which are suitable for earth observation in a cluster and for science missions

It is necessary to have payload capability from 100 kg to 10 tons, common and interchangeable propulsion modules, quick turnaround times for launch, simplicity and cost effectiveness. In addition to improving the efficiency of the current propulsion systems through continued R&D, the development of technologies for improved propulsion systems with green propellants including Hydrogen peroxide and Methane are under study. Such technologies will enable developing systems for future interplanetary exploration missions.