SPACE TRANSPORTATION IN INDIA AND ITS FUTURE: A REVIEW

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Abstract

Dr. Vikram Sarabhai father of Indian space research programme - who envisioned the development (in 1970 s) of Indian space capability for benefit to nation and meeting development goals of country[3] .self-reliance and indigenous capability development were the main objectives for which the space programme was started . Indian space has come a long way in this last half century , it have achieved technological excellence over these year. It has been helping nation in various fields like defence , communication and resource management. Every year our national space agency is having 13-14 high quality space missions. Now ISRO(Indian Space Research Organisation) is one of the most successful commercial satellite launching agency. Due to its better launching systems and cheaper cost many countries seeks its services.

Indian communication satellites in INSAT; Indian positioning satellite in IRNSS; Indian EO satellites in IRS; Indian launch vehicles in the GSLV and PSLV; various science missions; successful mission to mars have shown capabilities of india's space programme. Chandrayaan-1 moon mission; Successfully attracting customers from global markets have also been achieved. All this has enabled development and operations of Indian space assets and applications.
India has attained total self reliance in the last four and half decades by from SLV to successfully developing and operationalising the Geosynchronous Launch Vehicle (GSLV) and Polar Satellite Launch Vehicle (PSLV). Launch vehicle is a critical element in the self-reliant space programme because of existing geopolitical scenario, non-availability.

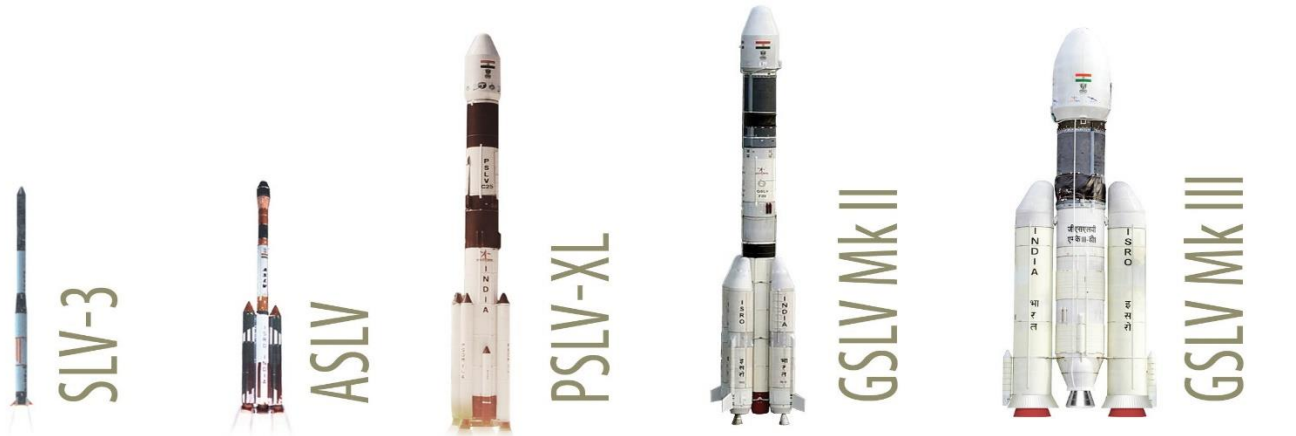
The paper provides review on future Indian Space transportation systems and its most important part that is technical development of launching vehicles . it will have direct impact on future space activities in India. The paper also discusses about evolution of launching vehicles and the need of developing them to meet needs of next few decades.

Keywords: *PSLV(polar satellite launching vehicle),GSLV(geosynchronus satellite launching vehicle),SLV(satellite launching vehicle),ASLV(argumented satellite launching vehicle, RLV(reusable launching vehicle).*

Introduction

A basic component in the independent space program is launching vehicle as a result of existing geopolitical situation, non-accessibility of the know-how from the individuals who have the innovation because of different double utilize based control administrations. This requested indigenous endeavors to create advancements in different controls of rocketry[1]. While the sounding rockets gave the fundamental innovative capacity to strong impetus, materials, compound frameworks, engine structures, and so on it was the improvement of SLV-3 which gave the more profound comprehension of streamlined features, control and direction frameworks, arranging innovation, orbital mission administration and so on[3]. Considering the requirement for higher payload ability for logical trials a design of ASLV with payload capacity of 150 kg was developed. The innovation advancements did amid this test stage incorporate tie on promoter innovation, bulbous payload fairing, inclined spouts and shut circle direction. The real commitment of the ASLV was that it empowered a superior comprehension of the perplexing mission administration[2].

When the advancement of ASLV was going on, ISRO took the testing assignment of creating PSLV for propelling of operational remote detecting satellites into Sun Synchronous Polar Circle (SSPO). PSLV gave a quantum bounce in the advancement of basic advances like expansive strong engine, earth storable fluid motors composite engine case, strapdown route framework and so forth[1]. Amid the main trip of PSLV in 1993 every one of the frameworks worked well, yet at the same time the mission couldn't prevail with regards to infusing the satellite into space because of a product usage blunder. From that point onwards all the PSLV flights till date have been fruitful. This vehicle has turned into a flexible stage for host of missions, for example, LEO, SSPO and GTO. The capacity of PSLV to convey 1300 kg to GTO has additionally been built up with the dispatch of Chandrayaan-1 as of late[5]. This vehicle has arrangement to convey different satellites with multi mission ability. Simultaneous to improvement of PSLV, ISRO started the testing assignment of creating GSLV with three phases, utilizing strong, fluid and cryogenic impetus modules for propelling 2 -t class of operational correspondence satellites into GTO. At first an acquired cryogenic stage from Russia was utilized for the upper stage. The significant innovation improvements amid this task stage are advances identified with cryo motor and stage frameworks. The indigenous cryo arrange improvement is a noteworthy testing advancement undertaking however the motor and stage have been qualified through a progression of ground tests, short and long span organize level tests. ISRO successfully developed indigenous cryo rocket in last decade .



SLV-3	ASLV	PSLV-XL	GSLV Mk II	GSLV Mk III
Height : 22.7m	Height : 23.5m	Height : 44m	Height : 49m	Height : 43.43 m
Lift-off weight : 17 t	Lift-off weight : 39 t	Lift-off weight : 320 t	Lift-off weight : 414 t	Lift-off weight : 640 t
Propulsion : All Solid	Propulsion : All Solid	Propulsion : Solid & Liquid	Propulsion : Solid, Liquid & Cryogenic	Propulsion : Solid, Liquid & Cryogenic
Payload mass : 40 kg	Payload mass : 150 kg	Payload mass : 1860 kg	Payload mass : 2200 kg	Payload mass : 4000 kg
Orbit : Low Earth Orbit	Orbit : Low Earth Orbit	Orbit : 475 km Sun Synchronous Polar Orbit (1300 kg in Geosynchronous Transfer Orbit)	Orbit : Geosynchronous Transfer Orbit	Orbit : Geosynchronous Transfer Orbit

Literature review:

Indian Space Transportation System constantly strives to improve technologies to meet the long-term needs. Currently identified technologies are realization of large semi-cryogenic boosters, air breathing propulsion, and development of reusable launch vehicles (RLV). Reducing requirement of propellant is fundamental to low cost access to space, as propellant forms about 85% of launch vehicle mass out of which bulk of the propellant is oxidizer[2]. In air breathing propulsion, the entire requirement of oxidizer need not be carried along with the vehicle and ISRO has initiated the development of such engines. In order to understand various critical technologies like hypersonic aerothermodynamics, reusable thermal protection systems, design of reusable structures including control surfaces, autonomous flight management etc. ISRO has initiated the development of Technology Demonstrator for reusable launch vehicles (RLV-TD) and slated for launch by middle of next year. The Indian Space Programme after crossing several major milestones with the main aim of utilizing the vantage point of space for a variety of applications relevant to national development it is now poised to explore newer dimensions as a part of long term goal[4]. Such goals are not only meant to retrain the pre-eminence of India in space but also to ensure the rightful role in other emerging areas of space research such as planetary exploration and human presence in space. It is against this backdrop that ISRO has initiated the detailed studies on different options for a human space mission. Compared to an unmanned space vehicle a host of new technologies will be required to accomplish such a complex programme and all such areas have been identified. Development of technologies in some of the critical areas has also been initiated.

Looking in front of the PSLV and GSLV, India should create propelled dispatch ability - diminished number of stages to enhance cost execution; semicryogenic impetus enhancing wellbeing and cost factors and furthermore increment geo stationary payload ability to 6t and 10t-in this way giving the country a capacity to set out upon more aspiring planetary missions as additionally a capacity to construct a space station/natural surroundings module in Low Earth Circle; build up a reusable dispatch vehicle which can convey men and materials to space and afterward return back to earth for restoration, refueling to leave upon next mission; innovation for suborbital trans-air transportation frameworks[6]. Thinking for a space shuttle may likewise be required as an innovation improvement for long term future.

Future :

GSLV Mk III is designed to carry 4 ton magnificence of satellites into Geosynchronous Transfer Orbit (GTO) or approximately 10 lots to Low Earth Orbit (LEO), which is about two times the functionality of GSLV Mk II.The two strap-on vehicles of GSLV Mk III are located on both facet of its center liquid booster. Designated as 'S200', each contains 205 heaps of composite stable propellant and their ignition outcomes in car lift -off . S200s characteristic for a hundred and forty seconds. During strap-ons functioning phase, the 2 clustered Vikas liquid Engines of L110 liquid core booster will ignite 114 sec after elevate -off to further increase the thrust of the car. These two engines hold to characteristic after the separation of the strap-ons at about one hundred forty seconds after carry –off[1].

Reusable Launch Vehicle – Technology Demonstrator (RLV-TD) is one of the most technologically tough endeavors of ISRO in the direction of growing critical technology for a fully reusable launch vehicle to permit low cost get missions to space[4]. The configuration of RLV-TD is similar to that of an aircraft and combines the complexity of both launch vehicles and aircraft. The winged RLV-TD has been configured to behave as a flying test prototype to evaluate various technologies, specifically, hypersonic flight, self sufficient landing and powered cruise flight. In future, this vehicle can be scaled up to turn out to be the first level of India's reusable orbital Launcher[2].

Scramjet Engine TD The first experimental challenge of ISRO's Scramjet Engine towards the advancement in field of an Air Breathing Propulsion System changed into efficiently carried out on August 28, 2016 from Satish Dhawan Space Centre SHAR, Sriharikota.With this flight, critical technologies such as ignition

of air breathing engines at supersonic pace, maintaining the flame at supersonic pace, air intake mechanism and fuel injection structures had been effectively validated.

The Scramjet engine designed by using ISRO uses Hydrogen as fuel and the Oxygen from the atmospheric air because the oxidiser. This check become the maiden quick length experimental test of ISRO's Scramjet engine with a hypersonic flight at Mach 6. ISRO's Advanced Technology Vehicle (ATV), that's a sophisticated sounding rocket, changed into the solid rocket booster used for the check of Scramjet engines at supersonic conditions. ATV sporting Scramjet engines weighed 3277 kg at carry-off

Conclusions

India's objectives for space endevors and its rising needs for next few many years for services and infrastructure improvement present an remarkable opportunity. Yet, there may be a foreseeable way in which the government can pursue such numerous and growing area programme desires – it has to outline an extended-time period National Space Policy; involve a chance-sharing industry for space belongings manufacturing/ownership; difficult countrywide space agency-ISRO for advanced space generation improvement/planetary missions/human area flight missions and invigorating studies and academia for front-ranking studies in space[6].

On independence day of 2018 prime minister of India announced a manned flight to the space in next 2-3 years and isro have to fulfill this wish of nation , so that India as a nation could show its capability and join the elite club of nations which have achieved this feat.

In beyond forty years, superb heights were carried out in India in area endeavors thru unfolding the utilitarian and pacific visions of Space.

If India has to amplify its horizon and permit a prime space thrust for home and international markets. To become a big a player in space market and to compete with other parties in this game, India has to make a remarkable technological development in its spacecraft launching system.

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