

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Small Launchers: concepts and operations (7)

Author: Mr. Yunus Emre ARSLANTAS  
DLR, German Aerospace Center, Germany, Yunus.Arslantas@dlr.de

Mr. Oguz Ozkan  
TÜBİTAK, Turkey, uidb@tubitak.gov.tr  
Dr. Tamer Özalp  
TÜBİTAK, Turkey, ozalp.tamer@gmail.com

## OUTLOOK AND FUTURE PROJECTION ON THE USE OF SMALL LAUNCH VEHICLE CONCEPTS

**Abstract**

Recent developments in technology are changing the trend both in satellite design and application of that technology. More compact as well as affordable options are available for the researchers during the design phase of the satellites. As the size of the satellites decreases inserting those satellites into orbit needs particular methods. Among the various studies that focus on the launch of those small satellites, research on development of an LV (Launch Vehicle) concept specially tailored for small satellites attracts special attention. This paper summarizes the current level and trends in the emerging Launch Vehicle concepts for small satellites by surveying and drawing an outline of the research projects carried out by universities and research institutes.

Advancements in technology effects cost, size and capability of the satellites. Due to the decrease in the design and manufacturing costs of satellites, number of universities and research centers which focus on affordable and small sized satellites (herein after referred to satellites up to 10 kgs) increases. In addition to this, companies and governments tend to launch multiple small satellites instead of a large satellite to overcome technical problems during the launch and operation phase. Parallel to the increase in the number of small satellites which have been designed in the last decade, demand for the launch of those satellites has also soared accordingly.

Nevertheless, launch options for small satellites are not as wide as large satellites. The most widely used method is the launch of small satellites as a secondary payload of launch vehicles. Although this may be considered as a solution, multiple launches of satellites have disadvantages as well, like delays in launch, risk of failure during launch and separation... etc. Such problems urged researchers to find a better and permanent solution for the launch of small satellites.

In this paper the general trend for the launch small satellites was analyzed. An assessment regarding the need of the launch market for the launch of small satellites was made by examining the studies going on both in universities and research centers. Feasible options for the launch of small satellites were evaluated by comparing the cost per launch. Moreover, possible launch sites constructed for small sized LVs were assessed by considering technical, geographical, political and judiciary issues. The last part of the paper focused on the future projections for the use of LVs by both space faring nations and space developing countries.