

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Future Space Transportation Systems (4)

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## CONCEPTUAL DESIGN OF A SPACE TUG FOR SATELLITES MISSIONS SUPPORT

**Abstract**

The paper deals with the conceptual design of a space tug to be used in support of Earth satellites transfer maneuvers. Usually Earth satellites are released in a non definitive low orbit, depending on the adopted launcher, and they need to be equipped with an adequate propulsion system able to perform the transfer to their final operational location. In order to reduce the mass at launch of the satellite system, an element pre-deployed on orbit can be exploited to perform the transfer maneuvers; this allows simplifying the propulsion requirements for the satellite, with a consequent decrease of mass and volume, in favor of larger payloads. The space tug here presented is conceived to be used for the transfer of many satellites from low to high orbits, and vice versa, if needed. To support many maneuvers, dedicated refueling operations are envisaged. Furthermore, the space tug is envisioned to perform the retrieval of payload on board a satellite, moving it from high to low orbits, and support its re-entry on Earth, by transferring it to a dedicated re-entry vehicle. The paper starts from an overview of the mission scenario, the concept of operations and the related architecture elements. Then it focuses on the detailed definition of the space tug, from requirements assessment up to its conceptual design. The overall architecture has been derived from a set of trade-offs performed accordingly to the objectives to be accomplished: the most important features are described within the paper. In the last part, further utilization projection in the frame of exploration is discussed. Specifically, an enhanced version of the space tug as described in the paper can be used to support assembly on orbit of large spacecrafts for distant and long exploration missions.