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**SpaceX's Interplanetary Transport System**

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SpaceX's Interplanetary Transport System (ITS) – revealed by Elon Musk to the public in September 2016 – represents one of the most audacious projects in space exploration, opening up doors to the Solar System for human and robotic exploration so far only envisioned in science fiction movies. Elon Musk is a Canadian-American entrepreneur, innovator, engineer and inventor, business tycoon who invests in grandiose innovative projects. The founder and head of SpaceX and Tesla Motors, co-founder of SolarCity and PayPal, this techno-messenger, as he is often called in the press, personally participated in the development of new technologies in alternative energy, the design of eco-friendly electric vehicles and economical solar power plants [1].

On May 22, 2012, Musk and SpaceX made history when the company launched its Falcon 9 rocket into space with an unmanned capsule. The vehicle was sent to the International Space Station with 1,000 pounds of supplies for the astronauts stationed there, marking the first time a private company had sent a spacecraft to the International Space Station [1].

The company enjoyed another milestone moment in February 2018 with the successful test launch of the powerful Falcon Heavy rocket. Armed with additional Falcon 9 boosters, the Falcon Heavy was designed to carry immense payloads into orbit and potentially serve as a vessel for deep space missions.

In September 2017, Musk presented an updated design plan for his Big Falcon Rocket (BFR), a 31-engine behemoth

topped by a spaceship capable of carrying at least 100 people. He revealed that SpaceX was aiming to launch the first cargo missions to Mars with the vehicle in 2022, as part of his overarching goal of colonizing the Red Planet. The following month, it was announced that SpaceX would construct a facility at the Port of Los Angeles to build and house the BFR.

The Interplanetary Transport System is a large architecture in development by SpaceX to achieve an operational crew and cargo transport capability for the exploration and settlement of Mars to lay the foundation for a self-sustained civilization off Planet Earth [2].

The project is of unprecedented scope and encompasses three major elements to deliver humans to the surface of Mars and return them safely to Earth – a large re-usable Booster capable of flying 1,000 times, a Spaceship hosting crews of 100+ people, and a Tanker for in-orbit refueling of the Spaceship prior to departure for Mars. Additional technical concepts required for the success of the project include hypersonic retropropulsion at Mars, landing technologies for an unprepared surface, and propellant production on Mars [2].

When founding Space Exploration Technologies (SpaceX) in 2002, Musk noted a core motivation of bringing humans to Mars and making mankind a multiplanetary species – a problem he thought about since his college days. As per his motivation for sending colonists to Mars, Musk cites unavoidable extinction events on Earth and the human drive to go beyond what's already been explored [3].

Armed with the necessary confidence and a personal wish to travel to Mars, Musk set the goal on creating an interplanetary launch system that could be economically viable, achieve flight safety and host a large number of people to establish a sizeable colony on Mars within a few decades time.

The architecture of SpaceX's Mars plans was kept under close wraps with only a few bits and pieces of information

being released to the public ahead of the big reveal of ITS at the International Astronomical Congress in September 2016, held in Mexico. The outline provided by Musk covered the initial development and architecture of ITS as well as future plans to establish a self-sustained colony on Mars, exploring targets beyond the Red Planet and potentially Terraforming Mars into a more Earth-like planet. However, Musk's address only dealt with the aspects of getting people to Mars and back and was not concerned with activities on the surface of the planet [3].

Towering 122 meters above a sea-side launch pad, SpaceX's future Interplanetary Transport System is envisioned to conduct its initial missions from Florida's Space Coast, using the same LC-39A launch pad that sent the first human expedition to the Moon in 1969.

Powered by a cluster of 42 methane-fueled Raptor engines, the Booster would generate a launch thrust of 13,000 metric ton force and accelerate the rocket to seven times the speed of sound. After separation, the Spaceship would double as a second stage, firing up to nine Raptor engines to achieve a Low Earth Orbit with a total upmass of 450 metric tons [3].

In a marvel of future engineering, the Booster would use a propulsive return profile pioneered by SpaceX's Falcon 9 rocket but taking it one step further by flying directly to its launch pad to be re-captured on its launch mount in order to enable a rapid re-flight. On the ground – in an operation lasting only hours or a day at most – the Booster would be topped by a Tanker and both would be fueled to blast off again and link up with the Spaceship in orbit for the transfer of propellant [4].

It would take five trips of the Tanker to fill up the spacecraft's tanks before it makes its departure for Mars, using a transfer taking some 115 days to reach the Red Planet though flight times could be reduced to roughly one month in the more distant future.

SpaceX's ambitious plan specifies that the Booster is designed for 1,000 flights to the edge of space and back, the Tanker can be re-used 100 times and the Spaceship could make 12 round trips to Mars [4].

In conclusion, it should be noted that the influence of Elon Musk on the development of science and technological progress is very great and invaluable on a global scale. His ideas haunt scientists and can charm a person of any age from a young schoolboy to a wise old man. Many progressive engineering students under the influence of Elon Mask's success begin to develop and promote their own scientific projects. Elon Musk gives us the opportunity to believe that the future we are dreaming about is very close. One has only to learn, believe and improve.

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