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Space Architecture: Habitats, Habitability, and Bases (1)

Author: Mr. Samuel Wald
Nanoracks, United States, swald@nanoracks.com

Mr. Zachary Taylor
Nanoracks, United States, zachtaylor468@gmail.com
Mr. Christopher Cummins
Nanoracks, United States, ckcummins@nanoracks.com
Mr. Jeffrey Manber
Nanoracks LLC, United States, adickes@nanoracks.com

IXION: A WET-LAB HABITAT PLATFORM FOR LEO AND THE DEEP SPACE GATEWAY

Abstract

In the 1960s, NASA Marshall Spaceflight Center (MSFC) engineer and architect Wernher von Braun quickly recognized the value of repurposing spent, in-space rocket upper stages, as habitats. Since rocket upper stages are placed in low-Earth orbit (LEO) as part of the overall launch activity and they are large, space-worthy structures, von Braun saw great potential for lowering habitat costs while developing robust capabilities. During the Shuttle era, engineers considered converting the large External Tank into a 'web-lab', however, despite many inherent benefits, the concept remained technically challenging and was never implemented. Today, with decades of advances in launch hardware and robotics, the strategy of repurposing rocket upper stages to serve as habitats is more appealing than ever, and could revolutionize the capacity and costs of in-space habitation.

The following paper provides a review of the Ixion Initiative team activities over the past year, a detailed description of the habitat created by spent, in-space upper stages, and its concept of operations, our plans for future development and eventual flights to LEO and cis-lunar space.

In 2017, an industry team known as Ixion and comprised of NanoRacks, SSL/MDA and Space Adventurers, as part of NASA's NextSTEP-2 public-private partnership model for explo-ration habitat capabilities. The team methodically demonstrated that the concept of repurposing the upper stages of ULA's launch vehicles into habitats is practical, safe, and far more affordable than traditional habitat development options. Specifically, the team focused on showing the fea-sibility of converting an upper stage into a habitat with the use of minimal crew time, instead re-lying on robotic systems to perform much of the modifications and assembly in orbit.

The Ixion platform takes advantage of highly reliable and capable heritage spacecraft, hardware reuse, and advances in robotics to provide effective solutions for the the International Space Station (ISS), LEO, and the Deep Space Gateway (DSG). Attached to the ISS, Ixion will provide a low-cost, high fidelity test-bed for those systems needed for the Deep Space Gateway. An ISS-based Ixion would also greatly expand the capabilities of the ISS for science, explora-tion, and commercial purposes including in-space manufacturing and tourism. Post-ISS, this same Ixion station can be used to continue to provide these capabilities in LEO as a free-flier. Finally, the Ixion station can be deployed to the Deep Space Gateway to provide a habitable destination in cis-lunar space for NASA, international partners, and private industry alike.