

# SHIFTING OUR MANUFACTURING OFF-WORLD:

## TUI/Firmamentum Lands 4 NASA Contracts to Develop Orbital Manufacturing and Construction Technologies

---

**Bothell, WA**, 20 April 2017 – NASA announced that it has selected Tethers Unlimited, Inc. (TUI) and its Firmamentum division for award of four Phase I Small Business Innovation Research (SBIR) contracts, with a total value of \$500,000, to develop technologies to enable in-space manufacturing of spacecraft components, orbital construction of space platforms, and advanced space robotics systems. The four new efforts include: “Metal Advanced Manufacturing Bot-assisted Assembly” (MAMBA), the “MakerSat Demonstration Mission”, “Automated X-link for Orbital Networking” (AXON), and the “COBRA-Bee” carpal-wrist mechanism for the Astrobee free-flier.

### **Metal Advanced Manufacturing Bot-assisted Assembly:**

The MAMBA project will build upon Firmamentum’s highly-successful work on the “Refabricator™” recycling and 3D-printing payload for the International Space Station (ISS) to develop a new in-space manufacturing system capable of recycling metal parts and using the material to fabricate new, high-precision components. Like the Refabricator, the MAMBA system will be configured as an EXPRESS-Rack payload for the ISS.

“The MAMBA system will provide NASA and future commercial space ventures a revolutionary capability for in-space manufacture of precision metallic parts, such as components for satellites, astronaut tools, and the replacement parts astronauts need to maintain the ISS and deep-space exploration spacecraft,” said Dr. Rachel Muhlbauer, Firmamentum’s Additive Manufacturing and Materials Program Manager.

### **MakerSat Demonstration of Constructable™ Structures:**

The MakerSat project will develop a small satellite mission to demonstrate a revolutionary “Constructable™” technology that uses in-space manufacturing to create extremely large structures to support long-baseline and spatially diverse sensing systems.

“Small satellites such as CubeSats and nanosatellites are rapidly becoming the “satellite of choice” for many NASA and commercial space venture,” said Dr. Dan Reuster, TUI/Firmamentum’s V.P. of Strategy. “The capabilities of these small satellites, however, are currently limited by the relative small antennas, optics, and other key apertures that can be integrated into these systems. MakerSat will demonstrate the ability to escape these limitations and achieve large-satellite performance at small-satellite costs.”

The MakerSat effort will integrate Firmamentum’s Trusselator™ technology with CubeSat components and sensors based upon TUI’s SWIFT® software defined radio technology to enable a low-cost small satellite mission to accomplish a high-performance science or sensing mission such as interferometric astronomy of cosmic physics or single-pass interferometric synthetic aperture radar (InSAR) measurements of the Earth.

### **AXON Connector:**

Currently, space systems such as geostationary communications satellites are built on the ground and blasted into orbit on a rocket, and thus the size and capabilities of these satellites are limited by the need to fit them inside a rocket. Under its Constructable Platform effort, Firmamentum is developing a suite of technologies to enable in-space construction of large, persistent space platforms by launching a number of small, low-cost modules as secondary payloads and then connecting them together on-orbit to create a highly-redundant facility able to support multiple hosted payloads. The AXON NASA SBIR effort will develop an open-architecture connector solution to enable robotic systems such as NASA’s RESTORE-L spacecraft or DARPA’s RSGS servicer vehicle to integrate these platform modules and payloads together. The AXON connector will provide key capabilities for sharing power, data, and thermal control resources between modules to enable multiple low-cost, limited-redundancy modules to link together to provide highly-redundant services to payloads.

“The Constructable Platform architecture has the potential to thoroughly disrupt the current satellite business model in GEO, replacing the traditional ‘owner/operator’ model, which is expensive and has very long lead times, with a far more affordable and rapid ‘leased storefront’ model,” said Dr. Rob Hoyt, TUI/Firmamentum’s CEO. “The AXON connector effort is developing a key element of this architecture

that will enable customers to build and launch just their payload with a standard, open-architecture interface, and that AXON interface will enable us to connect their payload to our platform. The platform will then provide all the utilities the payload needs to operate via the AXON connector, dramatically reducing the cost and time required for these customers to begin generating revenue from their payload.”

**COBRA-Bee:**

NASA is currently developing a next-generation free-flying robotic system for use inside the ISS, called Astrobee, to assist astronauts with their work and explore uses for robotic systems in zero-gee, such as in-space construction. To increase the utility of the Astrobee system, TUI will develop the COBRA-Bee carpal-wrist mechanism to provide precision positioning and pointing capabilities for the robotic system. The COBRA-Bee integrates the novel, compact COBRA™ gimbal mechanism TUI has developed for small satellite applications, such as pointing of satellite cross-link communications systems, with an advanced tool-change interface to support the many sensors, end-effectors, and tools under development for Astrobee by NASA, university, and industry researchers.

“The Astrobee Robotic Free Flyer is going to provide an exciting new tool to assist ISS astronauts with monitoring the interior of the station and testing out new robotics technologies in microgravity,” said Dr. Blaine Levedahl, Firmamentum’s In-Space Manufacturing Program Manager. “Astrobee is going to be a tremendous platform for us and other organizations to develop and test new methods for space robotics, and we are very excited to contribute the COBRA-Bee technology to that ecosystem.”

**About Tethers Unlimited, Inc. and Firmamentum**

Tethers Unlimited, Inc. (TUI) develops transformative technologies for Space and Defense missions. Its technology portfolio includes advanced space propulsion systems, programmable radios for small satellites, and systems for in-space manufacturing of spacecraft components. To learn more about TUI and its products, please visit [www.tethers.com](http://www.tethers.com).

Firmamentum is division of TUI established to develop an ecosystem of in-space manufacturing and construction services to build the infrastructure needed for a robust in-space economy. Firmamentum is currently preparing flight demonstrations of in-space recycling as well as in-space manufacturing of satellite components.

**MEDIA CONTACT: [information@tethers.com](mailto:information@tethers.com) or Rob Hoyt at 425-486-0100x111**