Advantages of Science Cubesat and Microsat Deployment using DSG Deep Space Exploration Robotics. A. Shaw[1], R. Rembala[1], P. Fulford[1]. [1]MDA Robotics and Automation (amy.shaw@mdacorporation.com; 9445 Airport Road, Brampton, Ontario, Canada, L6S 4J3).

Introduction: Important scientific missions can be accomplished with cubesats and microsats. Providing support capabilities for these satellites allows for relatively independent missions that can make tremendous contributions in many areas of solar system study including everything from investigating the lunar surface to observing near-earth asteroids [1]. Deep Space Exploration Robotics (DSXR) is a concept for a self-relocatable robotic manipulator [2, Figure 1] that would be able to move around the exterior of the Deep Space Gateway (DSG). A capability for the release of cubesats and microsats could be integrated into DSXR.

Cubesat and Microsat Science:

Science missions would benefit from the following advantages that are offered from having an independent cubesat/microsat deployment capability as part of DSXR:

- Significant number of cameras in proximity to capture images of the mission deployment that can be used for public outreach and proof of successful launch.
- Increased control over timing of satellite release
- Increased protection during launch
- Increased control over the initial orbital trajectory

Timing is an important consideration. For cubesats, such as the planned Near Earth Asteroid Scout [3], that are heading toward targets at greater distances, being able to time the release of the cubesat can allow for fuel savings and therefore allow more science targets to be accessible.

Different science missions require different orbits and would benefit from an ability to control initial trajectory. Orbit influences the spacecraft pointing relative to solar illumination (taken together, this forms the phase angle), therefore reflectance measurements and analyses of landform shape or morphology are heavily influenced. The ability to detect and characterize asteroids is also affected by the available orbital trajectories.

Deep Space Exploration Robotics for Cubesat Deployment:

A satellite release capability integrated into DSXR would afford a deployment capability for those cubesats or microsats that get a gentler ride to the Moon via the cargo vehicle (rather than the Orion-to-Stage Adapter). These satellites would then be taken by an astronaut and put out on a platform that the DSXR could access. DSXR could then pick up the payload for deployment.

There are two potential scenarios for cubesat deployment via DSXR:

1. Point a a deployment mechanism such as the Payload Orbital Delivery System (PODS) Hosted Payload Assembly (HPA) mechanism [4, Figure 2] built for the DARPA Phoenix program. The option of using a deployment tool or mechanism can offer a safe and reliable jettison capability for DSXR to support science through deployment of cubesats/microsats.
2. Place deployment mechanisms already loaded with satellites at specific external locations on the Deep Space Gateway from which they could deploy their cubesat/microsat at a later time.

In both of the above situations, the deployment could be positioned such that it is viewable by cameras on the arm. The current concept for the arm has 360-degree cameras, situational awareness cameras, and cameras on the end of a smaller, dexterous arm. These cameras would be useful for capturing images of the satellite deployment. These images could then be shared on social media if desired.

Conclusions: Cubesats and microsats have significant potential to achieve a variety of planetary science goals. The ability to release cubesats using the envisioned Deep Space Gateway DSXR robotic system has clear advantages.

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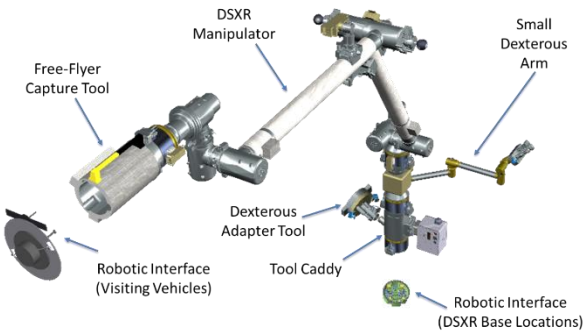

Figure 1: DSXR Flight System Concept Elements

Figure 2. MDA's HPA Payload Ejection Mechanism