In-Space Assembly of Large Telescopes for Exoplanet Imaging and Characterization. N. Siegler[1], R. Mukherjee[1], M. A. Greenhouse[2], J. M. Grunsfeld[3], H. A. MacEwen[4], B. M. Peterson[5], R. S. Polidan[6], H. A. Thronson[2]. [1]Jet Propulsion Laboratory/California Institute of Technology (nsiegler@jpl.nasa.gov), [2]NASA Goddard Space Flight Center, [3]NASA Goddard Space Flight Center Emeritus, [4]Reviresco, LLC, [5]Space Telescope Science Institute/The Ohio State University, [6]Polidan Science Systems & Technologies, LLC

Introduction: Envisioning the need for future large segmented telescopes to one day exceed the fairing size of existing or even planned launch vehicles, NASA will need to begin considering the in-space assembly and servicing of these future assets. Large aperture telescopes benefit all astrophysics as well as planetary and Earth science but are a necessity for advancing the search for life outside of our solar system. They provide unprecedented spatial resolution, spectral resolution, and signal to noise. Large telescopes equipped with coronagraphs will be able to explore the habitable zones of more distant Sun-like stars and, perhaps just as important, will more effectively probe their atmospheres in the near infrared where there are important spectral lines, potentially revealing information about life. This is because the resolution element, λ/D, is adversely affected at longer wavelengths but compensated with larger apertures. Improved spectral resolution is achieved because of the greater photon collecting power of these larger telescopes enable more detailed spectral features, potentially revealing new information about these exoplanets' atmospheres. Perhaps even life as we don't know it. Improvements in signal to noise enable greater sensitivities to faint objects, like exoplanets, and the ability to obtain more time-resolved data looking for changes in the surface features and seasons of exoplanets.

Gateway Assembly: NASA's proposed Deep Space Gateway (DSG) architecture provides an opportunity to assemble large space telescopes, test them, and release them onto the low delta-v highway arriving at the stable Sun-Earth L2 orbit. From the Sun-Earth L2 orbit, cis-lunar is an economic location to return for servicing. The same low delta-v highway may potentially bring telescopes back resulting in less fuel having to be carried. Servicing in cis-lunar in the vicinity of the DSG could include repairing (robotic servicers with and without astronaut support), replacing and upgrading spacecraft subsystems and payload instruments, refueling to extend lifetime, and re-positioning to new orbits when necessary. As has been shown with the Hubble Space Telescope, this capability may potentially enable longer telescope lifetimes and more frequently allow for instrument upgrades providing the science community with more advanced and timely technologies.

The approach of assembling large telescopes in space could very well help break the cost model for large telescopes by creating a new paradigm. A paradigm where telescopes across multiple wavelengths can escape the constraints of launch vehicle fairing sizes and mass limitations and complicated deployments by being assembled in space. These telescope apertures could even be designed to be increased over time and serviced to ensure longer lifetimes with continuously updated instrumentation.

We will present a few different concepts in which the DSG can be used to robotically assemble large space telescopes – both filled apertures like the JWST but working at UV/O/IR wavelengths as well as interferometers working in the near and mid-IR. We will examine potential interfaces and needed augmentations to the expected DSG assets and examine the use of telerobotics, servicers, and astronauts.