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Abstract

Space and Ground Trades for Human Exploration and Wearable Computing

Human exploration of the Moon and Mars will present unique trade study challenges as ground system elements shift to planetary bodies and perhaps eventually to the bodies of human explorers in the form of wearable computing technologies. This presentation will highlight some of the key space and ground trade issues that will face the Exploration Initiative as NASA begins designing systems for the sustained human exploration of the Moon and Mars, with an emphasis on wearable computing. We will present some preliminary test results and scenarios that demonstrate how wearable computing might affect the trade space noted below.

We will first present some background on wearable computing and its utility to NASA's Exploration Initiative. Next, we will discuss three broad architectural themes, some key ground and space trade issues within those themes and how they relate to wearable computing. Lastly, we will present some preliminary test results and suggest guidance for proceeding in the assessment and creation of a value-added role for wearable computing in the Exploration Initiative.

The three broad ground-space architectural trade themes we will discuss are:

1. *Functional Shift and Distribution*: To what extent, if any, should traditional ground system functionality be shifted to, and distributed among, the Earth, Moon/Mars, and the human explorer?

2. *Situational Awareness and Autonomy*: How much situational awareness (e.g. environmental conditions, biometrics, etc.) and autonomy is required and desired, and where should these capabilities reside?

3. *Functional Redundancy*: What functions (e.g. command, control, analysis) should exist simultaneously on Earth, the Moon/Mars, and the human explorer?

These three themes can serve as the axes of a three-dimensional trade space, within which architectural solutions reside. We will show how wearable computers can fit into this trade space and what the possible implications could be for the rest of the ground and space architecture(s). We intend this to be an example of "explorer-centric" thinking in a fully "integrated explorer" paradigm, where "integrated explorer" refers to a human explorer having instant access to all relevant data, knowledge of the environment, science models, health and safety-related events, and other tools and information via wearable computing technologies.

The trade study approach will include involvement from the relevant stakeholders (Constellation Systems, CCCI, EVA Project Office, Astronaut Office, Mission Operations, Space Life Sciences, etc.) to develop operations concepts (and/or operations scenarios) from which a basic high-level set of requirements could be extracted. This set of requirements could serve as a foundation (along with stakeholder "buy-in") that would help define the trade space and assist in identifying candidate technologies for further study and evolution to higher-level technology readiness levels.

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Focus Issue: Space and Ground Trades