



## Wireless Watchdogs: Intelligent Software for Astronauts and their Robots



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Computer software developed in California's Silicon Valley may prove indispensable to future astronauts tasked with the monumental job of exploring an entire planet.

Embedded in a backpack-worn laptop, the smart software responds to voice commands, links astronauts to mission control and their planet-side habitat. It even communicates with any robotic assistants that might be roving nearby.

The complete system -- autonomous rover included -- has already passed an initial shakedown test and is headed out to the Utah desert for another run under research conditions.

"What you're seeing is a fresh look at the whole science of data gathering," said Richard Alena, a computer engineer on the project at NASA's Ames Research Center in Moffett Field, California. "Basically, we're ensuring that we're ready for Utah."

But the Utah desert is just a proving ground for intelligent software dubbed 'mobile agents' which researchers hope will find a role in future human missions to the moon and Mars.

"We think that it's as critical and obvious as the idea of having wireless computing in the field," said Bill Clancey, principal investigator of the mobile agent project and chief scientist of human-centered computing at Ames. Clancey is also a senior research scientist at the Institute for Human and Machine Cognition at the University of West Florida in Pensacola.

### Agents on other worlds

The goal of the mobile agent software is to blend the extravehicular research conducted by human astronauts with the data management abilities inherent in a computer system.

The first role of an astronaut's personal mobile agent is to simply cut down on the amount of time astronauts take relaying information back to Earth, such as computer readouts or the temperatures of space suits and batteries. Using the agents to control a robot assistant, a landing party could identify interesting locations from the comfort of a habitat module and proceed directly into a scientific investigation.

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A pair of researchers test the computerized mobile agents as mock-astronauts on an extravehicular activity in Utah's Southeast Desert. CREDIT: NASA/ARC [Click to enlarge](#).



A researcher conducts a shakedown test of the mobile agent software - located in a backpack-mounted

it doing reconnaissance," Alena told *SPACE.com*. "You want astronauts to do targeted surveys, to follow the water and maybe even signs of life."

## Automating CAPCOM

A mobile agent's second role is more interactive, dating back to days of the Apollo program where humans walked on the moon while constantly reporting to their capsule communicator (CAPCOM) on Earth.

"We went back to Apollo EVAs, where the CAPCOM was providing blow-by-blow advice to astronauts who would narrate all of their activities," Clancey said. "The point is, when you're on Mars you can't be having this conversation with folks back in Houston because of the time delay."

The agents, Clancey said, is a way to automate CAPCOM's role on other planets. During an EVA, the course would be set into a mobile agent that would monitor astronaut progress throughout the excursion.

Should its humans get sidetracked or have an emergency, an agent could alert EVA astronauts, as well as the rest of the Mars-bound crew through habitat loudspeakers. The agent could also transmit an e-mail message for mission control on Earth.

"I do want a system that's much more sophisticated," Clancey said, adding that mobile agents need to be able to prioritize EVA tasks. "In Apollo, CAPCOM did a lot of work alerting astronauts when they were over schedule on EVA, how much work could be done in the remaining time."

## Earthly tryouts

During the shakedown test, as well as a previous trip to Utah last year sans autonomous rover, two mock-astronauts used mobile agents to monitor their EVA and report back to a simulated Mars habitat module. The 'astronauts' also relied on the software to control their robot assistant, telling it when to take a picture and stamping all data with time and location markers.

To make it work smoothly, Ames researchers had to factor in the need for realistic speech and dialogue between human and computer, the astronaut's need for mobility and wireless computing, as well as the need for automated science organization of data taken by humans and robots in the field.

"The trick is to make all of those elements work together," Alena said, adding that the shakedown was the first use of a completely autonomous rover that followed its human companions like a loyal mechanical assistant. "And it was a milestone that we've reached...I think the system is maturing nicely."

Like most new systems, there were some minor glitches. At one point during the shakedown, some data did not make it from the mobile agent to the proper database due to a connection problem with Ames' firewall.

"Because of the nature of a test, you're doing everything for the first time," Clancey said, adding that finding those bugs was the whole point of a shakedown test. "And you realize that there is always something nobody's ever thought of."

Clancey is confident that, with the next Utah field test under their belts, he and his team could have a fully functional mobile agent system in about a year. There would still be the task of deciding on a final computer platform, as well as meeting space-hardening requirements, before mobile agents could see their first spaceflight, he added.

Meanwhile, Alena hopes to expand the current system to include other robotic niches, such as a robot flyer for low-altitude reconnaissance or astrobiology applications that pick up where geology studies leave off.

"The current approach is to use the moon as a testbed, particularly for new modes of human-robotic systems," he said. "That's going to be a big difference from the Apollo age."



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laptop computer - at NASA's Ames Research Center in Moffett Field, California. CREDIT: NASA/AMES [Click to enlarge](#).



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An autonomous Extravehicular Activity (EVA) Robotic Assistant could be a useful tool for astronauts using mobile agents to explore Mars. CREDIT: NASA/AMES. [Click to enlarge](#).



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