Emerging Technology Trends

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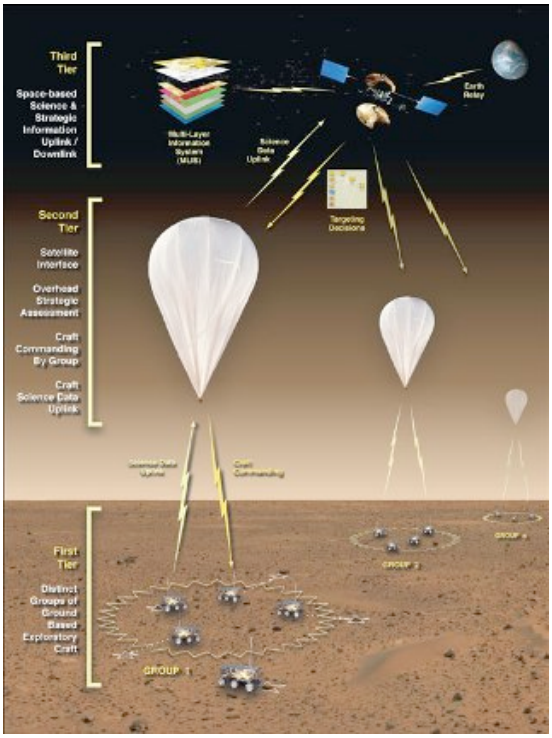
Air and ground robots to collaborate in space

Posted by **Roland Piquepaille** @ 10:38 am

Today's discoveries about our solar system are done by using robotic devices such as remote-sensing orbiters, probes, landers and rovers. But space missions usually rely on very few instruments. If one is lost, the mission is almost over — and has failed. But now, a team of scientists from the California Institute of Technology (Caltech), the University of Arizona (UA), and the U.S. Geological Survey is proposing a new concept for space missions. These future **multi-tiered robotic space missions** will associate orbiting spacecrafts, blimps and balloons with ground robots. All these instruments will communicate together and interact with each other. We will probably have to wait a decade or two before the launch of such space missions, but it makes good sense to rely on different robotic devices instead of a single one.

Before going further, below is an artist's rendering of a multi-tiered space mission (Credit: Caltech). And here is a link to **a larger version**.



And here are more details about this concept, taken from the Caltech news release.

> In addition to spaceborne orbiters, the "new paradigm" would involve sending orbiter-guided blimps (or other airborne agents) carrying instruments such as optical and thermal cameras, ground-penetrating radar, and gas and humidity sensors to chosen areas of a planet, as well as using herds of small, robotic, ground-based explorers.
>
> The ground explorers would communicate with the airborne and/or spaceborne agents, coupled with innovative software for identification, characterization, and integration of various types of spatial and temporal information for in-transit comparative analysis, hypothesis formulation, and target selection. This would lead to a "tier-scalable perspective," akin to the approach used by field geologists to solve a complicated geological puzzle.

How will this concept work on Mars for example? This **UA news release tells us.**

> In the case of Valles Marineris, for instance, the orbiting spacecraft would deploy sensors that would transmit weather conditions back to the spacecraft, said James Dohm, [a planetary geologist at the University of Arizona]. If the sensors give the spacecraft a good weather report - no high winds, for example — the spacecraft would then release the balloons or blimps.
>
> These airborne agents would start their searches for targets important to mission goals, collecting and adding new information as they go and deploying ground agents at promising candidate sites. The ground agents would collect and return data to the higher-level airborne probes, or the orbiter, or both.

And what about missions around Saturn or Jupiter? Caltech provides some answers.

> In the case of Titan, one of Saturn's moons with an atmosphere one and a half times as thick as Earth's, autonomously controlled airships would be ideal for exploration, rendering Titan perfectly suited for deployment of a three-tiered system consisting of orbiters, blimps, and both mobile and immobile ground-agents, especially in light of the even longer communication time lag than in the case of Mars.
>
> On Io, the extremely volcanically active atmosphere-void moon of Jupiter, in contrast, the orbiter-guided deployment of mobile ground-agents and immobile sensors would be a productive way of performing ground-based reconnaissance, capturing and studying active volcanism beyond Earth. In this case, the three-tiered system of spaceborne-, airborne-, and ground-level would be reduced to the two tiers of spaceborne- and ground-level.

So you think these kinds of missions are just around the corner? Think twice, as reminds us UA News.

> **Wolfgang Fink's homepage**Wolfgang Fink, a visiting associate at Caltech, and Dohm say the new concept needs further design, testing and ground-truthing in diverse Earth environments. They envision field camps for international researchers for designing and testing possible tier-scalable reconnaissance systems.

For more information, the research work has been published by the journal Planetary and Space Science under the title "Next-generation robotic planetary reconnaissance missions: A paradigm shift" (published online on October 6, 2005).

Here are two links to **the abstract** and to an early version of **the full paper** (PDF format, 2 pages), available from the **Lunar and Planetary Institute**.

Sources: Caltech Press Release, October 17, 2005; University of Arizona News, October 17, 2005; and various web sites

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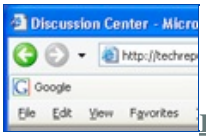

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