Designing a better satellite

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(Phys.org) —If you have ever plugged your digital camera into your desktop to download photos, then you have used what is known in computing circles as a "plug and play" interface. Basically, plug and play refers to any software program that can recognize many different hardware devices, and interface with them easily.

Plug and play has become ubiquitous in the world of personal computing , but it has yet to catch on in some loftier tech spheres, such as satellite design. A team of BU physicists, astronomers, computer scientists, and engineers wants to change this.

Based in the Center for Space Physics at CAS, the team is composed of over a dozen CAS and ENG students and faculty. The group has been working for over two years to develop a versatile, affordable satellite prototype. In January, they unveiled their creation at the Air Force Research Laboratories (AFRL) in Albuquerque, NM.: a 30-centimeter-wide cube made of 27 smaller cubes latched together, powered by wing-like solar panels.

The satellite can easily accommodate a wide range of scientific tools in its component cubes. The "hub," a stack of computing hardware located in the middle of the satellite, contains software and hardware to command and fly the satellite, as well as manage the data from its scientific instruments. Plug-and-play technology allows the satellite's Command & Data Handling software to read and interface with experiments and instruments that are plugged into the smaller cubes.

The BUSAT program (full name: Boston University Student Satellite for Applications and Training) is an emphatically student-driven initiative. CAS Professor of Astronomy John Clarke, the director of the Center for Space Physics, believes that involving undergraduate and graduate students at the core of research projects should be a more widespread practice.

"This project is a great example of involving students at all levels in current research and development," says Clarke. "Their enthusiasm was impressive to see. This is the kind of activity that universities should be doing."

A smart design

The BUSAT team's low-cost, modular design avoids some of the flaws found in more expensive, customized satellites. For instance, the component cubes fit snugly together using interlocking wedges, or wedge locks. This is significant because the metal bolts that hold together some more expensive satellites have been known to fail under the stresses of orbit.

But the biggest advantage of the modular design, says CAS Professor of Astronomy Ted Fritz, is that it can be modified quickly to meet unforeseen needs.

"You could in days or weeks configure the satellite and get it into orbit," says Fritz, who is the primary investigator on the BUSAT project. "You could quickly plug a new instrument into it, say to meet a battlefield need, and launch it. Plug and play could be used in other satellites. It has a lot of potential."

Fortunately, research administrators at the U.S. Air Force also see the potential in BUSAT's modular design. The Air Force funded BUSAT's

development with a two-year grant as part of a 10-team competition to launch a satellite into space. While the BU team did not win the competition, which ended in January, the team's presentation at the competition's final event captured the attention of administrators at the Air Force Research Laboratories.

Administrators at the AFRL agreed to fund an additional two years of development for BUSAT, at the end of which time the Air Force will decide whether to launch the satellite into orbit.

In awe of the Aurora

The BUSAT team's research goal is to study auroral activity in Earth's atmosphere by recording auroral light intensity in the northern polar region. Team members aim to create 3-D images of the aurora in order to better understand its behavior.

"If you have ever seen the aurora, it makes you very humble," says Fritz, who is also affiliated with the electrical, computer, and mechanical engineering programs at ENG. "You look up and see all those patterns swirling around, and you say to yourself 'I'm trying to explain that as a scientist.'"

Another team of BU researchers, also headed by Fritz and based in the Center for Space Physics, is creating a next-generation version of BUSAT. Using a similar modular design, the ANDESITE project is just getting off the ground. The ANDESITE team has received a two-year Air Force grant and will be competing against nine other design teams to have its satellite launched into orbit. Like BUSAT, ANDESITE will be solar-powered and consist of small cubes. However, the cubes will fly in tight formation rather than being connected to each other. Like BUSAT, ANDESITE will fly through the auroral zone to study the structure of auroras.

To learn more about BUSAT, visit 107.20.150.91/busat/

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