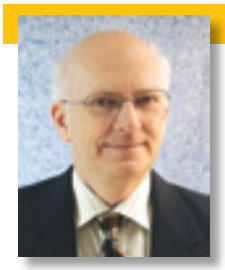

It Seems to Us

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CubeSats

"In April I attended a three-day CubeSat Developers' Workshop at California Polytechnic State University (Cal Poly) in San Luis Obispo to learn more about the burgeoning world of tiny satellites. They offer great promise — and some operational and regulatory challenges."

Radio amateurs have been building satellites and getting them launched for more than 50 years. For a time the trend was toward increasingly large and sophisticated packages to provide predictable long-distance communications between modest amateur stations on Earth. A couple of failures, along with shrinking opportunities for launches at prices amateurs could afford, caused such dreams to be put on hold even as rides into orbit for less ambitious satellites, including many built as university projects, continued to be found.

In the late 1990s two West Coast educators, Dr Jordi Puig-Suari of Cal Poly and Dr Bob Twiggs, then of Stanford University and now at Morehead State University in Kentucky, developed a specification for what are known as *CubeSats*. The basic building block is a cube 10 centimeters on a side although a single satellite may be made up of two or three strung together. CubeSats can be commercial, academic or amateur — sometimes in combination. As we shall see, the purpose of the satellite has important implications for licensing.

A single launch vehicle can carry multiple CubeSats along with other payloads. They also can be launched from the International Space Station (ISS). To avoid potential collisions with the ISS, CubeSats typically are placed in a lower orbit and deorbit relatively quickly, burning up on reentry into the atmosphere. While not all tiny satellites are CubeSats, the CubeSat specification has become a popular standard. A mini-industry serving CubeSat developers has sprung up, offering modules and kits so developers don't have to reinvent the wheel for system elements that are common to all satellites; instead they can concentrate on the unique aspects of their projects.

It is always refreshing to be surrounded by bright young people with a passion for science and technology. This was certainly true at Cal Poly, which has an active Amateur Radio club and a well-equipped club station, W6BHZ. This year's Cubesat Developers' Workshop was the 10th annual event and drew about 180 participants from all over the country and a few from abroad, including many students and licensed amateurs. There were more than 50 presentations, many of them by students, on subjects ranging from mission risk analysis to vibration testing to communications. The last, of course, is what brought me to San Luis Obispo.

While some CubeSats are designed in whole or in part to be communications satellites, connecting Earth stations with one another, others are collecting data and images for a wide range of research purposes. For these projects the radio links to and from the satellite are simply means to an end: commanding the satellites and downloading the data that has been collected.

Not all use CubeSats use the amateur-satellite bands — the ones with commercial and governmental objectives generally can access other spectrum — but it has been common practice for educational CubeSats to be commanded by control operators with amateur licenses and to be licensed as amateur satellites. Amateur-satellite spectrum that is available and suitable for use by tiny satellites in low Earth orbit operating in conjunction with simple ground stations is very limited: about 200 kHz just below 146 MHz, and 435-438 MHz. To minimize interference, frequency coordination for amateur satellites is performed by a Satellite Adviser appointed by the International Amateur Radio Union (IARU) Administrative Council. This volunteer position has been held for many years by Hans van de Groenendaal, ZS6AKV. Hans is assisted by an Advisory Panel of satellite experts from several countries.

Coordination was easy as long as such satellites were few in number. Lately, however, the popularity of CubeSats coupled with a dramatic increase in launch availability has caused the numbers to skyrocket. At the workshop it was reported that there are 22 CubeSats manifested for NASA's Educational Launch of NanoSatellite (ELaNa) program this year, with another 16 or so slated for next year and about three dozen more waitlisted. And that's just one NASA program; a European project envisions the deployment of 50 CubeSats in a single launch in 2015!

This level of activity has attracted the attention of telecommunications regulators. The FCC has begun taking a closer look at applications for amateur satellite licenses and is concluding in many cases — in spite of the recognition in the Part 97 rules of Amateur Radio's educational role — that the "no pecuniary interest" standard that applies to amateur operation requires experimental licenses instead. At the 2012 World Radiocommunication Conference (WRC-12) a number of European administrations pressed for frequency allocations for nanosats and picosats (satellites with a mass of less than 10 kg) to be placed on the agenda for the next WRC, but they had to settle for a resolution calling for the results of studies of the regulatory aspects for such satellites to be reported to WRC-15. These studies are now underway in Working Party 7B of the International Telecommunication Union's Radiocommunication Sector. Consideration of relaxed regulatory procedures for nanosats and picosats is on the preliminary agenda for WRC-18.

How a satellite is to be licensed is the prerogative of the regulatory administration, but the licensing of experimental satellites in the amateur-satellite bands raises an issue for IARU frequency coordination (as well as ITU issues, but that's another story). Non-amateur operation in the amateur bands should not be encouraged; on the other hand, refusing to coordinate would have significant negative consequences. For now the IARU has agreed to continue coordination while other spectrum for non-amateur satellites is being identified.

CubeSats provide a glimpse into the world of Amateur Radio for students, many of whom become licensed. They deserve a warm welcome to our ranks and support as they work to fulfill their dreams of a successful space mission.

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