

Amateur Radio and Manned Space

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Many readers might be surprised to learn that Amateur Radio's presence in space goes well beyond the Amateur Radio satellites. Amateur Radio has also been an integral part of operations aboard the US Space Shuttle, the Russian MIR Space Station, and more recently, the International Space Station (ISS). In fact, Amateur Radio's presence in various nations' manned space activities now goes back well over 25 years!

The whole idea grew out of the work of some forward thinking Radio Amateur Satellite Corporation (AMSAT) people back in the late 1970s and early 1980s. The first opportunity came when Owen Garrett, W5LFL, was selected to fly on NASA's SKYLAB the USA's first "manned orbital laboratory" that was made out of an old Saturn 5 upper stage. And while a formal request was made to NASA for Owen to carry his Amateur Radio along on that mission, it unfortunately came too late in the planning stages for NASA and others to make the necessary preparations for its use aboard the Skylab.

Some ten years later, and with the

encouragement of several AMSAT people working both in and outside of NASA (along with the good offices of the American Radio Relay League), permission was eventually secured for Owen to operate Amateur Radio during his STS-9 mission aboard the Space Shuttle *Columbia* in the fall of 1983.

And what a success it was! During his 10-day voyage, Owen made contacts with a number of Earth-bound hams from the Shuttle, including a few notables such as Jordan's King Hussein, JY1, and US Senator Barry Goldwater, K7UGA, (both now Silent Keys).

The Birth of SAREX

Needless to say, this activity eventually led NASA to conclude that carrying Amateur Radio aboard the Space Shuttle garnered benefits to both NASA and the Amateur Radio Service, so much so that ham radio equipment eventually became a "frequent flier" on a number of subsequent Space Shuttle missions.

For many years, the Shuttle Amateur Radio Experiment (or SAREX as it came to be known) put school children (and ordinary hams) in direct, "voice-to-voice" contact

with astronauts orbiting the Earth from the Space Shuttle. No doubt, those contacts launched countless careers in science, technology, engineering and math (STEM) from those who participated.

Ham Radio and MIR

But, the idea of carrying along Amateur Radio on space voyages also wasn't lost on other nations, including the Russians orbiting aboard their Russian Space Station MIR. In late 1988, Team Commander Vladimir Titov and Dr. Valeri Poliakov made several contacts with amateurs on the ground from MIR.

The MIR eventually carried a 2m voice transceiver as well as a packet radio transponder and Bulletin Board System (BBS). The packet radio BBS acted much like an early ham radio version of those Internet social networking sites we all now take for granted. At one point, even an amateur Slow Scan Television (SSTV) system was carried aboard the craft. Amateur Radio was in operation aboard MIR for over 10 years, and its ham equipment was used not only by hams from the (then) Soviet Union, but also licensed amateurs from Japan, Great Britain, Austria, France and the USA, all of whom spent various periods of time aboard MIR augmenting the permanent Russian crew.

ARISS Is Born

In late 1986, another meeting organized by Roy Neal, (K6DUE (SK) of NBC-News TV fame), once again brought together representatives of NASA, AMSAT and the American Radio Relay League (ARRL) to consider a program leading to Amateur Radio literally being built into the new International Space Station (ISS) then under development by NASA. The meeting established a formal working group to develop a proposal to be submitted to NASA for Amateur Radio's participation on the ISS. The group known today as the Amateur Radio on the International Space Station (ARISS) committee grew out of those early meetings and has since become the driving force behind keeping Amateur Radio aboard the ISS.

What Is ARISS?

The ARISS project has since evolved into a volunteer program whose principle aim



Photo 1: Long-time AMSAT member and former NASA Astronaut Ron Parise, WA4SIR (SK), makes a SAREX contact during one of his two flights aboard the Space Shuttle "Columbia" in the 1990s. (Courtesy: NASA and AMSAT)





Photo 2: An early NASA promotional poster for the SAREX project. (Courtesy: NASA)

is to inspire students, worldwide, to pursue careers in science, technology, engineering and math by providing Amateur Radio communications opportunities with the International Space Station (ISS) on-orbit crew. Students learn about life on board the ISS and explore Earth from space through their classroom participation in such things as

orbital tracking and radio wave propagation studies to and from space.

Currently, the ARISS working group consists of delegations from 9 different countries including several countries in Europe as well as Japan, Russia, Canada and the USA. Volunteers from the national Amateur Radio organizations of each country run



Photo 3: Former AMSAT VP of Operations Stacey Mills, W4SM, helps students from the Western Albemarle High School in Crozet, Virginia speak with Frank Culbertson, KD5OPQ, during an ARISS school contact in September 2001 (Courtesy: ARISS and NASA)

ARISS Operating Frequencies (Call Sign: NA1SS)

2m Crew Contact (ITU Regions 2 & 3):

Uplink: 144.4900 MHz FM
Downlink: 145.8000 MHz FM

2m Crew Contact (ITU Region 1):

Uplink: 145.2000 MHz FM
Downlink: 145.8000 MHz FM

2m APRS (Worldwide APRS Digipeater):

Simplex: 145.8250 MHz FM
1200 BPS
Downlink: 145.8250 MHz FM
1200 BPS

2m Imaging:

Downlink: 145.8000 MHz SSTV

70Cm/2m FM Voice Repeater (Worldwide):

Uplink: 437.8000 MHz FM
Downlink: 145.8000 MHz FM

the organization in partnership with their respective AMSAT organizations. Since ARISS is international in scope, the team also coordinates locally with their country's space agency (e.g. ESA, NASA, JAXA, CSA, and the Russian Space Agency) as well as through ARISS working group meetings, teleconferences and via electronic mail.

With the able assistance of experienced Amateur Radio volunteers from Amateur Radio clubs as well as coordination with representatives of the ARISS Team, the program puts ISS crewmembers "voice-to-voice" with large audiences in a variety of public forums where students, teachers, parents and communities can learn about space and space technology and ... of course ... Amateur Radio ... first hand.

More information about ARISS (including how and where to request an ARISS school contact) can be found at: <http://www.rac.ca/ariss/>. Also, NASA's "official" Web link to the ARISS project is at: http://www.nasa.gov/mission_pages/station/research/experiments/ARISS.html.

More than School Contacts

Besides interesting students in scientific careers, the ARISS equipment aboard the ISS also provides an emergency backup communications capability for NASA for use when their official communication channels to the ISS go down. While such occurrences are rare, the ARIS equipment aboard the



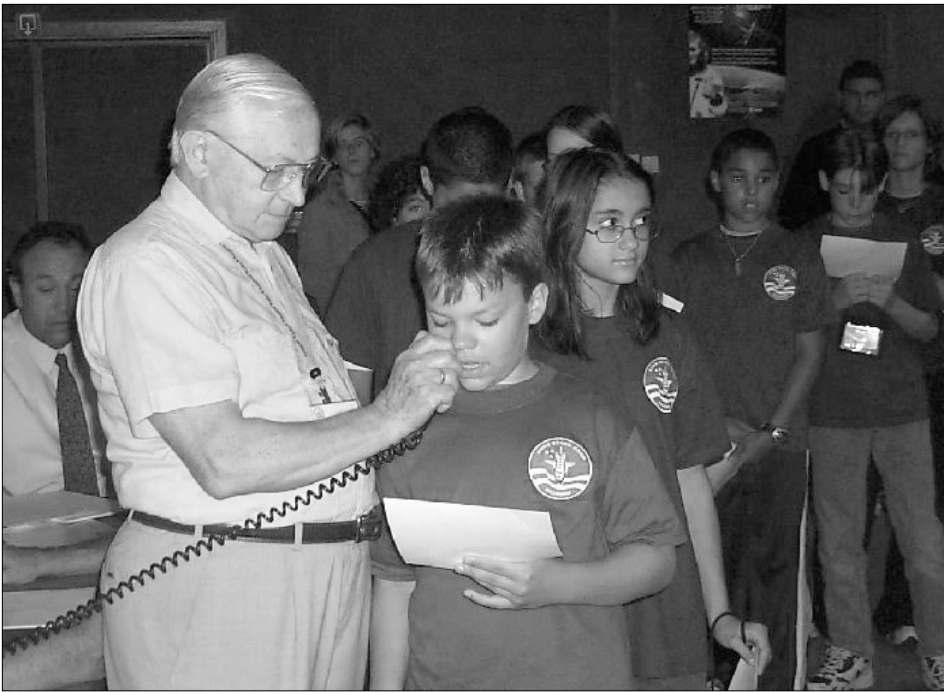


Photo 4: Students attending Space Camp at the Euro Space Center in Belgium gather in their auditorium to speak with Astronaut Ed Lu on board ISS during Expedition 7 in July 2003. (Courtesy: NASA)

ISS *has* actually been used for this purpose on at least two occasions. What's more, ARISS provides the onboard crew with an unofficial way for them to speak directly with friends and family as well as other Amateur Radio operators on Earth during their off duty time. In many ways, ARISS provides the ISS crew with a great way for them to stay connected with other human beings (besides their crewmates) during their many months of isolation aboard the

ISS. This may also be why nearly 75 percent of NASA astronauts now hold FCC issued Amateur Radio Licenses and why many who have spent long months aboard the ISS have expressed their sincere gratitude for the "morale boost" use of the ARISS equipment gave them while they were in orbit.

To help Earth bound hams get a better idea of what its like to operate via Amateur Radio from orbit, one of AMSAT's project engineers for ARISS, Ken Ransom, N5VHO,



Photo 5: Astronaut Sunita Williams, Expeditions 14 and 15 Flight Engineer, talks with students at the International School of Brussels in Belgium from the ISS's Zvezda Service Module during an ARISS school contact. (Courtesy: NASA)

recently posted a fascinating YouTube video from NASA TV on the Internet (<http://www.youtube.com/watch?v=h73EYcysz8>) that shows ISS Expedition 25's Commander Colonel Doug Wheelock, KF5BOC, operating the ARISS equipment from onboard the ISS. After taking viewers on a quick tour of the Space Station, Colonel Wheelock then puts the ARISS ham station on the air during an ISS pass over North America.

What to Listen For

As of this writing, the ARISS equipment aboard the ISS was capable of operating on a variety of frequencies as well as in a number of different modes in the 2m and 70cm amateur bands. Using the ISS's officially assigned FCC call sign NA1SS, these operating modes included FM voice, Slow Scan Television (SSTV), Automatic Packet Reporting System (APRS)[®] tracking and a 70cm to 2m cross-band repeater. While NASA has recently approved the addition of a second ham station aboard the new Columbus module, only one amateur station (currently consisting of a Kenwood D-700 amateur transceiver) is fully operational at this time (see the ISS frequency chart).

When to Listen

It is important to remember that the ISS is in a *very* low Earth orbit. As such, your available "talk time" during an ISS pass from any single location will be noticeably shorter than for most other Amateur Radio satellites. What's more, because the station does a lot of on-orbit maneuvering, having a fresh set of Keplerian Elements loaded into your computer's tracking program is absolutely critical when trying to make contact with the ISS.

Remember, too, that, aside from school contacts, the crew uses the ARISS equipment primarily during their off-duty time and, as such, they may actually be asleep when the ISS passes over your part of the planet. This, in turn, means that making a non-scheduled contact with the ISS crew will usually be a rare treat that is very much subject to the "luck of the draw".

Over the years, I've found the best way to snag a random ISS contact is to program all of the ARISS 2m downlink (and/or uplink) frequencies (plus a few more immediately above and below the published frequencies to account for Doppler shift) into your radio's memory well ahead of time. Then, as the ISS comes over the horizon at your location, rapidly switching (or scanning) all

of these frequencies will quickly tell you which, if any, of the ARISS downlinks are active on the pass.

If you have an Amateur Radio license and want to try and make a contact, once you've found an active ISS frequency and mode, common practice for voice contacts is to *very* quickly drop your call sign into the fray on the uplink after the ISS crewmember completes a CQ call (or finishes another contact).

Because there will most certainly be many other stations calling them (calls that you probably won't hear), keeping your calls short will significantly improve your chances of being heard above the fray on the other end. Unfortunately, the "capture" effect of FM means that the operator aboard the ISS may sometimes only hear "white noise" interspersed with small fragments of call signs, especially during passes over the more populated parts of the planet like North America and Europe.

So, unless you hear the ISS operator answering someone else, keep repeating your call sign over and over again (with frequent breaks) and be ready to repeat your full call sign once again ... or several times ... if asked. On the other hand, if the crewmember answers a call from another station, be courteous and stand by to await your next chance. Eventually, both your courtesy (and your patience!) *will* pay off with a coveted, ISS contact.

Looking Ahead

In future columns, I'll be taking a closer look at the history and operational characteristics of some other Amateur Radio satellites now in orbit along with a peek at some of those now under development. See you then.

REFERENCES

Tynan, William A. (et al), *AMSAT: The First Forty Years*, Silver Spring, MD: Radio Amateur Satellite Corporation, 2009. 🌐



Photo 6: Colonel Doug Wheelock, Commander of ISS Expedition 25 (shown here in a YouTube video) makes random contacts with Earth-bound hams using the ARISS radio equipment aboard the ISS. (Courtesy: NASA and YouTube)



Photo 7: ARISS contacts forever touch the lives of the school students who make them. Here a young girl goes "voice to voice" with a crewmember onboard the ISS during an ARISS school contact. (Courtesy ARISS and NASA).

