ARISS Annual Report, 2005

Introduction

Amateur Radio on the International Space Station (ARISS) is an educational outreach program, sponsored by NASA, in which students engaged in a science and technology curriculum are given the opportunity to speak with an astronaut orbiting the Earth on the International Space Station. Using amateur radio, the students ask questions about life in space or other space-related topics. Students fully engage in the ARISS contact by helping set up an amateur radio ground station at the school and then using that station to talk directly with the on-board crew member for approximately ten minutes, the time of an ISS overhead pass. Preparation for the experience motivates the children to learn about radio waves, space technology, science, geography and the space environment. In many cases, the students help write press releases and give presentations on the contact to their fellow students and to the local community. Through this hands-on experience, students are inspired to learn more in the Science, Technology, Engineering and Mathematics (STEM) fields, and to pursue STEM-related careers. From the first school contact in December, 2000 to the 195th school to date, ARISS has continued to inspire the next generation of explorers…as only NASA can.

Organization

ARISS is an international working group, consisting of delegations from 9 countries including several countries in Europe as well as Japan, Russia, Canada, and the USA. The organization is run by volunteers from the national amateur radio organizations (ARRL in the U.S.) and the international AMSAT (Radio Amateur Satellite Corporation) organizations from each country. Since ARISS is international in scope, the team coordinates locally with their respective space agency (e.g. ESA, NASA, JAXA, CSA, and the Russian Space Agency) and as an international team through ARISS working group meetings, teleconferences and through electronic mail. The team brings approximately $5 million per year of in-kind support to the ISS program, primarily through technical and educational volunteer support to the schools, hardware development, and operations support.

Program Objectives

There has been a real need for programs which encourage children to pursue STEM related careers. The ARISS program meets this need. Young people are exposed to human spaceflight by direct contact with crew members on board the ISS. The astronauts and cosmonauts benefit from the contact in that they are able to speak to people who are not solely involved with their ISS mission, reducing feelings of isolation during their long stay in space. The preparation for the ARISS contacts exposes the public as well as the ISS crew members to amateur radio. Opportunities exist for experimentation and for the evaluation of new technology as it relates to this program. The increase in public awareness of NASA and amateur radio benefits the next generation by promoting interest in science, technology and engineering fields.

Educational Outreach

Elementary through Secondary Schools

ARISS provides a forum through which students are encouraged to pursue STEM-related fields. Teachers employ NASA lesson plans and lithographs in their science and math curriculum. The Expedition 9 Tour video is also used in schools to demonstrate what life is like on the ISS. Lessons culminate in an amateur radio contact with the ISS. During the past year, children at the elementary, middle and secondary levels, throughout the world, have benefited from this unique experience as demonstrated below.

- ARISS formed a partnership with the NASA Explorer School (NES) program. NES students from Flory Academy of Sciences and Technology, Matthew J. Kuss Middle School, and Central Park Middle School participated in ARISS contacts in FY2005.

- The Air Training Corps 1132 Squadron of Stalham High School in Norfolk, England received extensive media coverage as BBC television broadcast the contact on the South England BBC TV program to an audience of millions. ARISS member, Carlos Eavis, G0AKI, coordinator of the event, provided an interview with BBC TV.

- The École secondaire Fernand-Lefebvre in Sorel-Tracy, Quebec, experienced an ARISS contact, and the media covering the event included a radio station of the National Canadian Broadcasting Network, which broadcast the audio live. Another TV station taped the event and used the footage on a program run on the Provincial Francophone cable network.

- Students from Manordale Public School in Ottawa, Ontario joined with Native Canadian children from Kujjuuauq in far north Quebec for their contact. Among the dignitaries who attended the event was Mrs. Sheila Martin, the Canadian Prime Minister's wife. Television coverage of the event reached an audience of 1 million.

- Twice each year, the European Space Agency sponsors an educational competition among primary schools in one of the ARISS European countries. During fiscal year 2005, these competitions took place at the University College Cork, Ireland and at the European Space Research Institute (ESRIN), Italy.

- Boy Scouts from the 92º Grupo de Escoteiro Caio Viana Martins in Rio de Janeiro, as well as two other scout groups, GE41 and GE82, took part in Brazil's first ARISS contact. Echolink was used to extend the outreach of this event as over two hundred additional radio stations reported hearing the contact audio.

- Young women at the Sacred Hearts School in Honolulu, Hawaii continued to support the ARISS program by running the Hawaii ground station under the direction of their teacher and a local AMSAT volunteer.

- Four hundred students, teachers, and dignitaries attended the Tregaron High School contact in Ceredigion, Wales. The contact audio was also webcast to all of the 10 local feeder primary schools, and to schools in Cardiff, Bristol, and Iowa, USA.

- NES teachers from Pine Ridge Middle School held a "NASA Nights" event to educate teachers, parents, and students about NASA programs. An amateur radio station was set up to allow students to question hams at the NASA Ames Center in California. The Ames radio operators then made contact with hams at Kennedy Space Center, and relayed students' questions to KSC experts about the ISS and shuttles. Pine Ridge looks forward to an ARISS contact in FY2006.

- The Japan Amateur Radio League (JARL) arranged for a contact to take place between 21 students and the ISS at the 2005 World Expo in Aichi, Japan. The event was covered by the official television station of EXPO 2005. World Expo 2005, held March 25 – September 25, was attended by over 22 million visitors.

- The Japan Red Cross Radio Volunteer Corps of Fukui-prefecture, Wakasa Branch, in Obama-City, Fukui-ken, Japan had a successful ARISS contact with the ISS. The Radio Corps provide training on how to communicate via amateur radio during an emergency, and the students who participated were also involved with the Wakasa branch of the Young Astronauts Club-Japan (YAC-J), which is lead by Japanese astronaut Mamoru Mouri.

Higher Education

ARISS has partnered with college and university students in STEM-related pursuits. This has given the students the opportunity to apply what they have learned to a hands-on activity, furthering their interest and abilities in science and technology and promoting STEM-related career possibilities in their future. During the past year, students at higher educational levels, throughout the world, have received benefits from this program as follows.

- In collaboration with ARISS and the DOD, students at the United States Naval Academy, under the direction of Bob Bruninga, designed and developed the PCSAT2 payload. An educational outreach project, PCSAT2 is a suitcase-sized spacecraft with a DOD solar cell experiment on one side and a ham radio communication system on the other. PCSAT2 flew on shuttle mission, STS-114, and was deployed via EVA as an attached payload on the ISS. Students have continued to participate in this project by commanding PCSAT2, monitoring its telemetry, and running experiments with the payload.

- As part of their honors program, students at the Nova Scotia College of Art and Design in Halifax worked on new ARISS website and display capabilities, in cooperation with the ARISS team.

- Students and faculty at the Santa Rosa Jr. College in Santa Rosa, California were responsible for the set-up and operation of the ARISS ground station located there.

- Under the guidance of Dr. Pawel Kabacik, Assistant Professor at the Institute of Telecommunications and Acoustics Wroclaw University of Technology, an ARISS-Europe student team continued to develop the ARISS antennas for the ISS Columbus module.

Public Outreach

ARISS engaged the public in exploring science through public outreach efforts. Through presentations, published papers, trade shows, amateur radio exhibits in museums and other public forums, and in ARISS participation in amateur radio events and activities, the public's interest in science has been advanced. Several examples of these items are described below.

- Public Relations

    - Announcements were made by the ARISS team and each school prior to and following each contact. As a result, members of the community and members of the local, national, and in some cases international press attended each school contact. These events touched tens of thousands from the general public and a worldwide public audience in the millions.

    - News items were posted to LM_NET, (a school Library Media listserv for school library media specialists) whenever an ARISS radio contact was scheduled in the U.S. during school hours.

    - ARRL consistently covered ARISS school contacts and other ARISS related items in articles printed in its monthly journal (150,000 circulation), posted on the ARRL website (100,000 regular readers), and written in their e-newsletter (circulation 115,000).

    - Interviews with the press were given. ARISS member Carlos Eavis was interviewed by the BBC while covering the Stalham High School contact, and again by BBC Radio 1 for a documentary production entitled, "Radio Anyone."

- Presentations

    - An ARRL representative gave a presentation which included information on ARISS at the 2005 National Science Teachers Association.

    - ARISS Chairman and ARISS Deputy Program Manager presented jointly, "Human Spaceflight Update: ARISS, the Moon and Mars," at the Dayton Hamvention 2005, the largest international convention of ham radio operators, which draws crowds of 25,000 annually.

- Prior to each school contact, AMSAT mentors, ARISS volunteers and school students give presentations on space, science education, and amateur radio to teachers, school staff, family members and the public in attendance.

- ARISS-U.S. delegate gave a presentation on the ARISS program at the 2005 Dayton ARRL National Convention.

- Inactive astronaut Tony England attended the 2005 Dayton Hamvention and gave two presentations. He spoke to ARRL about amateur radio and space, and his speech to AMSAT covered amateur radio satellite activities as a motivator for pre-college students' interest in science and math.

- Publications and Papers

  - ARISS Chairman wrote a paper, "THIS IS SUITSAT-1, AMATEUR RADIO STATION RS0RS!!" The paper was translated and posted on several international websites, and was used as a reference for other SuitSat articles including one published in the Japan *CQ* magazine, and another written for school children on the NASA Education website.

  - ARISS U.S. delegates wrote a white paper for the inclusion of Amateur Radio in the Space Exploration Initiative. "Amateur Radio on Human and Robotic Space Expeditions---An Outstanding, Cost Effective Educational Outreach Partnership" was submitted to NASA for consideration.

- Public Outreach Events and Activities

  - A contact via amateur radio was made with the ISS as part of a large international festival held near Moscow. The Union of the Radio Amateurs of Russia, the Russian Robinson Club and the RUSSIAN-IOTA participated in the festival, as did more than 350 amateur radio operators from Russia, Germanium, Hungary, Ukraine, Moldova, Byelorussia, Kazakhstan, Estonia, Latvia, Lithuania and the USA, including the ARISS Russian delegate and a few other cosmonauts.

  - An aerospace museum at Alfonso Air Base in Brazil placed an amateur radio station in its ISS exhibit. The radio continues to monitor ARISS activities.

  - AMSAT joined in the celebration of Space Day 2005 at the Steven F. Udvar-Hazy Center by setting up an activity station for students and the general public and

displaying and distributing ARISS lithographs. Visitors numbering 11,693 attended the Space Day event, and another 1,576 students participated through school groups. Through a partnership with the Fairfax Public Schools Network, the center reached 32,971 schools and 7.5 million students. Special guests attending Space Day included NASM Director General Jack Dailey, John Glenn, the STS-116 crew and NASA Deputy Administrator Fred Gregory.

- A teacher, whose school experienced an amateur radio contact with an astronaut in past years, gave a presentation to students with the help of ham radio volunteers, about space, technology and amateur radio. ARRL provided materials for the 107 students who took part. The event, tied in with "Take Your Kids to Work," was sponsored by the Institute of Electrical and Electronics Engineers, Inc. (IEEE).

- An ARISS member, who participated in the Pre-Service Teacher Institute at JSC, taught students how to include science and math in their curricula. Instruction was provided to 12 students who took and passed the amateur radio exam and received their technician licenses.

- ARISS members participated in a NASA Explorer School Satellite Communication Class at GSFC and introduced 35 teachers to ARISS and Amateur Radio. As part of the class, a contact was set up between the NES teachers and the ISS.

- The Expedition 11 crew participated in ARRL's Field Day, 2005. Both John Phillips and Sergei Krikalev logged several contacts with ham radio operators around the world.


ISS011E05496

- Cosmonaut Sergei Krikalev sent greetings via video to the International Amateur Radio Union (IARU) Region 1 conference held in Switzerland. One hundred delegates from 56 countries were in attendance. The conference approved the creation of a permanent Region 1 working group in charge of amateur radio activities related to Space Exploration.

Crew Operations

Crew members may use the ISS Ham Equipment to speak to friends, family and the general public to help prevent feelings of isolation.

- STS-114 astronaut Andy Thomas made contacts with stations in Australia and New Zealand while on board the ISS.

- Cosmonaut Sergei Krikalev made several contacts and received many wishes for a happy birthday from ground based stations around the world.

New Initiatives

Voice over the Internet Protocol

In 2004, work began in expanding the program's outreach to both students and the general public using Voice over the Internet Protocol (VoIP) technology which links the ISS to amateur radio over the internet. In 2005, work continued in this area. Internet Radio Link Project (IRLP) and Echolink have been successful in expanding the audience base of ARISS contacts as additional schools and individuals have tied into the audio made available through VoIP.

SuitSat

A satellite, proposed by the Russian delegation to send greetings to school children in commemoration of the 175th anniversary of the Bauman Moscow State Technical University, was designed, developed, and the components fabricated in 2005. A Russian ISS Orlan spacesuit already on board the ISS and past its useful life will be used to house an amateur radio system. The radio hardware for this system was launched in September, 2005. The suit will be assembled and deployed by the Expedition 12 crew in early February 2006. Once activated, the satellite will send greetings and special words in several languages which school children may decode. A Slow Scan Television (SSTV) image will also be transmitted. Those who hear SuitSat and provide the special words and messages heard or record image telemetry may request a certificate acknowledging their accomplishment.

Schools worldwide were also invited to submit artwork to be flown on the satellite. Over three hundred items were compiled and two copies of the artwork CD are now on board the ISS. One will be inserted into the spacesuit prior to its deployment, and the other will be available for viewing by the ISS crew. Once the ISS Ham SSTV equipment is fully functional, some of these images may be transmitted to earth, providing additional opportunities for school children to participate in this exciting project.

ARISS International Face to Face Meetings

Purpose of Face-to-Face Meetings

Because ARISS is managed by an international team of volunteers, and because the ARISS program covers a diverse and large number of aspects such as current and future hardware, school and community education, publicity, operations with crew, crew support, (and so on), the volunteers meet as a team once each month on a teleconference call. Each of the 5 major

ARISS committees that make up the entire team also meet among themselves on a weekly, monthly, or bi-monthly basis. Because the ARISS Team members come from many different cultures, the team learned that in order to interface effectively, we needed to hold an annual international delegate face-to-face meeting.

International delegate meeting agendas cover a broad array of items that are voted on after full discussions based on each country's point of view. The Fiscal Year 2005 Meeting was held in Guildford, U.K.

Details from the Most Recent Meeting

As reported above, the ARISS Meeting agenda covers a diverse and large number of aspects, including school and community education, on-orbit and future hardware, publicity, operations with crew, crew support, etc.

The ARISS Team is made up of 5 regions representing the 5 primary space agencies (US, Canada, Russia, Europe and Japan). ARISS radio activity for youths is divided equally between these regions, and at ARISS Meetings, regions report on their school successes. The ARISS-Europe team described their tremendous work with ESA. They set up a national semi-annual student competition, "Call ISS," that reaches far more students than any of the other ARISS radio activities. Twice each year, a different European nation is selected, and in FY2005, schools from Ireland and children from Italy successfully participated in the ARISS competitions. Winning students earned opportunities to speak by ARISS radios with astronauts Leroy Chiao (Expedition 10) and Roberto Vittori (Eneide Mission) on the ISS. The ARISS-Europe team set up four other radio contacts for taxi flight crews.

The ARISS U.S. Team described the changes going on at NASA, the new administrator, the new point of contact in NASA Headquarter's Education Office, and funding issues. The ARISS-U.S. partnership with the NASA Explorer School (NES) program was also discussed.

Other topics reported at the face-to-face meeting included the following.

- Progress on the Columbus Module antennas and radio system.
- The use of Skype (internet telephony) for school contacts.
- ARISS contact card and possible printers.
- Expanding our partnerships, and therefore, sustainability, through increasing our audience who listens to our radio contacts by using Internet Radio.
- Shadow Satellite Experiment.
- Discussion on planning to use our worldwide team for the Exploration *(Moon, Mars and Beyond)* initiative.
- Next ARISS International Meeting to be held in conjunction with the annual AMSAT Symposium in San Francisco, October, 2006.

Technical Interchange Meeting

ARISS-U.S. members met in Houston for a Technical Interchange Meeting (TIM) to discuss SuitSat's design. Russian delegate Sergey Samburov was able to tie in to the meeting via teleconference, and the SuitSat team met with SuitSat Deputy Manager Alexander Poleschuk.

The U.S. team visited the Russian Orlan spacesuit and a draft protocol was written. SSTV testing was also performed on both the Ericsson and Kenwood systems.

Program Evaluation and Outcomes

Teachers evaluate the ARISS program after their contact with the ISS by submitting a NASA Education Evaluation Information System (NEEIS) form. Additionally, input obtained from crew debriefs is taken into consideration for program improvement. Awards in excellence given to ARISS members are also an indicator of the program quality. Students and teachers continuing their education in fields related to the ARISS program, and remarks made by those involved with the program can provide necessary feedback to improve and refine the program. The items listed below are indicators of this program's success.

- Stephanie Radcliff experienced an ARISS contact as a student at Daviess County High School (DCHS) in Owensboro, Kentucky in May 2001. Today she is a graduate of Embry-Riddle University, and holds a degree in the aerospace field. She has applied and hopes to be accepted for astronaut training. Harold Wilson, the coordinating teacher of the DCHS - ARISS contact, remarked that it was the ARISS contact which inspired Stephanie to pursue this career.

- "I think the radio angle is novel enough that the reporters hadn't all 'been there done that' and so were very enthusiastic in their coverage. They were very impressed by the outreach NASA does in this regard, so the agency will get some good buzz on the evening news and in the paper. Again, I want to thank the NASA folks again for making it all happen."
  -Maura Mackowski, John Phillips' sister

- "Students were tracking the space craft, controlling the directional antenna, operating the radio transmitter and talking to an astronaut. Science doesn't come into the classroom better than this." - Matt Ryan, coordinating teacher of the Brigidine College contact in Sydney, New South Wales, Australia.

- "It's not everyday you get to talk to an astronaut on the International Space Station." "It was fun! We made history!" "I think we are really privileged to make a connection to the I.S.S." "I learned a lot, too!" –comments from Bentley School students after their contact

- "Thank you for the amazing chance to excite my students at Central Park Middle School. The event is one we will never forget. Thank you for giving us this opportunity and please keep us in mind in the future if there are any other events you would like me to coordinate." - Danielle Hartkern, Central Park, NES

- "The events leading up to the big day were very successful and contact day itself was really great. Flory students, teachers, parents, school staff, and the press were all amazed. It was a huge impact on the school."
  - Ota Lutz, AESP, NES coordinator, Flory contact

- "I've worked on many, many projects and programs in this district over all these years, and this is the first time I've ever seen our entire district come together so efficiently and with so much generosity of spirit. It is and has been an enlightening experience." –Pat Bachamp, Flory school teacher

- "I would like to thank – through you- ARISS/Ireland for their impeccable and enthusiastic support of the event in Cork last December. The event was a huge success, with excellent media coverage printed/radio and TV!! – and, above all, 400 happy kids, and their teachers. Thank you very much for your fantastic collaboration, and a very happy 2005." – Elena Grifoni, Head of ISS Utilisation Strategy and Education Office, European Space Agency

- Sonoran Sky Elementary, KA7SKY, received a Satellite Communicators Club award from AMSAT-NA. The school experienced a contact with the Expedition 8 crew, and continues with its amateur radio activities, including participation in Kid's Day and JOTA.

- Student SAREX volunteer, Mike Sufana, received his Aerospace Engineering degree and is now working at Northrop Grumman.

- SAREX student, Melissa Mladnic, from Jerling Jr. High, is attending Purdue University school of Aerospace Engineering with aspirations of becoming an astronaut.

Future ARISS Projects

SuitSat 2
ARISS has been presented with the opportunity to participate in a second SuitSat project. SuitSat 2 would be launched in 2007 to celebrate the 50th anniversary of the launch of Sputnik, the 100th anniversary of Korolev's birthday, and the 150th anniversary of Tsiolkovsky's birthday. The Russians are designing a new Orlan MK spacesuit, and it is expected that the suits currently onboard the ISS will be available for ARISS' use once the new suits are made available to the ISS crew. SuitSat 2 is expected to have greater capabilities than its predecessor, and may be equipped with solar panels, increasing its expected lifespan.

Exploration (Moon Mars and Beyond) Initiative
NASA is currently pursuing an exploration of space to the Moon, Mars, and Beyond. ARISS is considering educational payloads that may be included on these missions. A repeater on the moon, a remote amateur TV, and a Mars telecom satellite are such possible payloads.

These payloads will provide points of interest to the student, promoting again an interest in space, amateur radio, science and technology.

Appendix

Appendix A NEEIS forms

Appendix B SuitSat Paper, Frank Bauer

Appendix C School Contact Maps

Map, ARISS-USA Radio Contacts, FY2005

Map, ARISS-USA Radio Contacts through FY2005

Map, ARISS-International Radio Contacts through FY2005

Appendix A NEEIS Forms

FY2005 FINAL PROGRAM REPORT

General Information

Program Title: Amateur Radio on ISS (ARISS)

Program Manager:
Name: Erika Vick
Email: evick@hq.nasa.gov
Phone: 202-358-2209
Report Submission Date: 10-Apr-2006

Program Information

1. Will this program be offered in FY 2006? (Yes)

2. Primary Program Type:

(X) NASA-Wide
() Center-Unique
() Directorate:

Directorate:
() Exploration Systems
(X) Space Operations
() Science
() Aeronautics Research
() No Directorate

() Partnership
() Multi-Center

3. Project Type:

(X) Elementary and Secondary Participation
() Higher Education Capability
() Under-represented and Underserved Participation
() e-Education
() Informal

4. Project Focus:

() Teacher/Faculty Preparation and Enhancemen
(X) Student Support
() Curriculum Support and Dissemination
() Education Technology
() State Based Improvement
() Research and Development

5. Goals & Objectives :

Goal 6:	(X) 6.1	(X) 6.2	(X) 6.3	() 6.4
Goal 7:	(X) 7.1	(X) 7.2	(X) 7.3	

6. Program Duration :

(X) Short Event (A few hours only.)
(X) One time Only
() Multiple Meetings with the Same Participants
Number of Meetings:
(X) Short Intensive Program (less than 4 days)
() 7-13 Day Intensive Program
() 2 Week Intensive Program
() 3 Week Intensive Program
() 4 Week Intensive Program
(X) 5-8 Week Intensive Program
() 9-10 Week Intensive Program
Total number of Events/Workshops lasting between 1 and 10 weeks long offered :
() Extended Program Up To One Year
() Extended Program More Than One Year
Number of Years :

7. Program Content :

(X) Aeronautics/Aerospace	()Astronomy
(X) Astrophysics	() Bioengineering
() Biology	() Business
() Chemistry	(X) Computers/Computer Science
() Earth Sciences	(X) Education
(X) Engineering	() Environmental Sciences
(X) Geography	() Life Sciences
() Materials Sciences	(X) Mathematics
(X) Physical Sciences	(X) Physics
() Psychology	(X) Social Sciences
(X) Other	

Program Details Information

1. Applicants : 150

2. Location of Program Activities :

(X) NASA Center(s)	(X) Museum/Planetarium(s)
(X) University Campus(es)	(X) Industry or Private Sector Facilities
(X) Community College Campus	(X) Elementary/Middle/High School(s)
() Community Facilities	() Other

3. Program Activities Techniques and Resources :

(X) Computer Training	(X) Mentoring (K-12 or College Students)
(X) Demonstrations	(X) Movies/Video
(X) Group Discussions	(X) Problem Solving Activities
(X) Hands On Activities	() Research Analysis
() Field Trips	(X) Team Activities/Projects
() Independent Study	() Textbooks
(X) Interdisciplinary Activities	() Tours
(X) Internet/Communications Technology Training Sessions	() Video Teleconferences
(X) Investigation	() Working Group
() Laboratory	() Other
(X) Lectures	

4. Standards (Was support provided for any of the following standards?):

(X) National Mathematics Standards	(X) National Science Standards
() National Geography Standards	(X) National Technology Standards
() State Frameworks	() Local Frameworks
() Other	() Not Applicable

5. Participant Products (By end of the program, the participants prepared one or more of the following.):

(X) Action Plan	() Research Proposal
(X) Article for Publication	Report
(X) Presentation for a Conference	(X) Oral
() Course Outline/Revision	(X) Written
() Course Problem Set/Activity	() Software
(X) Drawing or Art	() Teacher's Manual
(X) Journal/Lab Workbook	Teaching/Learning Activity using:
Lesson Plans using:	()Experienced-Based Activity
() Experienced-Based Activity	() Scientific/Engineering Methods of Inquiry
() Scientific/Engineering Methods of Inquiry	() Technology
() Technology	() Interdisciplinary Approaches

() Interdisciplinary Approaches	() NASA Materials
() NASA Materials	() Technical Paper for Publication
(X) Multimedia Product (includes video)	(X) Educational Video
() Physical Model or Product	(X) No Product Required
() Portfolio	() Other
() Project Design	
() Research Paper	

6. Program Content :
(X) Science (X) Mathematics (X) Engineering (X) Technology (X) Other

7. Networking and Electronic Resources :

Does the Program provide some means to promote ongoing communications among participants after the Program is over?
(X) Yes () No () Not Applicable

Did the Program introduce participants to NASA On-line Resources?
(X) Yes () No () Not Applicable

8. Multiplier Effect :

Did you take any actions to encourage and/or facilitate a "multiplier" effect to extend the benefits of the Program beyond participants once the Program is over?
(X) Yes () No () Not Applicable

9. Underrepresentated Groups :

Did you take any actions to make your Program announcements and information available to members of various populations which are generally underrepresentated?
(X) Yes () No () Not Applicable

10. Funded (The program funded the following for the participants.) :

() Course fees/Credits Paid/CEU
() Expenses/Per Diem
() Fellowship/Scholarship
() Grant
() Materials, books to be kept by the participant
() Membership in a Professional Organization
() Stipend/Honorarium
() Other

Resource Details Information

1. Funding :

	Total
Funds from NASA HQ Codes (Not Ed):	$0
Funds from other NASA Centers:	$0
Funds from your Center:	$0
Funds from other Federal Agencies:	$0
Funds from State Government Agencies:	$0
Funds from Contractors/Grantees (Not NASA funds):	$0
Funds from Local Organizations:	$0
Funds from Educational Organizations/Institutions:	$0
Other:	$0
Total Funding:	$0

2. Staffing :

() This Program is primarily managed by a contractor/grantee

(X) This Program is primarily managed by NASA staff.

Number of NASA Civil Servants involved :

	Total
Administrative	0
Astronauts	8
Audio/Video Specialists	0
Computer Specialists	0
Education Specialists	0
Engineers	0
ERC Staff	0
On-line Resources Specialists	0
Pilots	0
Program/Project Managers	1
Scientists	0
Support Staff	0
University Affairs Officers	0
Total NASA Civil Servants:	9

TOTAL NUMBER OF PRESENTATIONS: 100
TOTAL NUMBER OF PRESENTERS: 25

Total number of NASA presenters: 2
Total number of contractor presenters: 23
NUMBER OF RETIREES (NON-NASA AND/OR NASA): 200

3. Partnerships/Collaborations - Rollup :

	Total
NASA Contractor Partnerships/Collaborations:	0
Other Industry Partnerships/Collaborations:	47
Community/Local Partnerships/Collaborations:	0
Museum/Planetarium Partnerships/Collaborations:	0
Non-Profit Partnerships/Collaborations:	47
Other Federal Agency Partnerships/Collaborations:	0
Higher Education Institution Partnerships/Collaborations:	0
Other NASA Center Based Partnerships/Collaborations: (not including the ED Branch or PAO if it is separate from the Education Office)	0
Other NASA HQ Program Office Partnerships/Collaborations:	0
K-12 School Partnerships/Collaborations:	47
K-12 School District Partnerships/Collaborations:	0
Professional Society Partnerships/Collaborations:	0
State Government Partnerships/Collaborations:	0
Education Resource Center Partnerships/Collaborations:	0
Community College Partnerships/Collaborations:	0
Total Partnerships/Collaborations:	141

4. Fellowships and Scholarships :

	Total
Students 9-12:	0
Undergraduate Students:	0
Graduate Students:	0
Post Doc:	0
Other:	0
Total Fellowships and Scholarships:	0

5. NASA Materials Distributed - Rollup :

	Total
Total Number of NASA educational materials (videos, publications, wall posters,--not patches, pencils, bookmarks, etc.) distributed:	900
Number of NASA individual educational materials demonstrated by presenter(s) during the Program:	25

6. NASA Facilities :

	Number
Aircraft:	0
Clean Rooms:	0
Computer Labs:	0
Control Room:	1
Drop Tower:	0
Ground Trainers:	1
Hanger:	0
Laboratories:	1
Launch Pad:	0
Maintenance Facilities:	0
Mockup Facilities:	0
Spacecraft Display:	0
Test Stands:	0
Wind Tunnel:	0

Participant Counts Information

A. DIRECT PARTICIPANTS:

1. Teachers:

	Physical Presence Number	Distance Learning Number
ENTER THE TOTAL NUMBER OF ALL K-12 AND IN-SERVICE TEACHERS:	**553**	**303**

	Physical Presence Number	Distance Learning Number
Teachers teaching grades K-4:	117	37
Teachers teaching grades 5-8:	181	126
Teachers teaching grades 9-12:	186	128
In-Service Teachers:	0	0

2. Higher Education Faculty:

	Physical Presence Number	Distance Learning Number
Community College:	7	36
4 year undergraduate:	31	30
4 year undergraduate/graduate:	89	41
Total Faculty:	127	107

3. Students:

	Physical Presence Number	Distance Learning Number
K-4:	1,262	455
5-8:	1,723	1,210
9-12:	1,583	2,105
Community College:	1,635	35
4 year undergraduate:	104	40
4 year undergraduate/graduate:	12	20
*Pre-Service Teachers:	9	0
Post Doctoral:	6	30
Total Students:	6,325	3,895

**The "Preservice Teachers" are not included in any totals. It is assumed that these participants will be reported under some other category e.g. 'Undergraduate Students', etc.*

4. Additional Participants:

	Physical Presence Number	Distance Learning Number
Administrators:	165	29
Civic Group:	302	118
Education Specialists:	93	13
Parents:	1,203	137
Professional:	189	54
Other:	279	62
Total Additional Participants:	2,231	413

TOTAL OF ALL DIRECT PARTICIPANTS: 13,959
(From A) (System Generated)

B. EDUCATION COMMUNITY PARTICIPANTS:

	Anonymous Physical Presence (number)	Anonymous Distance Learning (number)
K-12 Teachers	313	22
K-12 Students	3,426	300
Higher Ed Faculty	67	0
Higher Ed Students	466	0
Other (Administrators, Educators and Students where the academic level is not known,Parents, etc.)	219	20
Total Education Community:	**4,491**	**342**

TOTAL OF ALL EDUCATION COMMUNITY PARTICIPANTS: 4,833
(From B) (System Generated)

C. GENERAL PUBLIC/INFORMATIONAL OUTREACH:

	Participants (number)
General Public At Lectures, Tours, Conferences/conventions, museums/booths/displays, etc.	1,607
Estimated Newspaper/Magazine Audiences	13,676,774
Estimated TV/Radio Broadcast Audiences	16,102,474
Estimated CD-Rom Users	371
Web Audiences: Unique IP Addresses (*not included in totals below)	1,410
Other:	80
Total Public/Media:	**29,781,306**

TOTAL OF ALL OUTREACH PARTICIPANTS: 29,781,306
(From C) (System Generated)

TOTAL OF ALL PARTICIPANTS: 18,792
(From A & B) (System Generated)

GRAND TOTAL OF ALL PARTICIPANTS: 29,800,098
(System Generated)

Appendix B
SuitSat Paper, Frank Bauer

THIS IS SUITSAT-1, AMATEUR RADIO STATION RS0RS!!

Frank H. Bauer; KA3HDO
Amateur Radio on the International Space Station (ARISS) International Chairman
AMSAT Vice President for Human Spaceflight Programs
NASA Goddard Space Flight Center

Introduction

"**This is SUITSAT-1, Amateur Radio Station RS0RS**!!"

These words will echo from space in the near future, inspiring students, exciting ham radio operators and touching the world.

If all goes as planned, a unique Extra-Vehicular Activity (EVA)—or Spacewalk will be conducted on the International Space Station (ISS) in early February 2006. During this spacewalk, the ISS crew will push a Russian spacesuit overboard---with no humans in it, of course! But this Spacesuit holds the hopes, dreams and creativity of students around the world. And for a week or two, this Suit-robot-satellite will take on a life of its own---parroting students voices from around the world, voicing down suit health telemetry and sending a special commemorative picture to all who want to receive it.

Suitsat-1 (also called Radioskaf or Radio Sputnik in Russian) mission activities will be conducted on the amateur radio (ham radio) frequencies, a bit above the FM broadcast band. The voice signals can be picked up with ham radio receivers and FM VHF (Very High Frequency) scanners—like police-band scanners.

Students, scouts, teachers, ham radio operators, and the general public are encouraged to track the space suit, hear the conversations from space, copy the suit telemetry and capture the picture. A special certificate will be distributed to those who receive the voice signals and those who capture the picture. We also will have a special award for those students who receive the "special words" that are embedded in the messages from our SuitSat student "crew members." These special words are in different languages---English, French, German, Spanish, Russian, and Japanese. So you are encouraged to record the SuitSat downlink audio and get help from fellow students who know these languages.

Also included in this spacesuit is a computer Compact Disk (CD) with images of over 300 items collected from schools and educational organizations around the world. These include creative works of art from students as well as student signatures, school or scout logos, and class or group pictures. Students, schools and educational organizations that participated in the development of this disk earlier this year will all be part of the SuitSat spacewalk---as their creative works, signatures and pictures all float in space!

The following will provide more details on the Suitsat-1 mission and provide you information on how you and your school can participate.

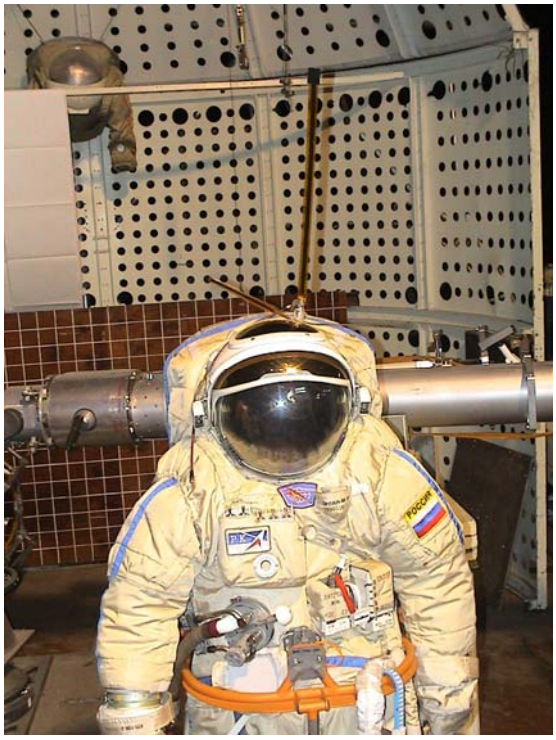
The Suit and On-Board Equipment

Through the miracle of ham radio, the ingenuity of the international space agencies, the help of students and schools, and the tireless work of a few volunteer "rocket scientists" Suitsat-1 was born.

SuitSat is sponsored by ARISS (Amateur Radio on the International Space Station), an international working group consisting of volunteers from national amateur radio societies (the American Radio Relay League in the U.S.) and the internationally-based Radio Amateur Satellite Corporation (AMSAT).

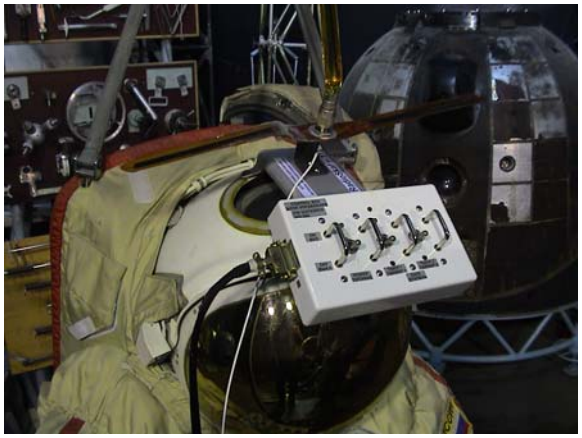
The idea for SuitSat was first conceived by the ARISS-Russia team, led by Sergey Samburov, RV3DR, and was extensively discussed at the joint AMSAT Symposium/ARISS International Partner meeting in October 2004. The project, is being led by project manager A. P. Alexandrov and Deputy Project Manager A. Poleshuk from RSC Energia, located in Korolev (Moscow area) Russia. The project was developed primarily by a joint US/Russian team. On the US side, the hardware project development was led by AMSAT member Lou McFadin, W5DID.

Embedded in the Russian Orlon Space Suit (Figure 1) are two boxes housing the ham radio transmitter and the micro-controller and electronics that stores and plays back the digital voice and video recordings. Also inside the spacesuit will be some batteries to power the system and the "School Spacewalk" CD. On the outside of the spacesuit is the SuitSat antenna and the crew interface control box---the crew interface device that turns the SuitSat power on. See figures 2 to 3. Prior to the spacewalk, the ISS crew connects cables to the two internal boxes (the Kenwood transmitter box and the micro-controller electronics box), figure 4, and stores these two boxes in a fabric container that is housed inside the space suit (see figure 6). Next, they mount the antenna and the interface control box to the exterior of the suit helmet as shown in figure 2. Next, the batteries, interface control box and antennas are all connected to the two internal boxes with special connecting cables. The SuitSat is then ready for deployment. Once the crew is outside on their EVA, they turn all three switches on the control box to the ON position and deploy the spacesuit from ISS. Their objective is to put Suitsat in a retrograde orbit so it "de-orbits" relative to ISS. This orbit will appear from the ground to be



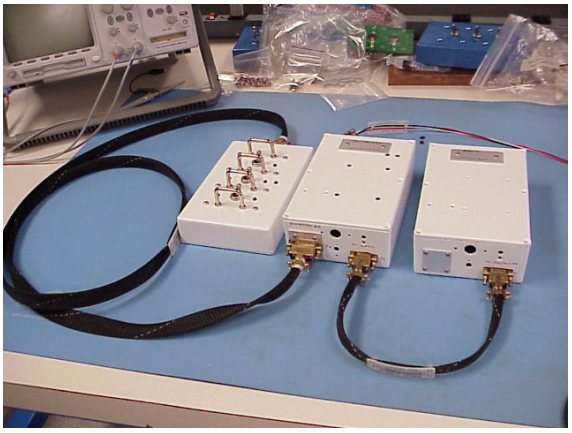
Russian Orlon Spacesuit
Figure 1

Crew Interface Control Box
Figure 3



SuitSat Antenna & Crew Interface Control Box
Figure 2

ahead of the ISS, while it is actually slowing down and is below ISS.



SuitSat Interface Control Box, Transmitter Box and Digitalker/Micro Controller Box
Figure 4

About eight minutes after the crew flips the three switches, the Kenwood transmitter, figure 5, will power up. About eight minutes after that, the first voice telemetry message will be transmitted and SuitSat operations begin! (This 16 minute delay is a crew safety measure).

Kenwood TH-K2 Transmitter
Figure 5

Please remember that this mission is battery operated. In other words, when the batteries run down, SuitSat stops transmission. We also do not know how fast SuitSat will heat up. So our ability to predict mission life is not very good. Our prediction is 1-2 weeks. However, it may stay on for as little as little as an hour or as long as several weeks. So if you want to hear SuitSat, your objective is to get prepared for SuitSat operations ahead of time.

Suitsat-1 Transmission Specifics

Suitsat Hardware -Transmitter and Digitalker/Microcontroller Box inside Fabric Container
Figure 6

All transmissions will be on 145.990 MHz FM. This is in the VHF (2 meter) portion of the amateur radio band. It can easily be picked up with a simple VHF hand-talkie ham radio, although ground-based antennas with higher gain are preferred to hear SuitSat for the entire 10 minute pass. SuitSat audio can also be received using a police band scanner. An external antenna is highly encouraged. SuitSat will be transmitting 0.5 watts into the same type of antenna currently used on the ISS ham radio station.

Additional Downlink Frequency and Information for Ham Radio Operators

Since SuitSat will be operating on the ISS world wide packet uplink frequency of 145.99 MHz, it is requested that all packet operations on that frequency be suspended for the duration of the SuitSat transmissions. Keeping transmissions off the downlink frequency will help to avoid local interference to the 1/2 watt downlink signal from SuitSat.

The ISS crossband repeater is under consideration for being temporarily reconfigured to listen for the SuitSat transmissions and then retransmit them on 437.80 MHz. It is hoped that persons with minimal equipment might have a better chance of hearing the SuitSat retransmissions from the crossband repeater since ISS has a power output of 10 watts. Please help us to avoid interference problems by not using the crossband repeater while SuitSat is active because anything else the repeater hears on 145.99 MHz will interfere with the SuitSat retransmissions.

Tracking Suitsat-1

If you plan to hear Suitsat, you need to know when it will be visible in your area. To do this, you need to obtain some orbit prediction software or see the ISS orbital path from the internet. Information on this can be found at the following:
http://www.amsat.org
http://www.amsat.org/amsat-new/tools/
http://science.nasa.gov/Realtime/jtrack/

Please understand that when you use an orbital prediction program you need an accurate synchronization of time (to a few seconds).

Downlink Specifics

To fully understand the Suitsat-1 downlinks, some background information is in order.

One of the reasons our Russian colleagues were interested in developing SuitSat was as an on-orbit commemoration of the 175th anniversary of the Bauman Moscow State Technical University. This university is where many of the engineers in the Russian Space Agency graduated. As a result, the Russian-generated messages include congratulatory comments to the Bauman Moscow State Technical University.

In addition to the messages from Russia, there are voice messages from students in Japan, Europe (Spanish and German), Canada (French) and the USA (English). The USA message is from a student enrolled in the Eastern Middle School, Silver Spring, Maryland. Eastern Middle School is a NASA Explorer School. In addition, the Suitsat-1 ID was voiced by a Korean-born young lady enrolled in Paint Branch High School, Burtonsville, Maryland, USA. As you can see, Suitsat-1 truly has an international flavor!

Special Word

Several of the student messages include a special word. One student project for SuitSat will be to copy all the special words (in different languages) and submit them to the ARISS team for special educational award recognition.

Suit Telemetry

The suit telemetry is sensed by the SuitSat microcontroller and converted to a voice message. Three telemetry data messages will be transmitted. These will be periodically repeated.

Specifically, the suit telemetry will be transmitted in the following order:

-Mission Time
-Suit Temperature
-Battery Voltage, where 28 Volts is the nominal voltage

The SuitSat team is quite interested all three pieces of telemetry as it will be a predictor for SuitSat mission life.

SuitSat Downlink Picture

The downlink picture will be transmitted using a set of audio tones, similar to a computer modem, using a ham radio picture standard called Slow-Scan Television (SSTV). SSTV, developed many years ago, provides Cell Phone quality pictures. A single picture was installed in the SuitSat microprocessor memory and will be downlinked. SuitSat uses an SSTV data transmission standard called Robot 36. This standard sends the entire image in 36 seconds.

For more information on SSTV, you may check out:
http://www.marexmg.org/spacecam/spacecam.html
http://www.ultimatecharger.com/SSTV.html

Suitsat-1 Downlink Sequence

Now that you understand the specifics, what can you expect when SuitSat is over your area? To save SuitSat power and to maximize the time that SuitSat is operational, 30 second pauses have been included between each of the voice messages. So the sequence will be as follows:

-SuitSat Voice ID (5 seconds)
-International voice message, Suit Voice Telemetry, or SSTV Image (15-45 seconds)
-30 second pause
….and repeat

The international message order will be as follows:

-Voice Telemetry
-Russian Message
-Europe Student Messages (Spanish and German)
-Bauman Institute Message (Russian)
-Canada Student Message (French)
-Mr. Alexandrov Message (English)
-Japan Student Message (Japanese)
-USA Student Message (English)
-SSTV Picture

Copying SuitSat Data

If you are planning on copying the Suitsat-1 downlink, you are highly encouraged to record it so you can replay it later. Tape recorders or digital voice recorders with at least 10-15 minutes of continuous recording are recommended. You can then use these to submit Suit telemetry information, the special words and the SSTV image to the ARISS team and the space agencies.

"School Spacewalk" CD

As part of the SuitSat project, a CD with hundreds of school pictures, artwork, poems, and student signatures is included. Two identical CDs were flown, one will go in the suit as part of the Suitsat-1 spacewalk. The other is available for the crew to review. There are approximately 300 items on the CD including artwork, school and educational organization logos, student signatures and student and school pictures. A composite of several of the items installed on the CD are shown in figure 7. As you can see, these are from all over the world (Japan/Asia, Europe, Russia, Canada, US, South America and Africa). Several NASA Explorer Schools participated as well as numerous ESA and Russian Space Agency-sponsored schools.

SuitSat postings of telemetry, special messages and the SSTV Image

This is still a work in progress. Please return to the web site often to get details on this as the SuitSat mission gets closer.

Special Certificates

Those that hear SuitSat will be eligible to receive a special certificate in commemoration of your achievement. Also, if you receive the SSTV image, copy the telemetry and/or copy the special words, special certificate endorsements will be provided. To receive a SuitSat special certificate, please use the standard QSL card address in your area of the world. These are located at:
http://www.rac.ca/ariss/oindex.htm#QSL's
Indicate the time and date you heard SuitSat and any other information that will acknowledge your reception of the information (telemetry, SSTV picture, etc) that will confirm that you should receive the proper endorsements on your certificate. Please include a self addressed stamped envelope. And provide a big envelope and protective cardboard if you do not want your certificate folded or damaged during shipment.

Current Status

On May 10, 2005 NASA gave the OK to fly. Four short weeks later, the USA built SuitSat hardware was sent to Russia for final testing, certification and integration with the Russian-built hardware.

On Thursday September 8 at 13:08 UTC, Progress 19P lifted off from the Baikonur Cosmodrome in Kazakhstan. Included in the 2.5 tons of fuel, food and supplies was the Suitsat amateur radio hardware. The successful docking of Progress to ISS on September 10 culminated the successful design, development, certification and delivery of this exciting educational project. The ISS Expedition 11 crew has unpacked the SuitSat equipment, making it available for installation, use and deployment by the Expedition 12 crew. SuitSat deployment is currently scheduled for February 2, 2006.

Figure 7

Conclusions

The SuitSat project was an extremely challenging endeavor for the ARISS hardware team, primarily due to the very short development time. Throughout the development effort, we have involved students. As SuitSat nears deployment, we are looking forward to the continued involvement and participation of students worldwide.

For all the amateur radio operators in the world, this is your chance to get your local school involved. Bring a radio, orbit tracking program, SSTV equipment, an audio recorder and your enthusiasm into the school. SuitSat promises to capture the imagination of the students and, if successful, will allow the students to learn more about space, amateur radio and satellite orbits. Please volunteer and wish our robotic astronaut in the Russian Orlon suit a good and successful journey in space!!

Additional Information

ARISS web site: http://www.rac.ca/ariss
AMSAT web site: http://www.amsat.org
http://en.wikipedia.org/wiki/Orlan_space_suits
http://www.issfanclub.com
http://space.cweb.nl/article.html?id=407 photo of how cosmonauts get into the Orlan suit

Acknowledgements

On behalf of the ARISS International team, the author would like to acknowledge and congratulate the Suitsat hardware development team for their "Can Do" spirit and ability to deliver the Suitsat hardware on such a very challenging schedule.

Specifically, we would like to thank the following: Alexander Alexandrov, Alexander Poleshuk, Sergey Samburov, RV3DR, Lou McFadin, W5DID, Kenneth Ransom, N5VHO, Frank Bauer, KA3HDO, Mark Steiner, K3MS, Steve Bible, N7HPR, Joe Julicher, N9WXU, Rawin Rojvanit, Farrell Winder, W8ZCF, Jeffery Winder, KB8VCO, Hiroto Watarikawa, JJ1LYU, Stan Wood, WA4NFY, Herb Sullivan, K6QXB, Dave Taylor, W8AAS, Deanna Lutz, K7DID, Claire Fredlund, Carol Jackson, KB3LKI, Kenwood and Microchip Technology Inc.

The author would also like to acknowledge the tremendous support, teamwork and volunteer spirit of the ARISS-International team as well as the technical, financial and administrative support of the ARISS member organizations--the AMSAT organizations and IARU organizations (ARRL in the USA). Also special recognition is in order to the space agencies: NASA, Energia, ESA, JAXA & CSA. Together we are pioneering the new frontiers of amateur radio and educational outreach.

Appendix C Maps

Map, ARISS-USA Radio Contacts, FY2005

Map, ARISS-USA Radio Contacts through FY2005

Map, ARISS-International Radio Contacts through FY2005

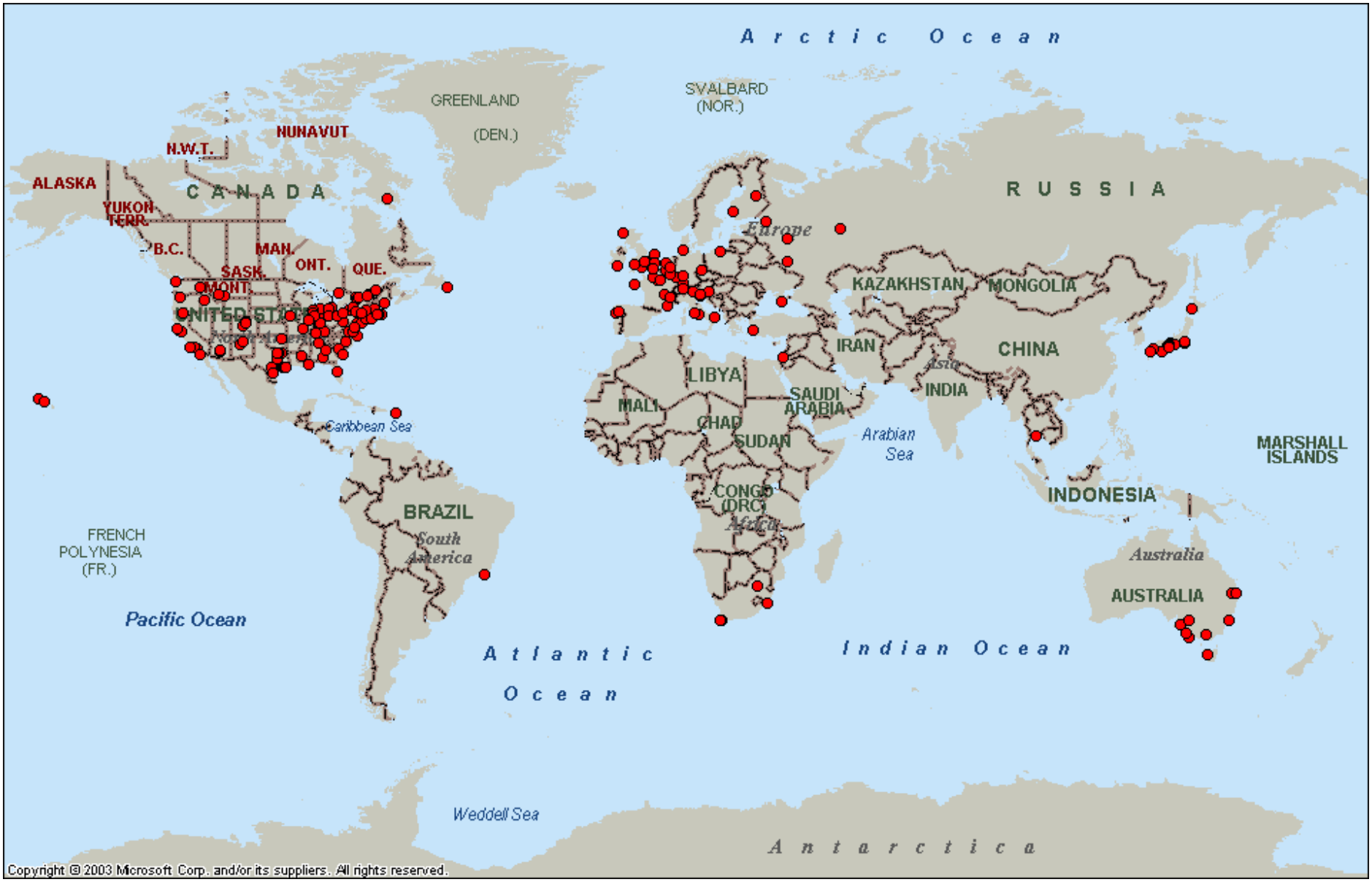
ARISS USA-only School Radio Contacts, FY2005

Notes:
1) ARISS assisted 27 other schools worldwide with radio contacts during FY2005.
2) Students at numerous other schools from around the USA and the world benefited from listening to radio contacts via Webcasts/audio streaming.
3) ISS crewmembers performed general outreach Amateur Radio contacts with children and adults from around the world.

ARISS USA-only School Radio Contacts, FY2001-2005

Notes:
1) ARISS assisted 95 other schools worldwide with radio contacts through FY2005.
2) Students at numerous other schools from around the USA and the world benefited from listening to radio contacts via Webcasts/audio streaming.
3) ISS crewmembers performed general outreach Amateur Radio contacts with children and adults from around the world.

ARISS-International School Radio Contacts FY2001 - 2005



Notes:

1) A total of 195 ARISS school contacts were made through FY2005.

2) Students at numerous other schools from around the world benefited from listening to radio contacts via Webcasts/audio streaming.

3) ISS crewmembers performed general outreach Amateur Radio contacts with children and adults from around the world.