ARISS Annual Report, 2004

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 160th 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 the astronauts. 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. The 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.

- Five hundred students participated in the Sonoran Sky Elementary School contact in Scottsdale, Arizona. The school then made their contact available to all other schools in their district through a video, reaching a total of 44 schools, 30 elementary schools and 35,000 students.

- As part of the Delta Research Mission, ESA sponsored two competitions among primary schools in selected European countries. The winning schools were invited to visit ESA ESTEC and participate in ARISS contacts. Countries participating this year were Spain and the Netherlands & Belgium.

- ESA Manned Spaceflight Educational Services set up a website for educational outreach related to ESA astronauts' missions.

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

- The ARRL provided material to Girl Scout Jean Arimond, 18, for the ham project she chose for her Gold Award at the Minnesota Girl Scout Camporee. She introduced other girls to ham radio, and was supported by local female amateur radio operators. Approximately 2000 girls from 30 states attended the event.

- Seven students from Berufliches Schulzentrum Elektrotechnik, in Dresden, Germany earned amateur radio licenses prior to their contact enabling them to participate fully in their ARISS contact.

- Monroe Elementary School in Santa Barbara, California distributed a video of their contact at amateur radio events featuring their experiences with the ARISS program.

- The School of Back in Scotland had tremendous media coverage reaching beyond the two hundred in-house students to an audience of 10 million.

- Kilburn Primary School with students of diverse backgrounds and special needs, experienced an ISS contact. An ARISS interview and the contact were broadcast via ABC Radio statewide to an audience of 1 million in Adelaide, Australia.

- Space Camp Turkey experienced an ARISS contact. This international space camp promotes friendship among students from many countries including Turkey, Greece, Israel, and the U.S., through space exploration.

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 education 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 is scheduled to fly on the next shuttle mission, STS-114, and will be deployed via EVA as an attached payload on ISS.

- 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 are 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 continue 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 tens of 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 their monthly journal (150,000 circulation), posted on the ARRL website (100,000 regular readers), and written in their e-newsletter (circulation 115,000).
- Presentations
    - An ARRL representative gave a presentation which included information on ARISS at the National Science Teachers Association.
    - An ARRL representative gave three presentations on space, wireless technology and amateur radio at the Ham-Com 2004, to an audience of school teachers, home schoolers, and amateur radio clubs.
    - ARRL sponsored the first Teachers Institute Education and Technology Program. Subjects discussed were wireless technology, amateur radio, and ARISS to promote a math and science curriculum in a classroom setting.
    - ARISS Chairman presented “AMSAT's Future Role in Human Spaceflight Exploration -- ARISS, the Moon and Mars,” at the Dayton Hamvention 2004, the largest yearly international convention of ham radio operators.
    - ARISS Chairman presented a paper, “Amateur Radio on the International Space Station- Phase 2 Hardware System” at the AMSAT-NA’s Annual Meeting and Space Symposium.
    - 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.

- Publications

    - ARISS Chairman Frank Bauer wrote a paper, "Amateur Radio on the International Space Station- Phase 2 Hardware System," which was published in both *CQ VHF*, and *CQ Japan* magazines.

    - The ARISS international delegates wrote a paper, "Amateur Radio on the International Space Station—2004 Status Report," which was published in the AMSAT Symposium Proceedings and presented at the 2004 AMSAT Symposium.

- Public Outreach Events and Activities

    - Since its premiere, approximately 10 million people have seen the IMAX Space Station 3D movie and have witnessed an ISS Ham radio contact between astronaut Bill Shepherd on ISS and school students on the ground.

    - The Roy Neal, K6DUE, Commemorative Event was held in honor of Neal's dedication and hard work on amateur radio in space. Approximately 150 amateur radio operators talked to the ISS, and received a certificate of participation. Thousands from around the world listened to this event.

    - The Expedition 9 crew participated in the annual ARRL Field Day. Both ISS crew members made contacts with the public, marking the first time both ISS amateur radios were operated simultaneously.

    - ESA ESOC held an event, "The Long Night of the Stars," in Darmstadt, Germany. This event drew a crowd of approximately two thousand. The ARISS contact with Mike Fincke was broadcast throughout the facility, and by radio to Germany, Switzerland, and Austria reaching over 1 million people.

    - Cosmonaut Gennady Padalka participated in an ARISS contact during the Russian aerospace festival "Let's Give the Planet to the Kids" at ARTEK Children's Center. Diplomats from over 20 countries attended.

    - Videotapes were produced on the ARRL Headquarters, including information concerning the ARISS program. These videos were made available to the 2000 ARRL affiliated amateur radio clubs.

    - ARISS volunteers attended the 2004 Wheels and Wings Airshow in Millville, New Jersey. The ARISS poster used during the IMAX premiere was displayed and members of AMSAT were available to answer questions regarding the ARISS program.

- ARISS photos and radio equipment modified to simulate the phase 2 equipment on board the ISS were displayed in the Kenwood exhibition booth at Japan's largest amateur radio festival, JAIA Ham Fair. The show was attended by 30,000 people.

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

- In Mobile, Alabama, an amateur radio system was added to the Gulf Coast Exploreum and Science Center's ISS exhibit.

- ARRL provided items which were used at the Neil Armstrong Air and Space Museum in Wapokoneta, Ohio during the 35th Anniversary Event celebrating Armstrong's first steps. The equipment was used for an amateur radio demonstration.

- Special Needs

    - The ARRL received a request for a radio contact confirmation card (called a QSL card) from a sight-impaired ham radio operator. The request was met by using ARRL's Brailler machine to fill out the ARISS QSL card.

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.

- Astronaut Mike Fincke used the ISS packet radio system's beacon to inform ham radio operators of the birth of his daughter, "It's a Girl."
- He made over 400 general contacts.
- He earned an International Amateur Radio Union (IARU) *Worked All Continents* award. He proudly accepted this award at the Johnson Space Center after his return to Earth.

Hardware Enhancements and New Initiatives

Phase 2 Hardware

The Kenwood radio, part of the Phase II hardware, was installed in the Service Module. Engineering tests were run with the ISS to check out the voice mode with ground stations at GSFC, Florida, and Houston. Tests were also run on the repeater mode that allows two amateur stations on the ground to communicate via the ISS when the crew is not operating the radio. Both tests were successful. The Kenwood was approved for operations, and became the primary radio used for school contacts. It has also proved to be popular in the repeater mode, extending the applicability of and interest in the ISS to a larger amateur radio population. In the future, pre-scheduled school-to-school contacts using this mode are possible.

Voice over the Internet Protocol
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. Internet Radio Link Project (IRLP) and Echolink are being considered for this purpose. Benefits in using this technology include wider audience access, no initial funding and no additional necessary crew training needed. Some trials have been run and work continues on this effort.

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 international delegate face-to-face meetings 1 or 2 times a year.

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. Fiscal Year 2004 Meetings were set up in the Netherlands and in Arlington, Virginia

Netherlands and Arlington, Virginia
During NASA's fiscal year 2004, the ARISS International Team met in March at the European Space Agency (ESA) ESTEC facility in the Netherlands, and later on in October in Arlington, Virginia, near Washington DC. The team decided to meet slightly less often to control costs, and during fiscal year 2005, we will meet in person only one time. Team members take turns hosting the meetings to attempt to equalize travel costs for everyone over the long run. This also allows for countries to send more representatives, cost effectively. In some years - for instance, many Europeans could afford to attend our Netherlands meetings versus our Washington meeting, and vice versa.

Details from the Most Recent Meetings
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 that reaches far more students than any of the

other ARISS radio activities. Twice each year, a different European nation is selected, and in FY2004, schools from Spain and children from the Netherlands and the Dutch speaking part of Belgium successfully participated in the ARISS competitions. Winning students earned opportunities to speak by ARISS radios with astronauts Pedro Duque (Cervantes Mission) and Andre Kuioers (DELTA Research Mission) on the ISS. The ARISS-Europe team set up two other radio contacts for taxi flight crews.

The ARISS U.S. Team described the large number of youth participants that ARISS touches, a white paper about educational outcomes written by a teacher whose students had an ARISS radio contact, and anecdotal comments about exemplary education programs.

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

- New weekly status reports that are prepared at the request of the NASA Education Office
- The NASA lithographs that are distributed by ARISS Team members
- Announcements about ARISS radio contacts sent to the LM Net (a school library email list)
- ARISS stories posted every week to Web sites, highlighting students of diversity whenever possible
- Expanding our partnerships, and therefore, sustainability, through increasing our audience who listens to our radio contacts by using Internet Radio
- An update on the NEEIS form
- Discussion on planning to use our worldwide team for the Exploration *(Moon, Mars and Beyond)* initiative.

Technical Interchange Meeting

A Technical Interchange Meeting (TIM) was held in Moscow, Russia to test Phase II hardware at the KIS Facility at Energia. The end-to-end testing of the Kenwood radio system and the SSTV system with the ARISS antenna systems, in the flight-backup Service Module located at Energia, was completed. The tests were successful, and the documents were signed, allowing the Kenwood radio and SAREX 70 cm radio to be used in the Service Module with the new ARISS antennas.

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.

- ARRL's Professional Educator of the Year Award went to ARISS member Nick Lance. Nick taught middle school students and presented course material to

Aerospace Education Specialists and ISS crew members to prepare them for their amateur radio exams.

- A Meizen high school student in Japan was licensed specifically for his ARISS event. He was the operator during the contact, and all preparation for the event was made by high school students

- Gilmour Academy students experienced a contact in January 2004. Since that time, two students and a parent studied for their amateur radio exams, took the tests and passed.

- Rita Wright, KC9CDL, the 8th grade science and math teacher from Burbank, Illinois, who experienced the very first ARISS school contact, passed her General Class license exam. She continues to use NASA materials in the classroom, and wanted to earn the next level license in order to help further the education of the student members of their amateur radio club.

- Astronaut Mike Foale of Expedition 8 said of the ARISS team, "Very, very impressed with how I started hearing the call at exactly when they said. … very, very professional on how they organized."

- After a contact with DuBose Middle School in Summerville, South Carolina, the sponsoring teacher, Alene Wilkins, summed up the contact with her comment: "How soon can I apply for another contact? This was the BEST experience I have had since I started teaching."

- A ham radio operator wrote on his QSL card: "Although I've been a ham operator for 36 years, this radio contact with the ISS got me more excited than I've been about ham radio in some time."

- DuBose Middle School in Summerville, SC had a March 2004 ARISS contact. Today they are setting up a ham station (using an ARRL grant). They would like to be the focal point for surrounding schools to have an ISS contact. -Alene Wilkins, KG4NKD

- Carl Hayden High School in Phoenix, AZ had a SAREX contact, and today they are heavy into Robotics competitions. -Allan Cameron, N7UJJ

- Due to ARRL informing teachers about aerospace, science and ARISS, LBJ High School in Austin, Texas asked for and received a grant from the ARRL, and is setting up a low-orbiting weather station. -Ronny Risinger, KC5EES

- Partly due to ARRL teaching educators about aerospace, science and ARISS, Allendale High School in Allendale, MI has been tracking weather balloon launches. -Brian Brethauer, KD8ANU

- 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.

- A number of NASA AESP team members volunteered to get the amateur radio licenses to extend the reach of ARISS into their school outreach activities.

Future ARISS Projects

SuitSat

A satellite has been proposed by the Russian delegation to send greetings to school children in commemoration of the 175th anniversary of the Bauman Moscow State Technical University. An amateur radio system would be housed in a Russian ISS Orlan spacesuit already on board the ISS that is past its useful life, which may be filled with foam so that it retains its human shape. If the schedule permits, the suit will also contain an earth sensor, slow scan television, and packet module. The suit will be assembled and launched by the Expedition 11 crew in October 2005. The nature of the project is intended to draw the attention and interest of school children worldwide.

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

FY2004 FINAL PROGRAM REPORT

General Information

Program Title: Amateur Radio on ISS (ARISS)

Program Manager:
Name: Deborah Biggs
Email: dbrown4@hq.nasa.gov
Phone: 202-358-1517
Report Submission Date: 10-Dec-2004

Program Information

1. Program Type:

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

Enterprise:
() Aeronautics
() Biological and Physical Research
() Earth Science
() Exploration Systems
() Safety and Mission Assurance
(X) Space Flight
() Space Science
() No Enterprise

() Partnership
() Multi-Center

2. NASA ERASMUS Theme :

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

3. Program Type :

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

4. Goals & Objectives :

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

5. Program Duration :

(X) Short Event (A few hours only.)
(X) One time Only
() Multiple Meetings with the Same Participants
Number of Meetings:

() Short Intensive Program (less than 4 days)
() 7-13 Day Intensive Program
() 2 Week Intensive Program
() 3 Week Intensive Program
() 4 Week Intensive Program
() 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 :

6. Program Content :

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

Program Details Information

1. Applicants : 0

2. Location of Program Activities :

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

3. Program Activities Techniques and Resources :

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

() 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.):

() Action Plan
() Article for Publication
() Presentation for a Conference
() Course Outline/Revision
() Course Problem Set/Activity
(X) Drawing or Art
() Journal/Lab Workbook
Lesson Plans using:
() Experienced-Based Activity
() Scientific/Engineering Methods of Inquiry
() Technology
() Interdisciplinary Approaches
(X) NASA Materials
(X) Multimedia Product (includes video)
() Physical Model or Product
() Portfolio
() Project Design
() Research Paper
() Research Proposal
Report
(X) Oral
(X) Written
() Software
() Teacher's Manual
Teaching/Learning Activity using:
()Experienced-Based Activity
() Scientific/Engineering Methods of Inquiry
() Technology
() Interdisciplinary Approaches
() NASA Materials
() Technical Paper for Publication
() Educational Video
(X) No Product Required
() Other

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

7. Networking and Electronic Resources :

Does the Program provide some means to promote ongoing communications among participants after the Program is over?
() Yes (X) 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):	$85,000
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:	$85,000

2. Staffing :

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

() This Program is primarily managed by NASAstaff.

Number of NASA Civil Servants involved :

	Total
Administrative	0
Astronauts	7
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:	8

TOTAL NUMBER OF PRESENTATIONS: 0
TOTAL NUMBER OF PRESENTERS: 0

Total number of NASA presenters: 0
Total number of contractor presenters: 0
NUMBER OF RETIREES (NON-NASA AND/OR NASA): 0

3. Partnerships/Collaborations - Rollup :

	Total
NASA Contractor Partnerships/Collaborations:	0
Other Industry Partnerships/Collaborations:	0
Community/Local Partnerships/Collaborations:	0
Museum/Planetarium Partnerships/Collaborations:	0
Non-Profit Partnerships/Collaborations:	0
Other Federal Agency Partnerships/Collaborations:	1
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)	1
Other NASA HQ Program Office Partnerships/Collaborations:	0
K-12 School Partnerships/Collaborations:	0
K-12 School District Partnerships/Collaborations:	0
Professional Society Partnerships/Collaborations:	1
State Government Partnerships/Collaborations:	0
Education Resource Center Partnerships/Collaborations:	0
Community College Partnerships/Collaborations:	0
Total Partnerships/Collaborations:	3

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:	865
Number of NASA individual educational materials demonstrated by presenter(s) during the Program:	0

6. NASA Facilities :

	Total
Aircraft:	0
Clean Rooms:	0
Computer Labs:	0
Control Room:	1
Drop Tower:	0
Ground Trainers:	1
Hanger:	0
Laboratories:	0
Launch Pad:	0
Maintenance Facilities:	0
Mockup Facilities:	0
Spacecraft Display:	0
Test Stands:	0
Wind Tunnel:	0
Total Facilities:	2

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:	**509**	**40**

	Physical Presence Number	Distance Learning Number
Teachers teaching grades K-4:	172	4
Teachers teaching grades 5-8:	245	13
Teachers teaching grades 9-12:	108	15

In-Service Teachers:	0	0

2. Higher Education Faculty:

	Physical Presence Number	Distance Learning Number
Community College:	112	0
4 year undergraduate:	1	0
4 year undergraduate/graduate:	3	0
Total Faculty:	116	0

3. Students:

	Physical Presence Number	Distance Learning Number
K-4:	2,301	150
5-8:	3,352	150
9-12:	798	0
Community College:	2,500	0
4 year undergraduate:	36	0
4 year undergraduate/graduate:	3	0
*Pre-Service Teachers:	3	0
Post Doctoral:	0	0
Total Students:	8,990	300

**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:	231	0
Civic Group:	173	0
Education Specialists:	36	0
Parents:	738	0
Professional:	73	0
Other:	75	0
Total Additional Participants:	1,326	0

TOTAL OF ALL DIRECT PARTICIPANTS: 11,291
(From A) (System Generated)

B. EDUCATION COMMUNITY PARTICIPANTS:

	Anonymous	
	Physical Presence (number)	Distance Learning (number)

K-12 Teachers	53	12
K-12 Students	287	56
Higher Ed Faculty	12	2
Higher Ed Students	36	2
Other (Administrators, Educators and Students where the academic level is not known,Parents, etc.)	174	12
Total Education Community:	**562**	**84**

TOTAL OF ALL EDUCATION COMMUNITY PARTICIPANTS: 646
(From B) (System Generated)

C. GENERAL PUBLIC/INFORMATIONAL OUTREACH:

	Participants (number)
General Public At Lectures, Tours, Conferences/conventions, museums/booths/displays, etc.	1,542
Estimated Newspaper/Magazine Audiences	6,055,048
Estimated TV/Radio Broadcast Audiences	12,260,081
Estimated CD-Rom Users	62
Web Audiences: Unique IP Addresses (*not included in totals below)	2,873
Other:	5,000
Total Public/Media:	**18,321,733**

TOTAL OF ALL OUTREACH PARTICIPANTS: 18,321,733
(From C) (System Generated)

TOTAL OF ALL PARTICIPANTS: 11,937
(From A & B) (System Generated)

GRAND TOTAL OF ALL PARTICIPANTS: 18,333,670
(System Generated)

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Appendix B Teacher Paper—Burbank School

REMEMBER, WE'RE PIONEERS!
The First School Contact with the International Space Station

Rita L. Wright, KC9CDL

Introduction

Those words came floating back to me as I watched the rocket being launched to Mercury. "Remember, Mrs. Wright, we're pioneers" said one of my eighth grade students as we stood on the stage at Burbank School, Burbank, Illinois shortly after our failed attempt to contact Comdr. Shepherd on the International Space Station. The date was December 19, 2000. Our gym was filled with students, parents, teachers, and dignitaries, along with various news media. It had been a long and sometimes wild ride up to that point. But I was soon to learn, it wasn't over yet!

How do you fill your time from application to contact?

Memories…I would have to go back to 1988 when I first attempted to involve my students in a NASA project. At that time we were trying to come up with a name for the new shuttle. Too bad the student who said "Endeavor" was out voted by his classmates. But we had fun investigating the history of various sailing ships and developing a board game about a lost treasure in Burbank.

It was shortly after that I heard about SAREX and the opportunities being offered for school children to communicate with astronauts on the Shuttle. I was so impressed with the program that I finally sent in my application in 1996. And so the wait began.

A waiting period can be boring as when you are sitting in a doctor's office watching mold grow on the fish in the fish tank. Then again, it can be an exciting learning and sharing time. I was once asked, what did I do during those years between application and contact? My answer was, I kept the dream alive. We did projects on space that involved designing and building spaceships of the future, art work showing the students ideas as to what they would see if they were in deep space, and research work involving discovering earth's problems and designing a solution.

We became involved with Argonne National Laboratory's Junior Solar Sprint. Students designed built and raced solar powered cars. We were lucky to race in the National Solar Sprint held in Washington D.C. where we placed 5th in the nation. We went on to win several 1st and 2nd places in Argonne's races over the years.

Eighth graders try to pick a name for the new shuttle. (1988)

Receiving a trophy at the Junior Solar Sprint National Championship race in D. C.

Speaking of racing, every year students had to design a car with as little friction as possible and one that was aerodynamically sound. Students raced these down a 5cm high ramp in the classroom. No motors, batteries, or flywheels were allowed. The students ran the entire race themselves. That included weighing and measuring the vehicles, measuring the distance traveled by the vehicle, and deciding upon a fair grading system.

Students participate in the Wheeled Vehicle race

Then my students became part of a project designed by Adler Planetarium. This project involved research, writing, designing, building, and artwork, but also involved children from different schools in the Chicagoland area sharing and critiquing each others projects using computer technology. One of the nicest things that came out of this project was the 30 robotic kits we received from Adler. That, of course, led to another fascinating project on robotics and the exploration of Mars.

From Newton's laws to the theory of flight to the building of rockets and looking into the Universe with help from Hubble photos. We researched, studied, wrote, designed, built and thoroughly enjoyed our adventure. We especially liked the trip to the space center in Woodstock, IL where students flew in a 737 simulator! Among all of that were trips to Argonne National Lab, Fermi Lab, and even appearing with Bill Kurtis on the show "Different Drummers".

Burbank's Robotics ready for Mars

And we waited. Time passed, students moved on to high school and then college. Teachers retired and a new group moved into their places. We waited for a Shuttle contact. Next it was Mir. I remember visiting Jerling Jr. High when they had their contact with Capt. Jerry Linenger (KC5HBR) on board the Mir space station. I kept pushing the dream, while we waited longer. My room was always filled with Hubble photos, NASA posters, and standing in the corner, was the life size trio from the movie Apollo 13.

The Apollo 13 movie crew

We get the call!

Finally in August of 2000 we received the call! Once school started, we hit the deck running. Our contact would be handled by Charles Sufana, AJ9N, with assistance from the Commonwealth Edison Employee Amateur Radio Society and the Lake County Amateur Radio Club. We were in good hands!

At our first teachers' meeting of the new school year, we set about explaining the opportunity and educational value afforded us and defining and describing the tasks we had to accomplish by December. We were met with school wide enthusiasm and cooperation. We were a team! We designated our school as Earth Station Burbank School, and the entire staff and students became our crew. Our very capable secretary, Colleen Sopkin, headed Mission Control.

We began by putting together a judging team composed of parents and teachers. Next, we sent out a call for students to audition for a position on our ISS team. Eighty students auditioned and from that group we selected 14. The students were from grades one through eight.

Our next task was to design a mission patch. Our entire school population participated in an art contest involving the creation of our Burbank School/ISS mission patch. This patch was to represent our school's contact with Commander William Shepherd, KD5GSL, on the International Space Station Alpha. After narrowing down the contestants to a manageable few, we held a general election. Burbank students selected our mission patch.

Burbank/ISS mission patch

Of course we had to have questions. Once again we sent out a call to all students asking them to write questions for our contact. Each teacher helped by evaluating all of the questions from her/his own class and then submitting the best. From that group, our Language Arts teachers helped select the questions our team would ask.

In the weeks and months that followed our initial notification, teachers and students in every classroom began working on a wide variety of "space topics". Our first graders

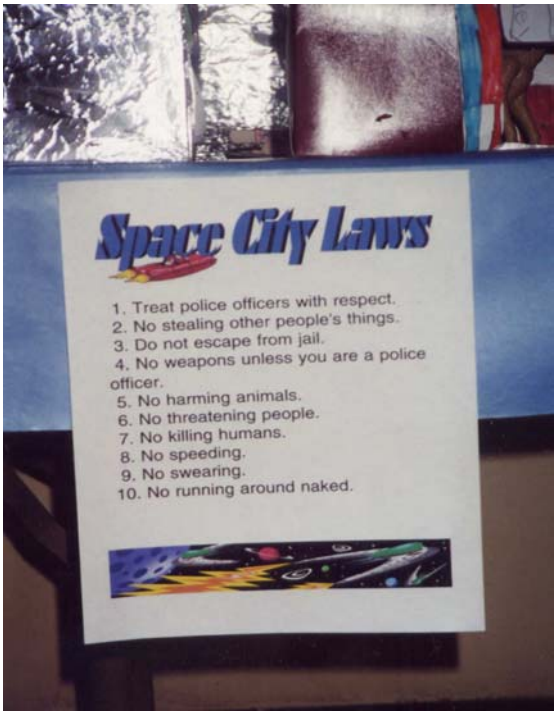
The Burbank/ISS team

created space people and space capsules. Their themes were "Flying High in Grade One" and "Adventures in Space". Their bulletin boards reflected the imagination and creativity only a first grader can have. They even had Winnie the Pooh in a space suit.

Second graders wrote stories about why they would like to be an astronaut and then made shuttles out of Pringles chip cans. They colored pictures of astronauts and put their own photos in the helmets. Their work decorated the hall outside their classroom.

Second graders shuttle to the Space Station

Fifth graders did one of the more spectacular displays. They created an entire Space City. It included cafes, laundromats, theaters, a water tower, shuttle station, and more. They even wrote laws for their Space City!



Fifth graders write laws for their Space City

Other students in middle grades created a Cosmic Café. Some of the items offered were Moon Popsicle's, Lift-off Lemonade, Space Station Steak, and Pluto Pudding. Their work also decorated the hall outside of their classroom.

Students in other classes were busy imagining they were astronauts working on the space station. They wrote their own biographies and included future missions they would like to be involved with. They tracked the ISS on the web and plotted on a map where the space station was every 45 minutes. They wrote time lines comparing our school day to the ISS. Some children wrote poems and made chalk drawings to accompany their poems.

To prepare for our ISS contact, the junior high students searched the web for information on the space station. After much discussion, the students created power point presentations. They made a ten-slide show, which consisted of one slide telling what the ISS is, one slide for the astronaut, and one for each cosmonaut on the ISS. The remaining slides contained information about space and the space station. Students presented this to our audience on the day of the contact. Our Special Education students in junior high did the power point work.

Students in a junior high Math class used the distance formula to calculate the distance to the ISS from Burbank School. This was done over a period of several days so those students would understand the idea that the station was moving constantly. In addition to distance, they considered time. They thought about their own future and where they would be in the year 2030. By then we will need a new ISS, so some of our future engineers designed and built the station of 2030. They also wrote a paper describing how and where it would be built. Our more artistic students decided to be scientists on the space station. They used their creativity and imagination to draw what they saw when they looked through a telescope while out in deep space. Our computer oriented students researched various Earth problems and developed plans for solving the problem using the technology on the space station.

All classes at all levels spent time using many of the websites that Charlie Sufana shared with us. As our students continued their search, one site led to another and their enthusiasm grew proportionately. If you were lucky enough to walk down the halls of Burbank School during those months you would hear students and teachers alike talking about space, shuttles, space stations, and what the latest information was about the ISS. You would be surprised at the variety of the topics, activities, and displays of work all centered around the ISS mission. Our school was vibrating with excitement and activity!

It's lovely weather in December. Time to put up the antennas!

December was soon upon us. The weather hit with a vengeance. Charlie Sufana and his

team began setting up for the contact on December 10th. One of the biggest challenges had to do with setting up the antennas. The system had to be placed on top of a 2-story building. According to Charlie, they had to carry up 12 concrete blocks, five 35-pound sandbags, 4 sheets of plywood, 2 tripods, and 2 antennas with their associated azimuth and elevation rotors, control cable, and coaxial cable. All of this was done with about 10 inches of snow on the roof and temperatures at the start of the day at about 34 degrees and falling, wind-chills were about zero. Charlie said it took about 8 hours to do the job. During the following week and a half Burbank was hit with 2 full-blown blizzards and 4 additional snows. Temperatures were mostly in the 20's and usually had below zero wind-chill factors. Charlie would stop by the school occasionally to see if everything was still in one piece.

On December 11th, Charlie Sufana met with the ISS student team and their parents at Burbank School. It proved to be a very informative meeting. Mr. Sufana shared with us his experiences with other school contacts. He went on to describe how we would make the contact and what was expected of the students. There were many questions from students, parents, and teachers. He did a tremendous job in responding to them and explaining in detail that what we were about to do was an experiment. There were no guarantees as to the outcome.

Contact! Or, Houston, we have a problem!

Which brings me back to the beginning of this paper. Contact day was December 19th. Yes it snowed the previous night. After re-hooking all of the cables and getting everything in place on stage, his team was ready. Our students were nervous and excited as they stood on the stage looking out at our capacity filled auditorium. A state senator and our mayor were sitting in the front row. A TV station was filming and reporters were making the rounds. Along one wall the audience could watch a map showing the exact position of the space station as it neared our contact window. Suddenly, the exuberant audience hushed. At about 2:59pm CST Charlie Sufana gave our first call to NA1SS. Nothing, we called and called but we were never able to establish contact. After a second attempt an orbit later, it became obvious that today was a "no go". I'm not certain what went wrong. Mr. Sufana said it was a technical problem. I think I crashed further down than my student team members. I was so disappointed for all of them. But then, they spoke to me.

A disappointment, certainly. A defeat, never! After all, we are pioneers!

Alpha Juliet 9 November NA1SS we have you readable. Go ahead.

To our great surprise and delight, we were given another chance. December 21st was our new contact date. And yes, it snowed again! The temperature was about 13 degrees - what else? Once again our audience was filled to capacity. They did not give up on us… but the media? Where were they? We had reporters from a few local papers, but nothing more. Once again we used the computer program to show the audience where the space station was and once again the audience hushed when the station came within our contact area. Then at 20:28 UTC, Bill Shepherd and the ISS came up over the horizon for what turned out to be a near direct overhead pass! Charlie and his team made a connection within seconds and continued up to 20:39 UTC. Upon hearing Bill Shepherd's voice the audience let out a loud cheer! At that moment I was saying a

Charlie Sufana, AJ9N, makes the call

prayer of thanks! Soon Jessica Lehocky was at the mike asking the first question. We had 14 students and everyone had their turn at the mike. Jessica, in fact, was able to ask an additional question. Charlie had a chance to ask a question and then at the end of the contact, I was handed the mike. I simply thanked Commander Shepherd for taking his time to talk to the students of Burbank School. The entire team said "73" and it was over. What a ride! The audience cheered.

Alex Bandyk asks a question

Some time later our principal wrote the following insightful statement. "Rita Wright's letter (to Commander Shepherd) pretty much summed up what the school did to make the contact an interdisciplinary learning experience for all grades across a variety of academic concentrations that included math, science, reading, writing and art…Howard Gardner would be proud of us for engaging multiple intelligences. Making the contact such an experience is a must for others who follow because the transformation that took place was quite revolutionary. We came closer together as a school. Teachers who might otherwise have stayed in their own worlds didn't. They wanted to be part of the experience. Junior high students who ordinarily trudge their way to school day in and day out hardly taking time to say hello were walking into school talking about why they thought the experiment failed the first time. Parents pitched in and helped because they sensed how special the event was and because they genuinely wanted to be a part of it. The community at large read about us in the papers…The excitement of the event will fade in time but some of the changes will endure to our benefit."

A lot to show, a lot to share

Christmas 2000 is over and we're back at school. Time to kick back and relax? Hardly! The school was still vibrating with excitement. We had another power point put together depicting our contact with Commander Shepherd and the ISS. A video was edited and offered to students and their parents. We had a big demand for more t-shirts and buttons displaying our mission patch. All of us were collecting photos for a memory album. One of our parents began sewing a huge banner commemorating the contact. And we had many people to thank. We were getting ready for parent conferences and we certainly had a lot to show them and a lot to share.

It was an exciting time for all of us. Our ARISS contact awakened our community to the adventures and thrills found in space exploration. The contact sparked an interest in careers in space-related subjects and a sharper interest in the study of astronomy and the design and building of the tools of exploration. The event did bring this K-8 school together as no other event ever did. We participated in an interdisciplinary learning experience for all grades across a variety of academic concentrations. All of us here at Burbank School believe that this type of experience is a must for all other schools who participate in a contact. As our principal pointed out, the transformation that took place in our school was revolutionary. Students, teachers, parents and community worked together to make our contact a success.

We send an invitation to a friend

In February our school extended an invitation to Commander Shepherd to visit our school and community. He is a positive role model for all young people. It seems a lifetime ago when young people had many positive role models to look up to, to help guide them

through some of life's trials and to teach them some basic life lessons. Like the lesson of perseverance. There were fliers like Lindbergh, Earhart, Glenn, and Yeager, ball players like DiMaggio and Ruth. Today young people have to search to find positive role models. Here at Burbank our students found a treasure in Commander William Shepherd, who took the time to talk to a group of junior high and elementary students in a small school in a small community. He touched their lives and opened their eyes to a whole New World a world of new opportunities and new career possibilities.

Commander Shepherd comes to Burbank School!

If we thought for a moment that the contact of December 21st was the only time that our students, teachers, parents and community would come together to accomplish a single goal, we were wrong. May rolled around and along with sunny skies and warm temperatures came another momentous phone call! Commander William Shepherd was coming to our school! The date of his arrival was to be May 10th!

Suddenly we were back in action! News items and invitations were immediately sent out. By now we had a teacher who handled all public relations. Meetings were held and tasks were divided among our team members. In no time we had our school organized and ready! Burbank's Mission control team was operating on all cylinders.

May 10th, Commander Shepherd walked into our building greeted by a line of teachers, staff, and parents. The halls were decorated with signs of welcome and a power point display was being shown on a screen in the foyer. A team of 8th grade students proudly exhibited their robotics and delivered an invitation to the Commander via one of their robotics. It was lunchtime and our parents had a surprise for Commander Shepherd. He was taken to the lunchroom where Burbank parents had worked tirelessly to decorate the room and then prepare a wonderful lunch for

Commander Shepherd greets the students at Burbank School

all. Shepherd was introduced to parents, staff, teachers, our ham radio team, and to three young ladies from the education department of Adler Planetarium.

After lunch it was on to the gym where about 500 students waited. After introductory ceremonies, everyone sat spellbound as Commander Shepherd described his days on the ISS. He even had a "home video" that showed Shepherd and the two cosmonauts at work on the ISS. This was the first showing of the video. Throughout his talk he

Commander Shepherd and Mrs. Wright

Cmdr. Shepherd signs autographs for the Burbank/ISS team

answered questions from students. What he really wanted to talk about was the kids and what was available to them if they just worked hard. "The first crew for the Mars mission already exists, "Shepherd told a rapt audience as he explained what big step was next for NASA. "We just don't know who they are yet. That's the problem. I'll leave it up to you to do what needs to be done to get there." Shepherd told them that the choices they make, even at an early age, could have consequences that ripple throughout their lives. Upon leaving the gym we headed out to the front of the school where a group of kindergarten through second grade students sat in the grass anxiously awaiting the astronaut from the space station. After sharing some thoughts with them, he answered some of their questions. He was surprised when our music teacher led them all in a song entitled "Mission Control". Then it was back to the gym where he graciously gave numerous autographs and

Cmdr. Shepherd meets the Ham Radio team

K-2 students sing "Mission Control" to Cmdr. Shepherd

posed for many pictures.

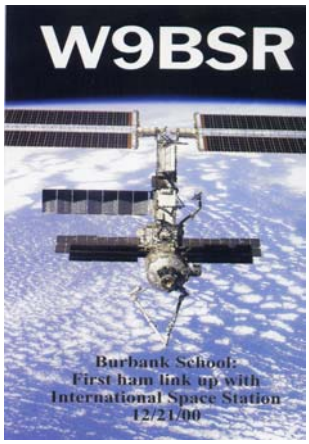
Our principal, Bob Mocek, later remarked that there probably is no such thing as a perfect day in a school, or anywhere else in this world, but that day (May 10th) was about as close as he could remember ever coming to that point. The harmonious spirit of cooperation throughout the building, the special efforts to show support for space exploration, more special efforts to decorate hallways and the gym, getting the best behavior out of our students all set the scene for an exceptional experience, one that held the power to inspire greatness.

A perfect day! Bob Mocek Principal

The antenna challenge and the birth of W9BSR

We were inspired enough to decide we wanted a Ham Radio Club in our school. Mr. Mocek and I enlisted the help of three other teachers and set out to put together a club.

Personally I felt confident that this would be an easy task to accomplish since our ARISS contact and the visit by Commander William Shepherd. I worked on getting my Technician's license and in the process was able to get help from Hamfesters Radio Club in guiding us in setting up a station. We needed, of course to get an antenna on our school. And that is when we hit a brick wall in the form of the building commissioner of the city of Burbank. Months went by. Mr. Mocek sent many requests to the building commissioner asking for an appointment. He ignored all of those requests. Not depending on any one avenue of attack, I wrote letters and/or spoke to our assistant superintendent, the superintendent, to the director of curriculum, and to the mayor of Burbank. I was about to give up when one day the Superintendent of our schools walked into my classroom while I was teaching, asked me a few questions about our proposed radio club and then promptly said OK! Great, but it still didn't happen until one summer's day I was called back to Illinois to speak to the school board during a general meeting. After explaining to them what we intended to do and how it would benefit the children of Burbank, the board gave their OK. Finally, our principal went to the mayor of Burbank and enlisted his help. The antennas went up! W9BSR was born!



W9BSR QSL card

We just ended the second year of our club. It has not been easy. I personally have a lot to learn about operating a station and getting students interested in getting licensed. I find that they enjoy learning Morse code and so we had them build their own keys and learn how to spell out their names. We started out our first year with about 8 members. The second year of operation we had 25. We have made some good contacts but it is becoming more and more apparent that we need more antenna power. I finally passed my code test and am now a General. So we are making progress.

Final thoughts

Our ARISS contact and subsequent visit by Commander Shepherd was like tossing a pebble into a stream. The ripple effects are still occurring and I suspect will continue to occur for a long time. We have a young staff and witnessing these events has inspired some to look for other interdisciplinary projects. They are beginning their dream. Many of our students are looking forward to careers associated with the space industry. As for myself, I keep looking up. I know we can put a bigger antenna on that school!


The antennas on Burbank School

Appendix C Teacher Paper—Sonoran Sky School

NA1SS, NA1SS, THIS IS KA7SKY CALLING…..

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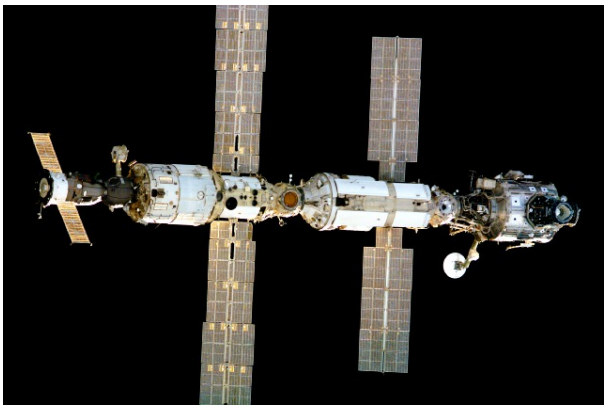
ABSTRACT



On Monday, April 5th, 2004, fourteen exuberant students at Sonoran Sky Elementary School in Scottsdale, Arizona had the unique privilege of a personal chat with an astronaut aboard the International Space Station (ISS).

This ARISS contact was the project of third grade teacher, Carrie Cunningham, N7NFX, an AMSAT member. Classroom representatives from grades 3rd-6th posed twenty-one questions via amateur radio to Expedition 8 astronaut Mike Foale, KB5UAC, as the ISS orbited over the school. ARISS (Amateur Radio on the International Space Station) is a program created through a partnership between NASA, ARRL and AMSAT.

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1. BACKGROUND

Sonoran Sky Elementary was built 10 years ago based on the theme of flight, with each grade level focusing on a particular aspect from bubbles and insects to aircraft and spacecraft. It is a K-6 school with approximately 500 students. The school has a classroom dedicated to the students' special projects relating to flight called the Flight Room.

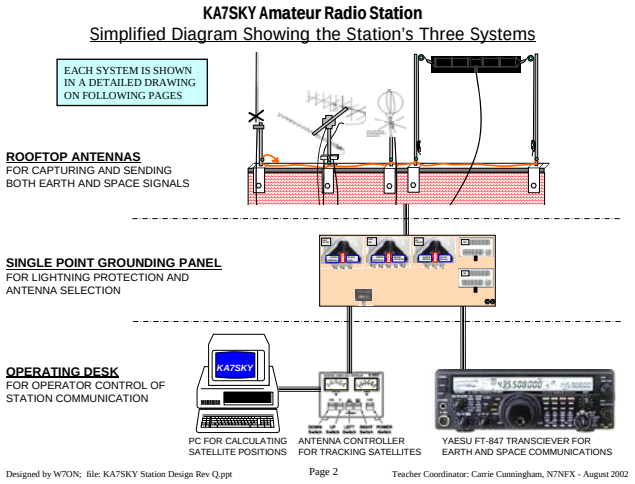
At Sonoran Sky there is an amateur radio station installed in the Flight Room having the appropriate call sign, KA7SKY. In addition to normal HF and VHF contacts with other hams, students have participated yearly in special events such as Kid's Day & JOTA.

It was the opportunity to talk with astronauts in flight that really sparked the students' imagination and was the motivation for installing the station in the Flight Room. But getting ready and being selected for a scheduled ARISS contact was not a quick or easy process. ARISS Schools are selected through a thorough and rigorous application process and generally must wait two to three years for their opportunity.

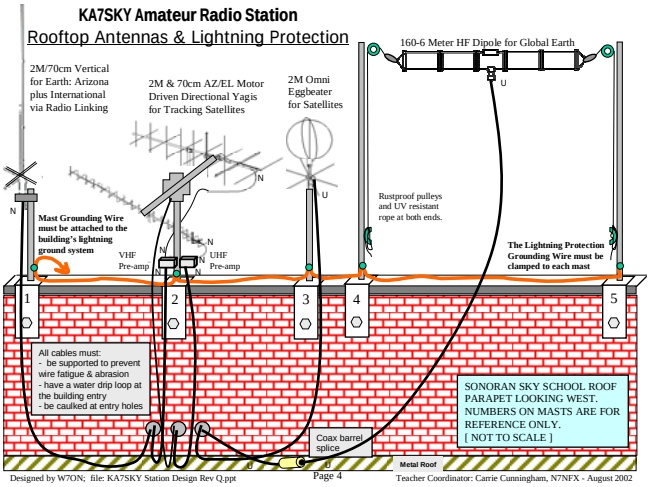
2. FUNDING

Teacher, Carrie Cunningham, N7NFX, submitted grant request applications to local community groups, organizations and businesses. One local community group, Scottsdale Charros, provided the initial funding of $5,000 by donation to Ms Cunningham. The Paradise Valley Unified School District provided much of the coax along with installation materials and labor. Yaesu and Ham Radio Outlet offered generous educational discounts on equipment and antennas. The Sonoran Sky PTO and others in the community donated the remaining needed funds.

3. STATION DESIGN & EQUIPMENT

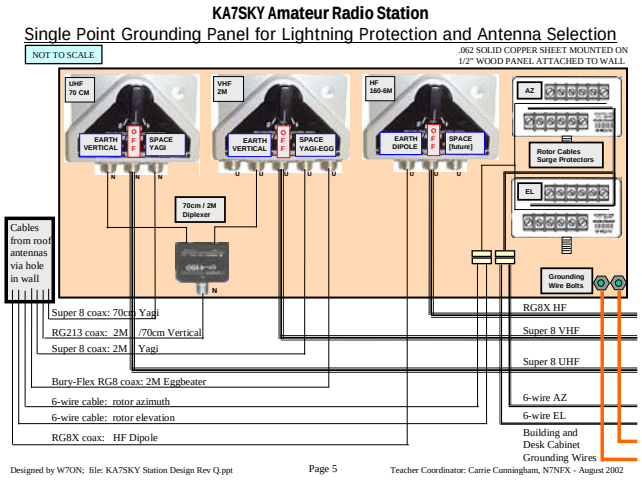


The station for KA7SKY was designed and installed by George Anderson, W7ON. The design consists of three basic systems: Rooftop Antennas, Single Point Grounding Panel, and the Operating Desk. A primary design objective was absolute safety for the children and others at the school while maximizing fun and easy operation.

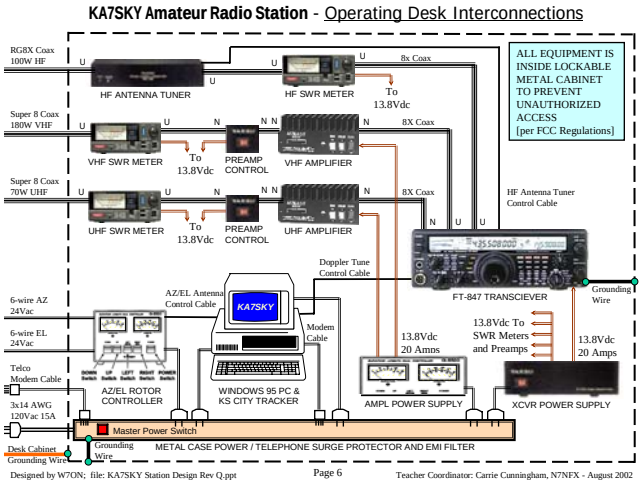


The Rooftop Antennas are mounted on a brick parapet about 50 feet high on top of the school, two for space communication and two for terrestrial communications. The main antenna for the ARISS contact was the 2m & 70cm AZ/EL motor driven Yagis. The ARISS back-up antenna was the 2m Omni Eggbeater. For ongoing terrestrial use of the station by students, there is a 2m/70cm vertical as well as a 160-6m HF folded

dipole. PVUSD employee, Paul Lintz, AA7AQ, spearheaded the design of the sturdy tilt-over mast and construction plus antenna installations.



The Single Point Grounding Panel is used as secondary lightning protection, station safety grounding and antenna selection. The copper panel connects via a large copper strap to a Ufer ground consisting of a steel building column embedded in the concrete slab foundation. Another large strap connects to the steel desktop station cabinet and equipment. Three gas discharge antenna switches select either an earth or space antenna for UHF, VHF or HF and routes the signal to the appropriate transceiver antenna connector. Surge protection is also provided on every line of the AZ/EL rotors.



The Operating Desk equipment consists of three parts: a transceiver with amplifiers and SWR bridges, a personal computer, and an AZ/EL antenna controller. For safety and in compliance with FCC Part 97, all Operating Desk equipment is housed inside a large grounded metal, lockable desktop cabinet.

Although the station normally has one Yaesu FT-847 transceiver, a second one was borrowed as a backup for the ARISS contact. It was identically programmed as a "hot" back-up including a separate power supply and antenna. A large speaker let everyone in the Flight Room clearly hear the receiver. A personal computer was used to track the ISS using NOVA software. Another software program and interface card, Kansas City Tracker, ran the antenna controller, which in turn guided the directional Yagis high on the roof as the ISS orbited above the school.

4. CLASSROOM INTEGRATION

Every student in the school wrote a question to be asked of astronaut, Mike Foale, KB5UAC. Each classroom in grades 3-6 had one representative chosen to read their question. In addition, each representative read a second question, one that was posed by a student in grades K-2.

Teachers were provided with books, posters, photographs and daily information about space exploration, the ISS and amateur radio. Students were provided with information about visible passes of the ISS to share with parents.

Many students had prior experience with amateur radio from previous visits to the KA7SKY station in the Flight Room.

5. ARISS CONTACT PREPARATIONS

Student representatives met with teacher Carrie Cunningham several times prior to the ARISS contact to practice reading their questions. Two days prior to the contact the students conducted a live run-through by cell phone with Frank Bauer, KA3HDO, International Chairman for ARISS. He provided valuable feedback to the students.

Invitations, handwritten by students, were sent to a variety of VIPs including the Governor of Arizona, the Mayor of Scottsdale, the Superintendent of Education, Paradise Valley School Board Members, and PTO Members.

A press release was sent out to TV and radio stations, newspapers, ARRL, and local media.

Arrangements were made to have the event documented by a videographer.

The PVUSD technology department arranged for a live video broadcast of the event throughout the school district.

Sonoran Sky's PTO designed and purchased a large KA7SKY banner for the Flight Room wall.

Bright aqua green KA7SKY shirts, in the school's colors, were given to each classroom representative to wear on the Big Day.

All station equipment and computer antenna tracking were tested, then retested, with the latest Keps and simulated passes. It was a good thing, because about a week before the contact the 2 meter amplifier literally smoked! A new one was rapidly shipped overnight and worked great.

6. THE BIG DAY!

Finally the big day came. On the morning of 05 April 2004 students, parents, press, and dignitaries in the Flight Room and listeners across the school district were filled with excited anticipation. Our antenna was pointing at the horizon, our clock was precisely synchronized with NASA's clock, NOVA was showing the approaching ISS footprint, and the media cameras were rolling. We were ready!

At 1837 UTC, it was our appointed time to attempt contact with Astronaut Mike Foale as the ISS began its pass over Scottsdale, Arizona. After two unanswered calls as the ISS began to peek above the horizon, the third call was greeted by the crackling voice of Mike Foale. In an instant he was loud and clear, and ready for our students' questions.

Photo 1 - Adam asking Mike about his daily chores

During the full 10 minute pass, twenty-one of the twenty-two prepared questions were successfully asked by students and answered by Mike Foale.

Here are the students' insightful questions:

1. Why were you chosen for Expedition 8?
2. What did it feel like when you launched?
3. What did you do to prepare for working with people from other countries?
4. Do you have to wear a space suit all the time?
5. If you were not an astronaut, what job would you have?
6. If you could keep one thing from your mission, what would it be?
7. What is your favorite part of being an astronaut?
8. Do stars and planets look different from the ISS than from Earth?
9. What experiments are you doing?
10. How does the G-force affect your weight during launch?
11. How did you become interested in being an astronaut?
12. What is the most interesting thing you have learned in space?
13. How long does it take the ISS to orbit the Earth and at what speed does it travel?
14. What medical equipment and training do you have if someone is sick or injured?
15. What did you eat for Thanksgiving?
16. What are the pros and cons of living in space for so long?
17. What are some of your daily chores?
18. Do you have to steer the ISS?
19. How do you know what to do while you are up there?
20. What is the temperature inside and outside the ISS
21. How do you wash your clothes?
22. What is the most amazing thing you have seen while in space?

Mike Foale surprised the students with many of his answers. He shared his personal experiences while inspiring them to pursue their studies and dreams.

Photo 2 - Mia asking Mike what job he would have if he were not an astronaut

Photo 3 - Taylor asking Mike about the pros and cons of living in space for so long

Photo 4 - Rylee asking Mike about experiments being conducted on the ISS

7. MEDIA RELATIONS

Photo 5 - Bailey being interviewed by media as Nicholas looks on

The ARISS contact was well attended by a multitude of VIP's including the Mayor of Scottsdale and media personnel. Local representatives from FOX, CNN, NBC, the Arizona Republic, and the Scottsdale Tribune were in attendance. The TV and press coverage given by each of these media was phenomenal. In one case the event was used to promo the TV newscast. Newspapers ran various stories for several days. And, the full story was recently featured in World Radio.

Since the ARISS contact, Ms. Cunningham has given invited presentations to three local Amateur Radio Clubs and at the ARRL Southwest Division Convention.

8. THE FUTURE

Sonoran Sky Elementary School is beginning their very own after school Amateur Radio Club. Sparked by the excitement of the ARISS contact, many students have shown an interested in pursuing their own Amateur Radio experience.

There will be continued linking of the student experience to their classroom instruction for cultural sharing, geography, math, science and the general excitement space communication brings to their imagination. The students getting to know and use AMSAT's new Echo AO-51 satellite will be one of the first activities of our school's new Amateur Radio Club.

9. ACKNOWLEDGEMENTS

Our school's ARISS contact was the culmination of many people and organizations working toward the common goal of enriching our children's education. I would like to acknowledge the tremendous support of the Paradise Valley Unified School District, Sonoran Sky PTO, Scottsdale Charros, Yaesu, and Ham Radio Outlet.

10. DEDICATION

Photo 6 - George Anderson, W7ON, being interviewed about the successful ARISS contact

This paper is dedicated to my father George Anderson, W7ON, AMSAT Life Member, for the countless hours he spent making this ARISS contact possible for my students and myself. His expertise in the field of Amateur Radio and his ongoing dedication to the education of our youth is truly priceless and inspirational.

Appendix D ARISS Delegate Paper

AMATEUR RADIO ON THE INTERNATIONAL SPACE STATION 2004 STATUS REPORT

Larry Agabekov; N2WW, Frank H. Bauer; KA3HDO, Gaston Bertels; ON4WF, Joerg Hahn; DL3LUM, Robin Haighton; VE3FRH, Keigo Komuro; JH1KAB, Ken Pulfer; VE3PU, Sergey Samburov; RV3DR, Masanobu Tsuji; JH2PRZ, Rosalie White; K1STO, and Alberto Zagni; I2KBD

INTRODUCTION

The international working group called ARISS—Amateur Radio on the International Space Station—was formed at a meeting in Houston, Texas in 1996. ARISS is an international consortium of delegates that represent the 5 international regions that are actively supporting the development and operations of the International Space Station (ISS)—Canada, Europe, Japan, Russia, and the United States. Delegates were chosen from these region's International Amateur Radio Union (IARU) organizations (ARRL in the US) and Radio Amateur Satellite Corporation (AMSAT) organizations to represent each region in the development and operation of the ISS ham radio system. Thanks to the support of the space agencies and the IARU and AMSAT organizations, ARISS is thriving and continually looking toward the future. To date, the ARISS team has enabled tens of thousands of students to experience a ham radio contact with the on-orbit astronauts and cosmonauts. In addition, thousands of ham radio operators communicate through the on-board equipment which consists of two major hardware development phases.

This paper provides a status of the ham radio equipment and operations currently on-board ISS. It also contains reports from the delegates from the 5 ARISS regions, our expectations for the near future and our plans for the distant future.

HAM RADIO EQUIPMENT STATUS

The Amateur Radio on the International Space Station (ARISS) international team devised a multi-phased hardware development approach for the ISS ham radio station. Three internal development Phases---Initial Phase 1, Mobile Radio Phase 2 and Permanently Mounted Phase 3 plus an externally mounted system, were proposed and agreed to by the ARISS international team.

The Phase 1 system hardware development, started in 1996, was delivered to ISS in several increments starting in September 2000, and is currently operational on 2 meters. The Phase 2 system is partially operational with the Kenwood D700 operational on 2 meters and 70 centimeters. Phase 3 is still in the future. Several externally mounted systems are in different stages of design and development.

The following provides a high-level status of the hardware development. For more details on the ISS ham radio hardware, see reference 6.

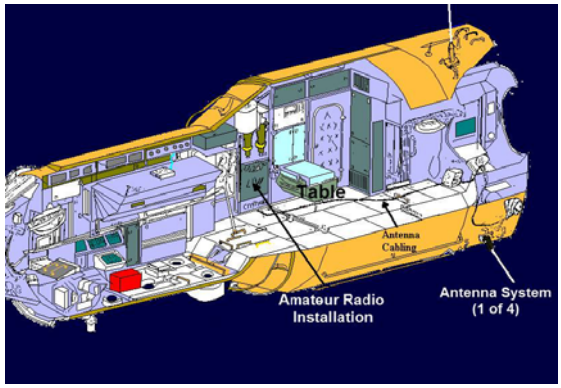
Ham Station Location

The ham radio equipment resides in two locations inside the ISS and several locations outside the ISS. 2-meter (144 MHz) operations are primarily conducted inside the Functional Cargo Block (FGB), named Zarya, using antennas that supported docking of the FGB with the Russian Service Module. See figure 1. This is the current location of the 2 meter portion of the Phase 1 ISS ham radio station.

To support multi-mode, multi-operation on ISS, four ham radio antenna feedthrough ports were installed on the Russian Service Module (SM), named Zvezda. This was accomplished through the leadership of Sergey Samburov, RV3DR, from the ARISS Russia team. The ham station is installed near the SM dining table. See figure

2. Simultaneous multi-band operations can be conducted with these two (SM and FGB) station locations.

The ARISS team is also working to install externally-mounted amateur radio equipment on the ISS. This hardware will enable the crew to communicate with Earth-bound radio amateurs and school students using handheld systems that can be moved throughout the ISS. It will also support communications experimentation that will enable students and radio amateurs to receive telemetry data from ISS.

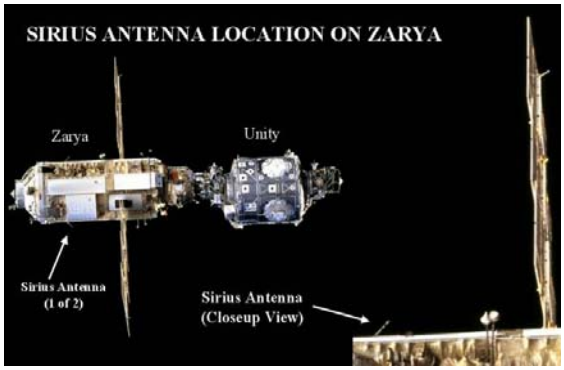


ARISS Hardware in Service Module
Figure 2

Phase 1 Hardware

The Phase 1 system consists of two hand-held Ericsson MP-A transceivers for 2 meters and 70 cm, power adapters, signal adapter modules, packet modules, headsets, and the required cable assemblies. The Phase 1 system supports voice and packet (computer-to-computer radio link) capabilities. The packet radio system has several capabilities including an APRS Instant Messaging-type system and a Bulletin Board System that allows radio amateurs to store and forward messages and allows the orbiting crew to send e-mail to all hams or to individuals. This configuration can be operated in the attended mode for voice communications and either the attended or automatic mode for packet communications.

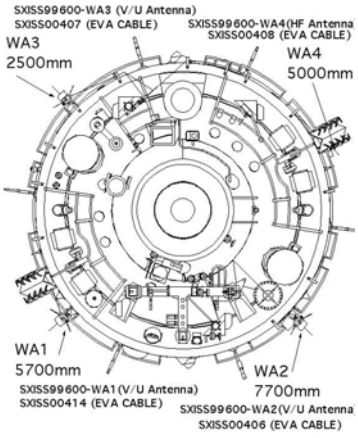
The Phase 1 radio system was launched on-board three space shuttle flights: STS-106 on September 8, 2000, STS-105 on August 10, 2001 and STS-108 on December 5, 2001.



FGB 2 Meter Antenna Locations
Figure 1

Antenna Assemblies

In 2002, a set of four antenna systems, developed by the ARISS team, were deployed on the aft-end of the service module during three Russian EVAs. These antenna assemblies permit operations on HF (20 meters, 15 meters & 10 meters), VHF (2-meters), UHF (70cm), and the microwave bands (L and S band), including GPS. They also permit the reception of the Russian Glisser EVA video signals (2.0 GHz). This dual-use (Ham/EVA video) capability is the primary reason the ARISS team received access to the four antenna feedthroughs located on the outside of the Service Module.

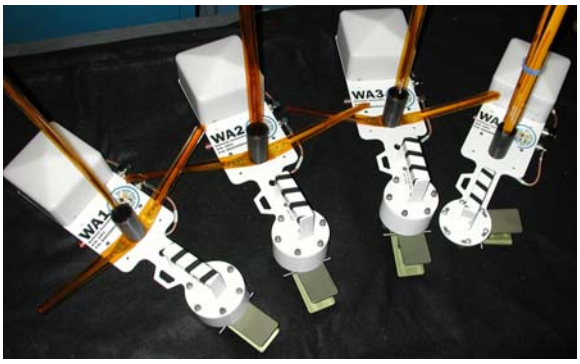


Antenna Location from End of Service Module
Figure 3

These four antenna systems were installed around the periphery of the far end of the Service Module. See figure 3. Three of the antennas (WA1-WA3) include a VHF/UHF flexible tape antennas. WA4 includes a 2.5 meter flexible

tape HF antenna. The antenna systems were developed by the U.S., Italian, and Russian ARISS partners.

Each antenna assembly consists of a mounting plate, spacer, a black striped handle, a Russian handrail clamp, an orange-colored VHF/UHF (or HF) metal flexible tape antenna with black delrin mounting collar, an L/S band flat spiral antenna with a white delrin radome cover, a diplexer (mounted underneath the plate) and interconnecting RF cables. See figure 4.



Antenna Systems WA1-WA4
Figure 4

Phase 2 Hardware

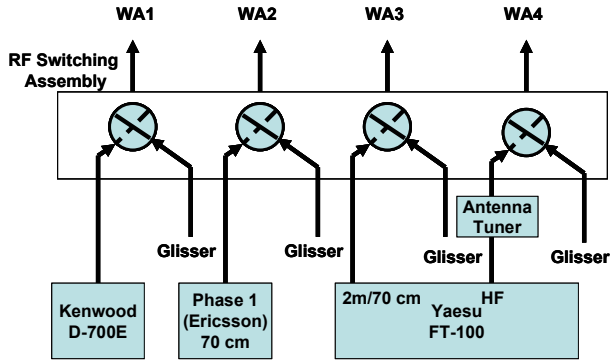
The Phase 2 hardware, consisting of two new radio systems, utilizes the ham radio antennas mounted on the Service Module. The phase 2 hardware augments the Ericsson Phase 1 hardware already on-board the ISS. Combined, the Phase 1 and Phase 2 system provide more capabilities for the crew and permit simultaneous, multi-mode operations by more than one crew member.

The Phase 2 hardware includes the Kenwood TM-D700 radio and the Yaesu FT-100D radio. The Kenwood radio supports 2 meter (144-146 MHz) and 70 cm (435-438 MHz) transmit/receive operation and L-band uplink operation. It provides a higher output power capability (10-25 Watts) than the Phase 1 radio system and can support FM and packet operations. The Yaesu FT-100 permits operation in the high frequency bands as well as on 2 meters and 70 centimeters. The Yaesu will also enable ionospheric propagation experimentation using the WA4 (high frequency) antenna.

The Service Module ham radio equipment includes the Phase 2 hardware: the Kenwood and Yaesu radios, an RF tuning unit for the Yaesu radio system, interconnecting signal and RF cables, two specially developed Energia power supplies, a power distribution assembly developed by the USA team, and a computer. It also includes the 70 cm Ericsson Phase 1 hardware system. These are all mounted on a Velcro-backed table as shown in the on-orbit photo depicted in figure 5.


Mike Foale, KC5UAC Next to the
Velcro Table Mounted in Service Module
Figure 5

In the future, these radio systems will be connected to the four Service Module antenna systems through a Russian developed antenna switching system. See figure 6.



Service Module Antenna/Radio System Utilization
Figure 6

Kenwood D-700 Specifics

A set of 5 default options, or Programmable Memories, were embedded in the D700 to support ISS operations. These five memories enable 2 meter and 70 cm operations to be conducted using these fundamental configuration baselines:

PM1: Voice Operations (mono band)
PM2: Voice Operations (cross band/repeater)
PM3: APRS/Packet and BBS operations
PM4: Attached PC and packet operations
PM5: Emergency Voice and alternate 9600 baud Packet Operations.
PM-off: No defaults. This mode is for knowledgeable licensed crew member's experimentation.

Yaesu FT-100 Specifics

The ARISS technical team has specified several modifications to the Yaesu radio system to prepare it for flight. These modifications include:

1. Replacing cable to enable flight certification of the hardware.
2. Reducing power output to 25 watts maximum.
3. Replacing the RF cables and connectors on the back of the radio with SMA connectors.
4. Tuner cable replacement with flight cables
5. Replacement of 6-pin data connector with an 8-pin connector. One of the additional pins on this connector supports a 12 V DC output capability.

Development of the Yaesu system is still on-going.

Phase 2 Delivery, Testing and Checkout

The initial set of Phase 2 hardware, including the Kenwood D-700 radio, were delivered to the Baikonur Cosmodrome and launched on the Progress 12P rocket on August 29, 2003. A series of tests were performed in November, 2003 at the KIS facility (Service Module engineering model equivalent) located at Energia in Korelev (Moscow area) Russia. These tests validated that the Kenwood Phase 2 system and the Ericsson Phase 1 system are compatible with the other electrical systems on the Service Module. See figure 7.

Sergey Samburov, RV3DR, Conducting Phase 2 Hardware Testing in the KIS Facility
Figure 7

Once the KIS testing was completed, Expedition 8 crew members Mike Foale and Alexander Kaleri were given the go ahead to install and checkout the Kenwood Phase 2 hardware. This was completed on December 8, 2003. Equipment checkout was accomplished through an engineering checkout opportunity in Russia on February 2, 2004 and a USA-based opportunity on July 22, 2004. With the completion of these checkouts, the D700 has been cleared for use for school contacts. Tests of the PM 2 cross-band repeater are planned to be performed in the August-September timeframe.

The remaining Phase 2 hardware, including the Yaesu radio system is planned to be launched on a future Progress flight.

Hardware Systems Under Development

Two projects are currently in development for delivery in the near future. These are the SSTV system which can be operated with the Phase 1 and Phase 2 hardware and the MISSE-5/PCSat-2 externally mounted payload.

In the near future, a Slow Scan Television (SSTV) system will be deployed on ISS. This system will consist of a software interface, developed by the MAREX-MG team and a hardware interface, developed by the AMSAT-NA hardware team. Flight hardware and software systems have been developed and are completing the final validation and certification phases. The SSTV system will allow digital still pictures to be uplinked and downlinked in both crew-tended and autonomous modes. The ARISS team expects the SSTV system to be flown within the next year.

MISSE-5/PCSat-2 is an externally mounted ISS payload that will support 2 meter and 70 cm voice, APRS, PSK31 and telemetry downlink of the spacecraft solar cell experiment. Launch of MISSE-5/PCSat-2 is currently planned on a shuttle after return to flight.

ISS HAM RADIO OPERATIONS STATUS

All ISS operations have slowed as a result of the reduction of the ISS crew size from three to two. This temporary reduction will continue until Shuttle return to flight. ISS ham radio, too, has seen a bit of a slowdown in school group events. However, ISS Ham radio community experienced a substantial increase in general ham radio contacts. In a sense, the school slowdown, coupled with the enthusiasm by the Expedition 9 crews on general contacts have resulted in a more balanced program which includes school contacts, general ham contacts and experimentation.

Packet Operations

After being off the air for about a year, packet operation was brought back to life in early December 2003. The activation of the Kenwood D700 has enabled the ARISS team to restart packet despite not having access to a computer. The two packet modules that have been utilized as part of the Phase 1 system require a reset and parameter modification that can only be done by computer. The ARISS international team is working diligently to acquire a dedicated computer system. Once it is available, the ARISS team hopes to re-enable phase 1 packet system. The current plan would be to have the Phase 1 packet and the D700 voice repeater capabilities running on ISS simultaneously. This will provide multiple capabilities to ground-based hams.

School Group Contacts

The ARISS school contacts for expeditions 8 and 9 are about half of what it was for the previous expeditions. To date, 21 school contacts have been completed during the expedition 8 and 9 combined. This compares with an average of 15-18 school contacts on previous increments. These two increments have had to contend with several anomalies on their flights (e.g. crushing noise on expedition 8 and unplanned EVA on expedition 9). These anomalies, coupled with the small crew size resulted in frequent postponements and rescheduling of ARISS school contacts. Despite these challenges and delays, the schools have all enjoyed a one-in-a-lifetime opportunity to talk to a crew member in space. Survey information from the schools indicate that about 15,000 students participate in ARISS each year. Some of the comments from the educators include: "Students realized an opportunity of a lifetime by speaking to the astronauts on the ISS. This was a life changing events for all participants." And: "This event brought an awareness of space exploration to not only the students, but teachers, parents and the extended community. It made space exploration meaningful to them."

Roy Neal Commemorative Event

ARISS team member and noted NBC news correspondent Roy Neal, K6DUE (SK), had a vision---to make amateur radio a permanent feature on human spaceflight missions. To commemorate Roy Neal's vision and dedication to the development of amateur space communications, the ARISS International team sponsored a special event activity with the ISS crew during the months of November and December 2003. These two months were significant because they represented the convergence of three major milestones for ham radio operations on human spaceflight vehicles.

November 28, 2003 represented the 20th anniversary of the launch of the first amateur radio station on the STS-9 Space Shuttle Columbia mission. During this flight Astronaut Owen Garriott, W5LFL, became the first on-orbit crew member to talk to hams from space.

In October 1988, the Russian Amateur Radio team, led by Sergey Samburov, RV3DR and Larry Agabekov, UA6HZ/N2WW, launched and deployed the first amateur radio station on Mir. On November 12, 1988 at the AMSAT-NA symposium in Washington DC, Leo Labutin, UA3CR (SK), started amateur radio operations by communicating with cosmonaut Musa Manorov, U2MIR on-board Mir. Soon thereafter, hams all over the globe were talking with the cosmonauts and astronauts through the Mir amateur radio station. 15 years later, hams still reminisce about their ham contacts with the Russian cosmonauts and US astronauts on Mir.

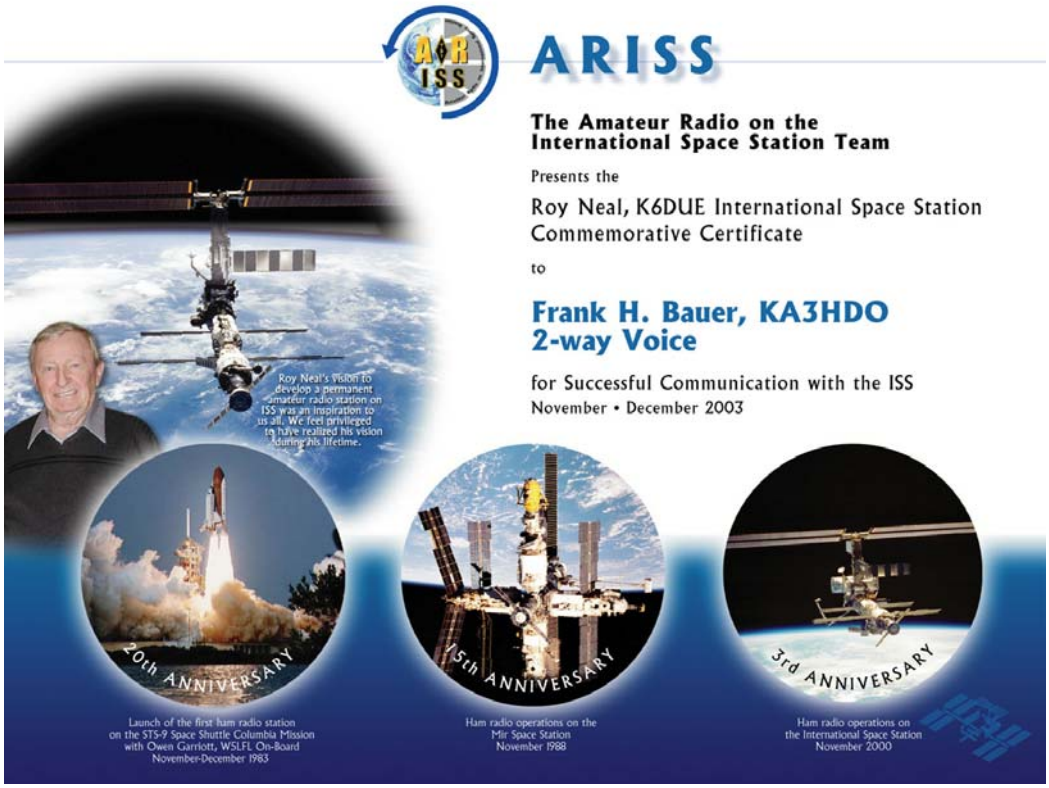
The third milestone was the 3rd anniversary of amateur radio communications from the ISS. On November 13, 2000, Sergei Krikalev, U5MIR and Bill Shepherd, KD5GSL, on ISS could be heard talking to the ham radio teams located at the Energia amateur radio station, R3K, in Russia and the Goddard ISS ground station, NN1SS in the USA. Roy's vision was suddenly realized with the deployment and first operation of a permanent amateur radio station on ISS.

A special commemorative certificate was developed for this special event. See figure 8. Shortly before the commemorative event, the Expedition 8 crew members, Mike Foale and Alexander Kaleri, installed the Kenwood D-700 radio. In late November the packet system was activated and during the weekend of December 6 Mike Foale got on the air in the voice mode. He made numerous contacts during several opportunities, worldwide over the next few weeks. When the commemorative event was complete, over 150 hams worldwide contacted the ISS. This very successful event was a fitting tribute to Roy Neal's vision as well as to the worldwide teamwork of the ham radio volunteers that transformed the dreams of ham radio permanence in space to reality.

Expedition 9 General QSO Operations

The expedition 9 crew, consisting of astronaut Mike Finke, KE5AIT, and cosmonaut Gennady Padalka, RN3DT, are the most active general QSO ham radio operators to date. After being licensed just a few months prior to his flight to ISS, Mike Fincke learned how to beacon a special packet radio message to hams on the ground. This knowledge was put to good use when his wife Renita gave birth to a daughter on Friday June 18, 2004 while Mike was on-orbit. On Saturday June 19, the proud father announced the birth of his new daughter via the packet beacon. "It's a girl! Tarali Fincke" was sent down on the packet beacon about once a minute over the next week.

During the annual ARRL Field Day, both Mike Fincke and Gennady Padalka were on the air. Mike supported 2 meter operations using the Phase 1, Ericsson radio system using the callsign NA1SS and Gennady surprised the ham community with a booming signal on 70 cm using the Kenwood D700, the new ARISS antenna systems and the callsign RS0ISS. For the first time in human spaceflight history two crew members in the same vehicle were on the air at the same time. Multi-band, multi-operation became a reality on June 27 during



Roy Neal, K6DUE Commemorative Certificate
Figure 8

ISS field day operations. All in all, Mike and Gennady made 56 contacts during Field Day. Field Day 2004 was a huge success on ISS!

After getting bitten by the ham radio "bug," Mike Finke continues to make random contacts with the ham community throughout his ISS expedition. Most of these are during the weekend, including the weekend of July 31-August 1 when he made 30 QSOS on 5 continents. However, he also picks up the microphone when he has an opportunity and he is over "dry land." This is much easier in the Service Module since the new Phase 2 hardware is located near the window, dining table and exercise equipment.

ARISS DELEGATE REPORTS

Canada Team

The Canadian team has been busy investigating and developing various ways of presenting the ARISS Program as well as amateur radio in general to the public with a specific focus on educators. The areas of concentration are:

- Evaluation of various Voice over Internet (VoIP) techniques that can used to distribute ARISS events (school contacts), with emphasis on the use of the IRLP
- Development of a dedicated IRLP "Reflector" (located in Halifax, Nova Scotia) capable of providing effective distribution of ARISS events
- Providing ARISS Educational Outreach Information to Educators
- Development of "updated" ARISS displays
- Publicizing visible passes of the ISS and
- Planning for future collaboration with the Discovery Center (located Downtown Halifax) for a permanent ARISS/amateur radio display.

More details of these initiatives follows.

Investigation into the various VoIP (Voice Over Internet Protocol) voice communications

methods that are available to the radio amateur and how they might be interfaced with the IRLP system is ongoing. Our findings to date indicate that an interface is possible. In fact a few owners of IRLP Nodes have successfully "cross-linked" various VoIP based systems with the IRLP. Despite these successes some concerns remain as to whether these methods of "cross-linking" would be suitable for an ARISS application. It is expected that much of this will be sorted out in the near future through planned teleconferences.

In the event that the IRLP is selected as the method of distribution for ARISS events, the Canadian team is planning the establishment of a dedicated reflector based in Halifax.

Arrangements have been made to provide delegates to the 2004 Nova Scotia Association of Science Teachers (NSAST) Conference information on the ARISS Program. It's hoped that this will help to inform educators of how they and their students might benefit by integrating not only ARISS but amateur radio in general into their course studies. In addition, the ARISS Canada team has been approached by the Editors of both the NSAST and Nova Scotia Teachers Association to submit an article describing ARISS for publication in their Journals. This article would result in the maximum amount of exposure to educators in Atlantic Canada. Work has already begun with these articles with expected publication in the first quarter of 2005.

While not yet officially released, newly designed ARISS "display panels" continue to evolve. It's expected that design changes will be made in mid-fall with an official presentation of the completed design being made shortly thereafter. In addition, information is being collected in support of an ARISS information brochure.

In an effort to increase public awareness of the ISS, local Broadcasters (both television and radio) are provided information from the ARISS Canada team on high elevation passes over Canada. The criteria for broadcast are that the pass is over 45 degrees elevation and that sky conditions are clear. Canada is blessed with fairly "dark skies" which make the ISS very bright and easy to pick out amongst the background stars. Efforts are also being made to provide this service to Parks Canada within Nova Scotia (on a trial basis) for the enjoyment of visitors to the parks.

Also, the ARISS Canada team has been in discussions with the Discovery Center located in Downtown Halifax regarding the inclusion of a permanent amateur radio station in their future expansion plans. Current plans include providing radio equipment and antennas, operators as well as contributing to the schedule of on-going "special events" that the Center offers to visitors. This is an obvious opportunity for ARISS and amateur radio.

Europe Team

The ARISS-Europe team have developed a terms of reference to define the roles and responsibilities of the various team members. As such, ARISS-Europe is defined as the common working group of the European societies involved in Amateur Radio operations on board of the International Space Station (ISS). The ARISS-Europe working group is a subgroup of the Amateur Radio International Space Station (ARISS) working group.

The objective of ARISS-Europe is:

- to plan, implement and co-ordinate amateur radio projects and activities on board of the International Space Station, in agreement with the ARISS teams worldwide
- to build flight and monitoring equipment for ISS amateur radio
- to carry out the technical and operational service for ISS amateur radio equipment
- to develop operating procedures for ISS amateur radio
- to plan future development of ISS amateur radio

- to promote ISS amateur radio in the educational field and toward the general public.

Membership of ARISS-Europe consists of all European astronauts wishing to perform amateur radio operations during their flights and owning a corresponding Amateur Radio license, European national societies, members of the International Amateur Radio Union, Region 1 (IARU R1), involved in planning, organising and co-ordinating Amateur Radio projects on board of the ISS, European AMSAT societies and other European societies, wishing to contribute and introduced by their national IARU R1 society.

According to the Memorandum of Understanding established in Noordwijk, the Netherlands on March 27, 2000 the founding members of ARISS-Europe are AMSAT-Belgium, AMSAT-France, AMSAT-Italy, ARI, DARC, REF-Union, RSGB and UBA. Other societies are invited to join ARISS-Europe. To date, these additional societies include AMSAT CT (Portugal), AMSAT UK, PZK (Poland), and REP (Portugal).

ARISS-Europe is administered by a board consisting of a chairman, a technical director, and two technical counselors. The members of the board are elected for two years terms and they can be re-elected. Gaston Bertels, ON4WF serves as the ARISS-Europe chairman.

ARISS Europe has organised three ARISS International meetings: ESTEC, March 2000, ESTEC, May 2001 and ESTEC, March 2004. The ARISS Europe team has also prepared and performed 30 ARISS School Contacts in the 2002-2004 period.

ARISS Europe has developed close cooperation with ESA, the European Space Agency. ESA's Directorate of Human Spaceflight has hosted ARISS International meetings at ESTEC, (European Space Research and Technology Centre), Noordwijk, The Netherlands. ESA's ISS Utilisation Strategy and Education Office has submitted a Memorandum of Understanding to ARISS, intended to set up every semester an educational event in one of the European ESA countries. All the primary schools of the country are invited to participate to a Space and Science oriented competition, especially dedicated to an ESA astronaut performing a Soyuz Mission. Winning classes participate, courtesy of ESA, to an overnight educational encounter, the ARISS School Contact with the ESA astronaut being the climax of the event. To date, these events have been accomplished with the following ESA astronauts: Frank De Winne, ON1DWN in November 2002, Pedro Duque, ED4ISS in October 2003 and Andre Kuipers, PI9ISS in April 2004.

ESA's Directorate of Human Spaceflight has accepted the principle of incorporating an ARISS station on board Columbus, the future European Space Laboratory ISS module. To this end, patch antennas would be fixed on Meteorite Debris Panels on the nadir (Earth) side of the module. The antennas would be designed for UHF, L- and S-Band. Danny Orban, ON4AOD is in charge of developing and building these antennas. Currently, the stumbling-block in the design development is the +100,000 Euro price ticket of the engineering work to be done by the Columbus contractors for fixing coaxial feedthroughs, coax cables and the antennas. ESA's ISS Utilisation Strategy and Education Office offers 50,000 Euro for the project. No other funding has yet been found, despite our intensive efforts.

Japan Team

The Japan Team have been quite engaged in school contacts and working with the hardware team on the Phase 2 radio systems. To date, eight ARISS school contacts have been successfully accomplished in Japan. These include: 1) Iruma Children Center JK1ZAM on 23 November 2001, 2) Kansai Ham Fest 8N3ISS on 02 August 2002, 3) Hirano Elementary School 8N3HES on 08 February 2003, 4) Higashi Kaneko Junior High 8N1ISS on 26 Mar 2003, 5) Kuise Elementary school

8N3ISS on 18 June 2003, 6) Ube Collage Junior High 8N4ISS on 20 September 2003, 7) Meizen High school 8N6A on 13 July 2004 and 8) Habikino social and welfare committee on 29 July 2004. For the Meizen contact, the high school students prepared and carried out this ARISS contact by themselves. See figure 9. The audience included 50 elementary school children, 20 junior high students, 250 high school students, 80 parents, 6 TV stations and 5 Newspapers. The educational benefits of the ARISS program have resulted in follow-on, noteworthy accolades for the schools and educators. For example, the Iruma Children Center Ham club, JK1ZAM received the Yomiuri Education Award on 16 July 2004 under the category of Local Social work and Education activity. Also, an ISS educational application Workshop was held on 08 August 2004 at Chiba University. Mr. Miki, ex-director of Hirano Elementary School made a speech regarding their ARISS school contact.

Meizen High School, Japan School Group Contact, 8N6A
Figure 9

The Japan team was also instrumental in the acquisition and modification of the Phase 2 radio systems. Working with the leaders in Kenwood and Yaesu, the ARISS team was able to swiftly acquire the Kenwood and Yaesu radios for flight use as well as crew training. Also, the Kenwood team in Japan was instrumental in providing technical support to modify the D700 radio to best support on-orbit operations.

Russia Team

The ARISS Russia team have made some substantial contributions to the ISS Ham radio program, especially in the hardware development and installation area. The ARISS Russia team is led by Sergey Samburov, RV3DR. At the first ARISS meeting in 1996, Sergey Samburov proposed the potential use of 4 antenna feedthroughs on the Service Module. This proposal is now realized through the four ARISS antennas, WA1-WA4 on the aft end of the Service Module. Also at this meeting, Mr. Samburov proposed the use of the FGB antennas as an interim solution while the Service Module antennas were being developed, qualified and installed. All three Extra-Vehicular Activities (EVAs or spacewalks) performed to install the ARISS antenna systems were led by the Russian team. As such, it was the responsibility of the ARISS Russian team to develop and validate the EVA procedures and then participate in the EVAs as a member of the Russian Mission Control, TSUP, team. The successful deployment and utilization of these ARISS antenna systems is the result of significant coordination of the EVA planning by the Russian team. See figure 10.

The Russia team is also responsible for coordinating the Ham Radio activity and training of tourists and ESA astronauts on the Soyuz flights to ISS. In addition to training ESA astronauts, Frank De Winne, Pedro Duque, and

WA4 Antenna being Deployed During EVA
Figure 10

Andre Kuipers for ISS ham radio support, the Russian team also trained USA tourist Dennis Tito and South African Tourist Mark Shuttleworth for their use of the ISS Ham radio equipment.

A satellite proposal is currently being submitted to the Project Selection and Use Committee to honor the 175th anniversary of the Bauman Moscow State Technical University. Most of the engineers at Energia went to this University. It is expected that the satellite would be launched on a Progress in September/October 2005. Because it is still in the proposal stage, the satellite specifics are still open to suggestions. The current plan is for the satellite to be attached to the side of ISS by EVA. For several months it will be operated as an attached ISS payload. Ultimately, it would be deployed overboard on a subsequent EVA where it would operate for several more months, until it re-entered the Earth's atmosphere. The baseline design of the satellite is a 23 cm cube. Some of the ideas for this satellite include a digital camera with S-band capability. In addition to the satellite payload being undefined, the Russian team proposing this satellite is looking for solar arrays and batteries to power the satellite for its expected lifetime.

USA Team

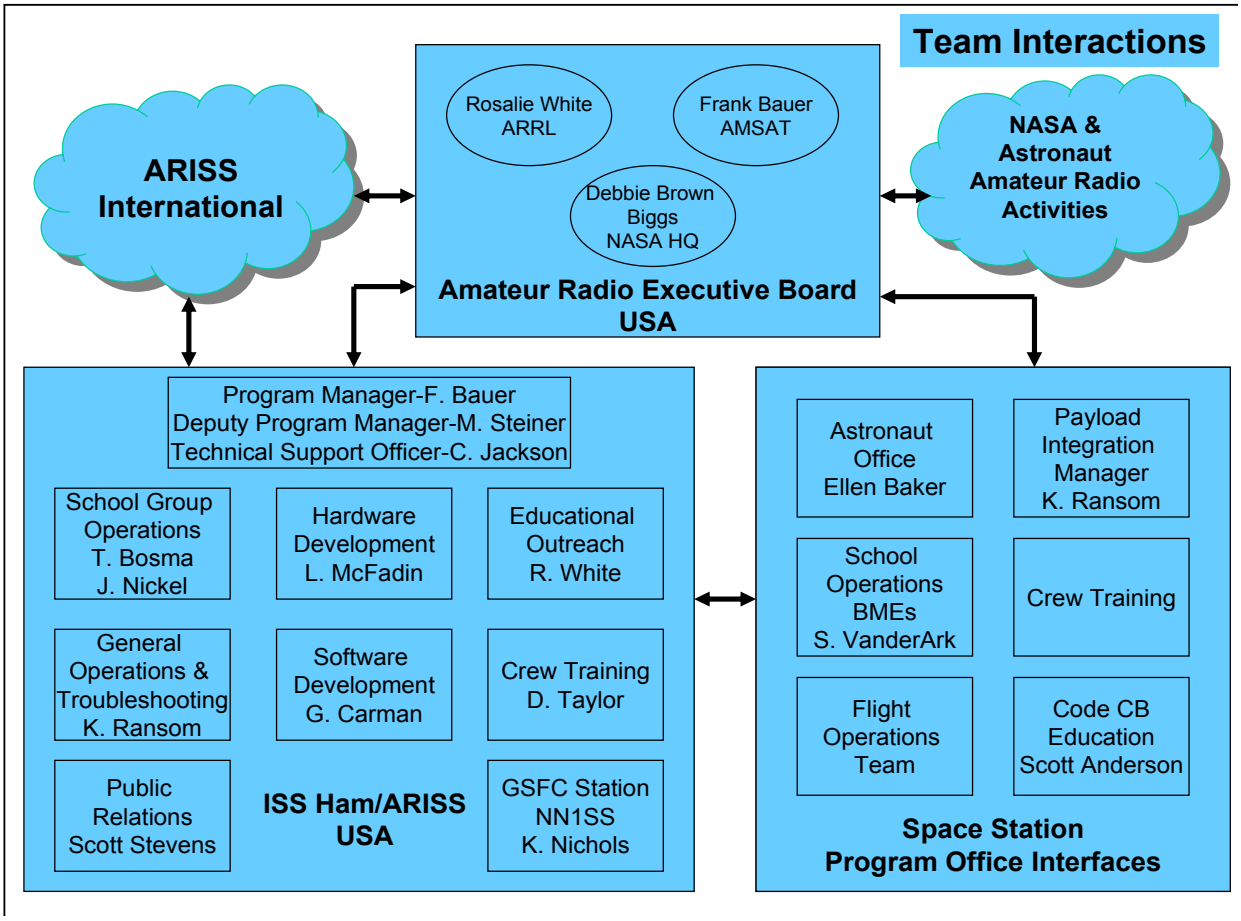
The ARISS USA team has undergone a substantial reorganization over the past year with new roles and responsibilities to better serve the ISS Ham program. Several new positions were modified to ensure that the USA has team backups. In addition, over the past year, several new leaders were added to the team and several others no longer support the team.

Some of the key personnel changes within NASA were that Debbie Brown-Biggs replaced Pam Mountjoy (SK) as the new NASA education outreach coordinator, Carlos Fontanot replaced Jeff Theall as the NASA ISS Program Office Liaison, and Kenneth Ransom, N5VHO, replaced Carolynn Conley, KD5JSO, as the ISS Ham technical manager at the NASA Johnson Space Center.

Key appointments within the ARISS USA team included the selection of Mark Steiner, K3MS as the ISS Ham USA Team Deputy Program Manager, Scott Stevens, N3ASA as the USA team's public relations lead, Mark Spencer, serves as an educational outreach specialist from the ARRL, Dave Taylor, W8AAS serves as the USA team's training coordinator, and Carol Jackson, from Orbital Sciences Corporation, serves as the technical support officer to the ISS Ham team. In addition, Rick Lindquist, N1RL, was named to the public relations committee. Rick regularly posts stories for all schools worldwide about their ARISS contacts after compiling this information from the school mentors.

The USA team responsibilities and interactions with the ISS program office and the ARISS international team is depicted in figure 11.

This new team structure has substantially improved the effectiveness of the team and the communications of key information to the general public and to NASA. For example, the team is now posting weekly reports on ARISS-related activities. These reports are disseminated to NASA, ARRL, AMSAT, the ARISS International team and are posted on the ARISS web site: www.rac.ca/ariss Also, by clearly defining the new roles and responsibilities, the USA team and the ARISS international partners



ARISS USA Team Interactions
Figure 11

now know who best to work with on the US side to accomplish a specific task. These organization changes have also lifted a significant burden off a few individuals so that more are sharing the load. For more details on this, refer to reference 7.

This past year, the US team worked with NASA to complete layout and printing of an ARISS lithograph. This photo montage, with a detailed description of the ARISS goals and mission printed on the back, will be given to students, educators and the general public during ARISS events and NASA outreach activities. See figure 12.

ARISS Lithograph
Figure 12

THE FUTURE

NASA is now embarked on a new exploration initiative---a focus on going to the Moon, Mars and beyond. There are strong expectations that, like ISS, the exploration initiative will be an international endeavor. The ARISS program has shown that volunteers, internationally, can come together and do great things. Together we inspire the next generation of explorers. Together we improve the well being of the ISS on-board crew. So it makes logical sense that ham radio, using the ARISS team as a model, should be an important part of this new exploration initiative. As such, the NASA Education Office has asked the ARISS team to to look at the role ARISS might play in the exploration initiative. We need to focus on specific strategies to bring ham radio into this initiative. This could include things such as a Mars payload, a repeater on the moon, a Mars telecom satellite, and hamsats at the Moon-Earth libration point. There will be many challenges, such as the long path length. But it will be the ingenuity of the ARISS team that will bring cost effective, volunteer solutions to the space agencies.

Our space agencies are starting their trek to the moon and Mars. It is our challenge and destiny to be an integral part of this challenge. The ARISS international delegates will discuss this at length at the October 2004 meeting in Arlington, Virginia. You are welcome to attend and participate.

CONCLUSIONS

2004 will be known as a year that the ARISS international team has made great strides in on-orbit hardware installation, new antennas, simultaneous operation on 2 bands, outstanding school group contacts, numerous voice contacts with hams and a robust on-board packet system. The ARISS international working group has proven itself as a highly motivated, results-oriented team that can provide significant positive benefits to the space agencies. As such, their current and past efforts have resulted in dialogue with NASA on the new exploration initiative to the moon and Mars. As the ham radio community has achieved permanence on the International Space Station through ARISS, it is our expectation that this ARISS team will evolve in the future to support the next ham radio challenges to places and planets unimagined.

ACKNOWLEDGEMENTS

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these organizations if this program is to remain successful. 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.

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For more information on the ARISS program, you are welcome to visit the ARISS web page at: http://www.rac.ca/ariss