AMATEUR RADIO ON THE INTERNATIONAL SPACE STATION 2004 STATUS REPORT

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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.

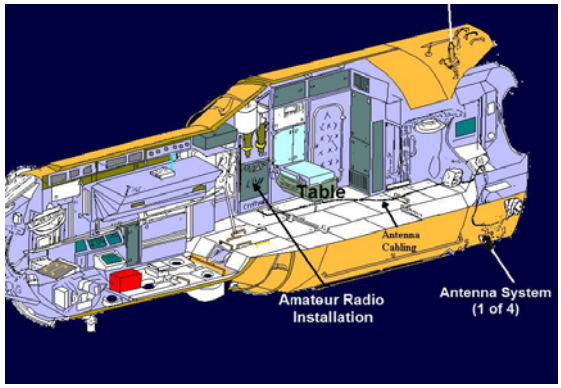
Ham Station Location

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.

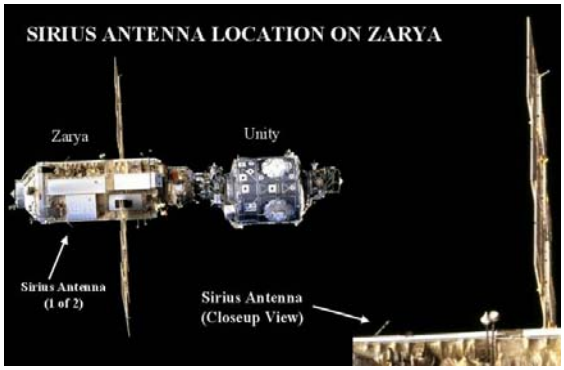


ARISS Hardware in Service Module
Figure 2

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.

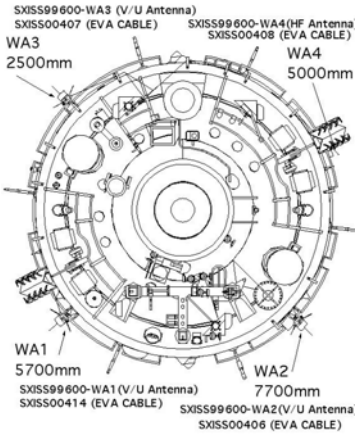
The Phase 1 radio system was launched on-board three space shuttle flights: STS-106 on September 8, 2000, STS-105 on August 10, 2001 and STS-108 on December 5, 2001.



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.

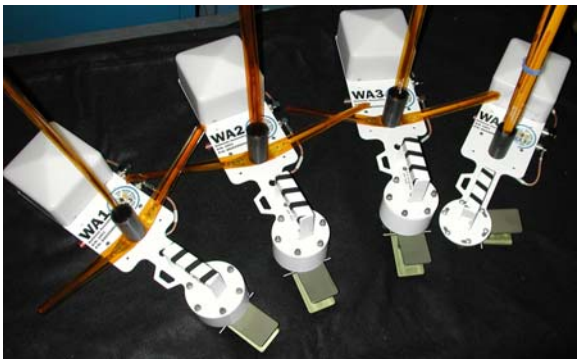


Antenna Location from End of Service Module
Figure 3

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

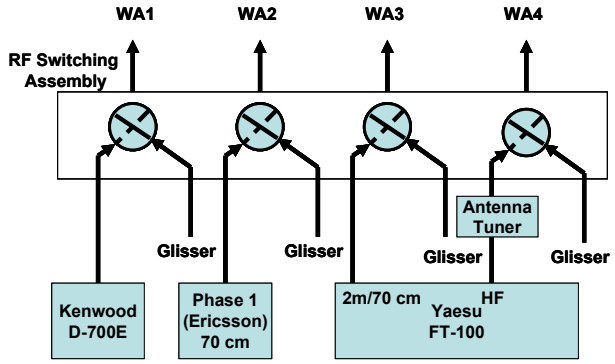
The Phase 2 hardware, consisting of two new radio systems, utilizes the ham radio antennas mounted on the Service Module. The phase 2 hardware augments the Ericsson Phase 1 hardware already on-board the ISS. Combined, the Phase 1 and Phase 2 system provide more capabilities for the crew and permit simultaneous,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

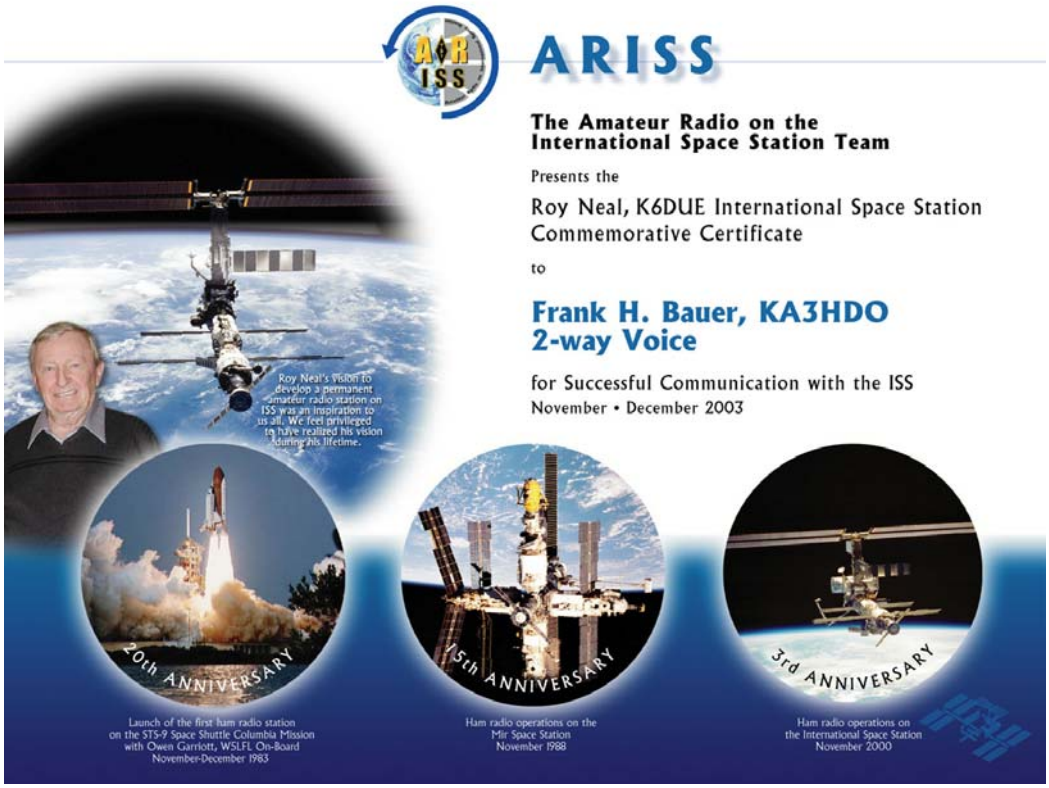
The third milestone was the 3rd anniversary of amateur radio communications from the ISS. On November 13, 2000, Sergei Krikalev, U5MIR and Bill Shepherd, KD5GSL, on ISS could be heard talking to the ham radio teams located at the Energia amateur radio station, R3K, in Russia and the Goddard ISS ground 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

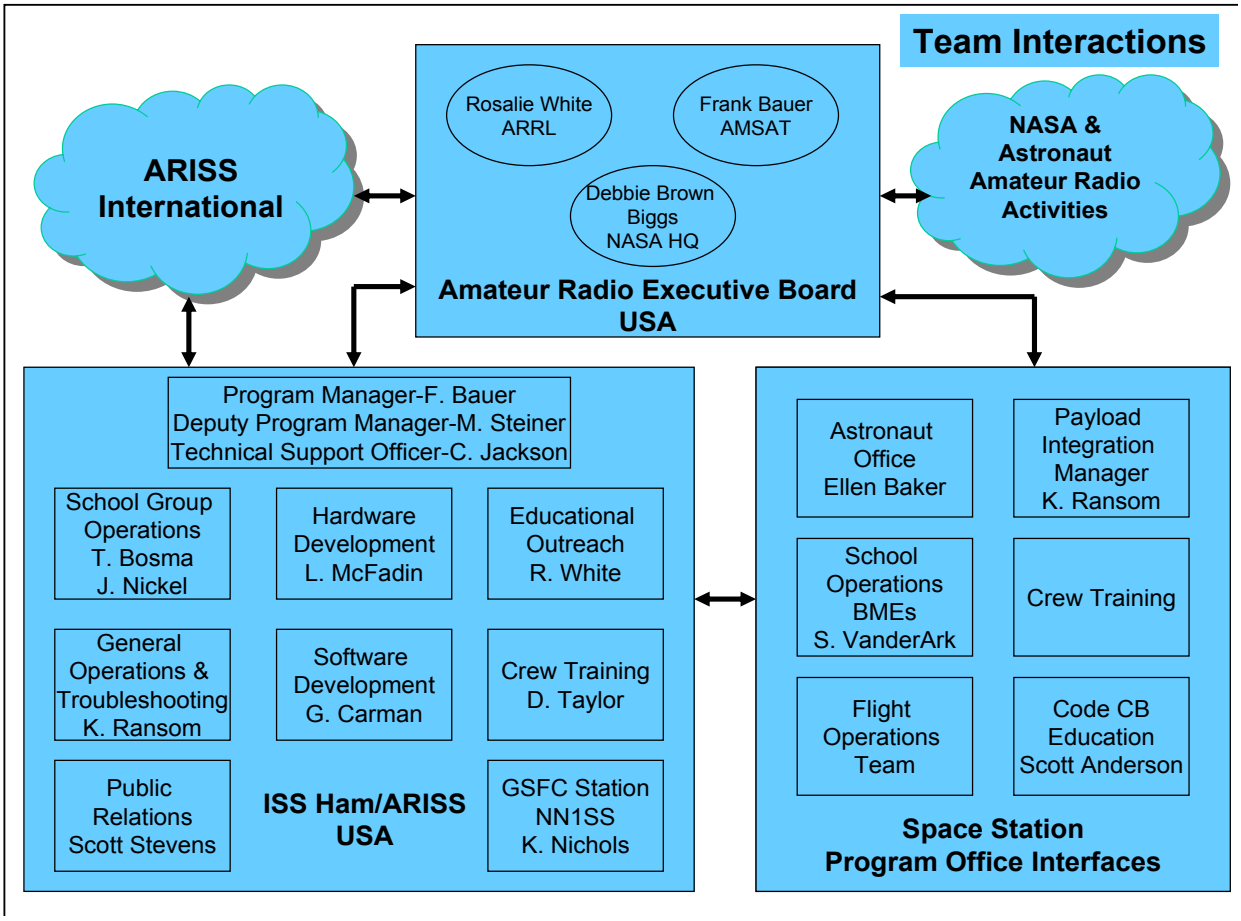
The ARISS USA team has undergone a substantial reorganization over the past year with new roles and responsibilities to better serve the ISS Ham program. Several new positions were modified to ensure that the USA has team backups. In addition, over the past year, several new leaders were added to the 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.

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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