Amateur Radio on Human Spaceflight Missions

Since 1983, international amateur radio organizations have worked with the space agencies to fly amateur radio and to support Educational Outreach on:

- Space Shuttle (SAREX)
- ISS (ARISS)
- Mir (Mirex/SAREX & SAFEX)
Amateur Radio on Human Spaceflight Missions
Development and Operational Phases

**Phase I**
- Pure Experimental Phase
- Infrequent Flights (<<1/year)
- New Untested Hardware
- New Techniques
- Occasional school contacts
- Shuttle Based
  - 1980s-early 1990s

**Phase II**
- Operational Phase
- Frequent Flights (>3/year)
- Specific Hardware Configs
- Flew on all 5 Space Shuttles
- AMSAT Operations Team
- Operational STEM Outreach
  - 1990s

**Phase III**
- Operational Phase
- Long duration missions on Mir & ISS
- Permanently Installed Hardware
- International Development & Operations Team
- Operational STEM Outreach
  - 2000s+
SAREX-ARISS Objectives

Spark Student’s Interest In STEM Careers

Crew Contacts

Promote Interest In Amateur Radio

Human Spaceflight Awareness

ISS Backup Communications

Experimentation
STS-9 Owen Garriott, W5LFL
First Amateur Radio Operations from Space!
STS-51F Tony England, W0ORE
First SAREX Flight

SSTV

Spacelab 2

W0ORE

Informal Student Events
STS-35 Ron Parise, WA4SIR
Packet Robot, School Contacts, Telebridge

WA4SIR on SAREX

SAREX Stowage in Mid-Deck

Astro-1

Science Observations

Ron Parise & Window Antenna
Telebridge Stations

Graham, VK5AGR Australia (former)

Sacred Hearts Academy, Hawaii

Tony, VK5ZAI, Australia

Santa Rosa Jr College, W6SRJ, California
Mission Control
Customer Support Room Ops
STS-37—The Entire Crew isLicensed! School Contacts, Voice QSOs, TV Uplink

Ken Cameron, KB5AWP on SAREX

School Contact
Shuttle/SAREX Astronauts
Shuttle/SAREX Astronauts II
SAREX Operations on Mir

SAREX School Group operations on Mir completed with safe return of Andy Thomas, (KD5CHF, VK5MIR) from Space

John Blaha, KC5TZQ
8 Schools

Jerry Linenger, KC5HBR
9 Schools

Mike Foale, KB5UAC
No Schools due to 6/25 accident

Dave Wolf, KC5VPF
(left) & Andy Thomas, KD5CHF (right)
15 Schools
ARISS Meeting at ESA ESTEC
Historic Firsts

- First human tended amateur radio in space (1983)
- First communications between astronauts and people outside official NASA channels (1983)
- First pictures uplinked and downlinked to Shuttle (1985)
- First astronaut-student interviews (1990)
- First scheduled crew contacts with families & friends (1990)
- First computer-to-computer radio links (1990)
- First Television uplink (1991)
- First backup communications during TDRSS outage (1992)
- First direct contact between the Space Shuttle and Space Station Mir
- Most frequent flyer payload in Shuttle Program (25 Flights on all 5 Shuttles)
- FGB-mounted 2 m Ericsson radio for voice & packet
  - Operational less than 2 weeks after first crew arrival making ARISS the first payload on ISS
Amateur Radio on the International Space Station (ARISS)

What is ARISS?

• International program that inspires students, worldwide, to pursue careers in science, engineering and mathematics through communication with the ISS on-orbit crew via amateur radio
• Local community drawn into this once-in-a-lifetime human spaceflight pursuit
• Provides an experiment platform for new telecommunications techniques
• Promotes interest in the amateur radio (ham radio) hobby as a link to better engage students in science and math

ARISS development, operations and student mentoring is performed almost exclusively by a world-wide network of amateur radio volunteers who are passionately committed to the above objectives
ARISS Astronauts
International Space Station

- Service Module (Zvezda)
- FGB (Zarya)
- Columbus Module
On-Orbit Capabilities

VHF 2-way Voice in Columbus Module

VHF and UHF Voice in Service Module (Zvezda)

Slow Scan TV (Picture uplink and downlink)
Columbus Module Radio System

Astronaut Randy Bresnik installing VHF/UHF Antenna on Columbus Module, Nov 2009

Tom Marshburn, Exp 34 using Ericsson radio sans headset in Columbus Module—Feb 2013
SSTV—Current Capability

SpaceCam 1/MMSSTV
H/W & S/W

VC-H1 SSTV
Hardware Solution
SSTV

http://www.amsat.org/amsat/ariss/SSTV/
Future Capability—Ham TV

贺姆电视控制模块

在哥伦布上

现场视频来自国际空间站

ARISS L/S频段天线

在哥伦布上

On-orbit!
ARISS Educational Satellites Deployed From ISS 
SuitSat-1 & ARISSat-1

SuitSat-1--Amateur Radio Extra Vehicular Activity (EVA) In a Space Suit

ARISSat-1—Educational Experiments on hand-deployed Nanosatellite
SuitSat School Spacewalk Pictures, Artwork and Signatures from Students around the world
Deployments

SuitSat-1
Feb 2006

ARISSat-1
Aug 2011
Press Visibility
Small Sampling

Major Web Sites
- CNN
- National Geographic News
- Aljazeera
- Discovery Web Site
- MSNBC
- Spaceflight Now
- Yahoo

Television
- Fox 5 News (DC)
- ABC News (National)
- CBS News

Radio
- NPR—All Things Considered
- CBC
- Discovery Channel Canada
- WTOP (DC)

Newspapers/Periodicals
- New York Times
- Washington Post
- Florida Today
- Houston Chronicle
- Washington Times
- Boy's Life
- Reader’s Digest
- Popular Science
- Aviation Week & Space Technology
- Design Electronics
- QST
- CQ-Japan
Hardware Development/Ops
Lessons Learned

• ISS is not like Mir → don’t expect the same type of ops

Differences:
  – Mir crew relied on ham radio equipment to support family contacts, radiograms, air to ground comm
  – Ham radio on Mir was the prime external outlet for the crew
  – ISS communications system much more robust
  – IP Phone on ISS requires very few ARISS family contacts

Similarities:
  – Proven educational outreach capability that requires nearly zero setup overhead
  – “Dyed in the wool” hams use the equipment extensively

• After 13 years of continuous operations little crew time for hardware installation, checkout, or troubleshooting

Lesson Learned

Future ARISS Equipment needs to be Completely Autonomous
Amateur Radio Debuts on 3D IMAX Film

SPACE STATION 3D
Narrate by
TOM CRUISE

Coming Soon
Opens 6 June in Sydney
13 June in Melbourne
Susan Helms on the Air during Field Day

Field Day Results:

• 250 stations contacted
• 202 after dupes removed

Bonus Points:
• Solar Power
• Off Commercial mains
• PR

• Total points: 1010
ARISS QSL Cards
Sergej Samburov, RV3DR
&
Lou McFadin, W5DID
with ARISS Flight Hardware
Lunch at Durangos
Conclusions

• Multi-mode, multi operations capability is a reality on ISS
• Payloads provide an outstanding Educational Outreach foundation for ISS
• ARISS’s solid performance and outstanding international teamwork is recognized and respected by the Space Agencies
• This is YOUR resource---we look forward to your participation

Frank Culbertson During Scout Jamboree on the Air
ARISS Information

http://www.ariss.org
Backups
Bill McArthur Only Person to Operate SAREX, Mir & ARISS Stations

Shuttle STS-58

Shuttle/Mir STS-74—Mir Radio  Worked All States Award

ISS Expedition 12
Expedition 12 Highlights

The Best Increment Ever for Ham Radio

- Inspired students at 37 schools
- At least 1755 general contacts made
- 130 DXCC entities contacted (approximately 94 U.N. recognized countries). ARRL has confirmed 52.
- Earned ISS Honorary Awards
  - Worked All States
  - Worked All Continents on UHF
  - Worked All Continents on VHF
  - DXCC
- Peter Island
- Vatican
- EVA in US and Russian suits
- SuitSat-1
  - Assembled and deployed SuitSat-1.

Bill McArthur, KC5ACR
Most active ham aboard ISS
1988 AMSAT Symposium
QSO with Musa Manarov, U2MIR on Mir

Musa, U2MIR

QSO with U2MIR on Mir

AMSAT Award
Owen Garriott, W5LFL & Richard Garriott,
Richard Garriott and Mike Fincke
Commander Chris Hadfield
ARISS Immersion in Canada

• Chris Hadfield, KC5RNJ/VA3OOG, Expedition 34/35
• First Canadian to Command the ISS
• Social Media and Music Phenomenon
• 23 ARISS school contacts all across Canada and around the world!

Chris Hadfield Poster at RCMP Headquarters, Yellowknife, NWT Canada
Outstanding first: connecting Canadian students all across Canada from space via Amateur Radio

Nova Scotia to Newfoundland to New Brunswick to Ontario to Manitoba to British Columbia to Prince Edward Island to Saskatchewan to Quebec to Alberta to Nunavuc/Quebec to Ottawa (National Capital) to Yukon to Nunavut to Return to Quebec to Northwest Territories
The ARISS “Buffalo Connection”

- Hay River, NWT, home of Buffalo Airlines (of Ice Pilots fame)
- Hay River school contact held May 3—attendance approximately 300
- ARISS Ottawa Ops Team attended courtesy of Buffalo Airways who provided transportation
- The television series Ice Pilots by OMNI Productions was on location
- Buffalo Airways helped sponsor the contact and made it happen
- Watch the Ice Pilots first episode in the fall, you might see the Hay River contact.
Ground Team at Harrowgate
Ten+ Years Later—Our Accomplishments

• 1st human spaceflight freq plan for 2 m & 70 cm
• Installed Ericsson 2 m radio system for voice & packet in the FGB less than two weeks after first crew arrival
  – Making ARISS the first payload on ISS
• Developed and mounted 4 multi-functional antenna systems by 3 EVAs on the periphery of the Russian service module; supports 2 m, 70 cm, L band, S Band, HF and GPS reception
• Installed UHF/VHF Kenwood D-700E in Service Module, near the dinner table and window
• Successful completion of over 298 international schools—kudos to the operations team and volunteer mentors on a job well done!
• 15 consecutive ISS expedition crews used our radio system to conduct thousands of QSOs with hams on the ground
• Over 15,000 students touched each year
• Millions, worldwide have heard an ARISS connection
• Witnessing students, worldwide, become scientists and engineers as a direct result of the ARISS connection
• The first Spacesuit satellite—SuitSat-1/Radioskaf deployed from ISS.
The Amateur Radio on the International Space Station (ARISS) Team

SuitSat-1/Radioskaf-1/AO-54
RS0RS, Commemorative Certificate

presented to

Frank H. Bauer
KA3HDO

For Successful Reception of the SuitSat-1 radio downlink during its operation from February 3, 2006 – February 18, 2006.
The Amateur Radio on the International Space Station (ARISS) Team

SuitSat-1/Radioskaf-1/IO-54

Certificate of Recognition

presented to

William C. McArthur
KC5ACR

Presented in recognition of your outstanding volunteer support to ensure the successful development, crew training, deployment, operations, educational outreach and information dissemination of the SuitSat-1 mission. As a result of your efforts, SuitSat-1 captured the imagination of people and students worldwide providing unprecedented outreach and visibility for a ham radio event.
The Amateur Radio on the International Space Station (ARISS) Team

is proud to present the

Chicken Little Prognostication Award

to

Aaron Russo
Student K-8

As one of the “Select Few” to successfully predict the reentry of the SuitSat-1/Radioskat-1/AO-54 satellite,

SuitSat Deployment: February 3, 2006 @ 23:03 UTC
SuitSat-1 Reentry: September 7, 2006 @ 16:00 UTC
WA4 (HF) Antenna during EVA
Exp 1 School group contacts

- Started December 21
- About once a week was the goal
- Seven total: 3 crew pick, 4 old
- Shuttle gaps were a big issue
- Lack of good orbital predictions, short notice of which pass will be supported