Human Spaceflight Update: ARISS, the Moon and Mars

Dayton Hamvention
May 21, 2005

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Amateur Radio on Human Spaceflight Missions

Since 1983, organizations in the U.S. (SAREX), Germany (SAFEX) and Russia (MIREX), have worked with the space agencies to fly amateur radio and to support Educational Outreach on:

- ISS
- Space Shuttle
- Mir
ARISS Objectives

- Spark Student’s Interest In Science & Technology
- Crew Family Contacts (Crew Psychological Ops)
- Promote Interest In Amateur Radio
- Human Spaceflight Awareness
- Experimentation
Development & Operations on the International Space Station (ISS)

Working with our international partners to develop & operate Amateur Radio on the International Space Station (ARISS)

ARISS Organization

- Nine international partners thus far—Belgium, Canada, France, Germany, Italy, Netherlands, Japan, Russia and United States
- MOU—Formed ARISS to represent the amateur radio community to the ISS Program
- All volunteer organization
10 ISS Expeditions Completed

4.5 Years continuous ARISS operations

Expedition 11

Nov 2000 – Mar 2001
Mar 2001 – Aug 2001
Dec 2001 – June 2002
June 2002 – Nov 2002
Nov 2002 – Mar 2003
Apr 2003 – Oct 2003
Oct 2003 – Apr 2004
Apr 2004 – Oct 2004
Oct 2004 – Apr 2005

Sergei Krikalev
U5MIR

John Phillips
KE5DRY
ARISS HARDWARE DEVELOPMENT

*Development to be conducted in four phases*

- Initial Amateur Station (Phase 1 is on-orbit)
- Transportable Amateur Station—Phase 2 (Developing/On-Orbit)
- Permanent Amateur Station (Future)
- Express Pallet/External Experiments (Developing & Future)
Ham Station Location:
Service Module and FGB

- Initial ops in FGB
  - Using Phase 1 VHF radio system
- Primary ops in Service Module
  - Multi-mode, multi-operator capability after installation of 4 antenna systems
Phase 1 (SAREX) Hardware Status

- Ericsson 2 meter radio operational on voice in FGB
  — “Best downlink audio on ISS” Bill Shepherd, November 2000
- Packet Module non-operational
  — Needs to be reset by the crew
- Ericsson 70-cm radio awaiting installation in Service Module
- Preparing replacement headset and extension cable for launch on Shuttle
  — Extension cable on STS-114 Shuttle Return to Flight
Planned Capabilities for Phase 2 Station

- Phase 1 VHF & UHF Systems
- Higher power (25 W) VHF & UHF FM Radio System
- HF (shortwave) radio system for ionospheric experimentation
- Packet Radio
- SSTV

Supports Multi-Band, Multi Operator Autonomous and Crew-tended Modes
ARISS / ISS HAM
Location in and on the Service Module

Amateur Radio Installation
Antenna Cabling
Table
Antenna System
(1 of 4)
Antenna System Installation on Service Module
Antenna System w/ VHF/UHF Antenna Installed

Internationally Developed
Italian Contribution:
- Microwave Antennas
- Diplexer
- L/S Glisser Antenna

US Contribution:
- Mounting Plate
- Handle & Spacer
- VHF/UHF & HF Antennas

Russian Contribution:
- Handrail Clamp
- Interconnecting Cables
WA3 and WA4 Antennas on Service Module

Ham Radio Antennas
All Four Antennas

WA1

WA2

WA3

WA4
WA4 (HF) Antenna during EVA
Installation/Launch Status (2003-2005)
3 Launches in 3 Years!!

- Progress 12P flight, August 30, 2003
  - Phase 2 Kenwood D-700E Radio System
  - Energia Phase 2 Power Supplies
- Progress 19P flight, Aug 2005
  - SSTV Hardware and Software
  - ARISS Computer
- STS-114 Shuttle Return to Flight, July 2005
  - MISSE-5/PCSAT2 External Payload
  - Phase 1 Headset extension cable
- Future Flight
  - Phase 1 Headset
  - Phase 2 Yaesu FT-100D Radio System

Transitioning to Joint Operations in FGB and Service Module
Service Module Hardware Architecture
(Phase 1 70 cm and Phase 2)

- Phase 1 Ericsson 70 cm
- Yaesu FT-100
- Kenwood D-700E
- Power Supply 2
- Power Supply 1
- Power Distribution Assembly
- Spares 70 cm
- FT-100
- D-700
- Power Receptacle
Kenwood D-700E Closeout Photos
5 Program Modes

PM 1 Voice
PM 2 Crossband Repeater
PM 3 APRS
PM 4 Packet
PM 5 Emergency & 9600 Packet
Phase 2 Hardware Status

- Kenwood D700 & WA2 Antenna System Operational on 2 meters and 70 cm
  - General voice QSOs
  - Packet
  - Repeater operations
  - School group operations
Phase 2 Hardware Status
Future ISS Hardware Deployments

• SSTV—August 2005
• Phase 2 Yaesu hardware—2006?
• External payload—1st payload (MISSE-5/PCSAT2)—July 2005
SuitSat—Amateur Radio Extra Vehicular Activity (EVA) In a Space Suit

- Russian-led initiative w/ USA Support
- Potential capabilities:
  - Message downlink
  - SSTV
  - Eagle Earth Sensor demonstration
  - Telemetry
  - School Spacewalk—DVD/CD with school name, artwork and student names included
- Expected deployment: 9/14/05
- Expected Freqs of Operation: 145.99 MHz downlink, 437.55 MHz uplink
Operations

• Downlink:
  – Worldwide both voice & packet: 145.80
• Uplink:
  – Packet: 145.99
  – Region 1 voice: 145.20
  – Region 2 & 3 voice: 144.49
  – Voice Repeater: 437.80

• Callsigns:
  – DL0ISS
  – RS0ISS
  – NA1SS

• Crew Schedule
  – ~0700 to 1900 UTC
  – Off Saturday Noon to Sunday evening
Expedition 10—Leroy Chiao, KE5BRW
Record Number of School Contacts

23 Schools—177 total schools to date
Thanks Leroy!!
Flory Academy of Sciences and Technology
Moorpark, CA, April 8, 2005
Flory Academy of Sciences and Technology
Moorpark, CA, April 8, 2005
Voice Over Internet Protocol (VOIP)

IRLP, Echolink and Internet Streaming Provides a Wider Reach to Schools and Hams Around the World

Echolink
AMSAT and EDU_NET Servers

IRLP
9010 "Discovery" Reflector

www.amsat.org
Calendar of Events

www.discoveryreflector.ca
Expedition 12 Potential Plans

Bill McArthur, KC5ACR, Expedition 12 Astronaut

- Random QSOs
- Extensive school ops (2 per week)
- SSTV operations
- Simultaneous Multi-operations (SSTV, Packet & Voice)
- Reset Phase 1 packet system
- 23 cm uplink repeater operations
- HF operations (if Yaesu available)
Amateur Radio Executive Board

Rosalie White
ARRL
USA

Frank Bauer
AMSAT

Debbie Brown
Biggs
NASA HQ

Amateur Radio Executive Board

Astronaut Office
Ellen Baker

Payload Integration Manager
K. Ransom

NASA & Astronaut Amateur Radio Activities

ISS Ham/ARISS

USA

School Group Operations
T. Bosma
J. Nickel

General Operations & Troubleshooting
K. Ransom

Public Relations
Scott Stevens

Hardware Development
L. McFadin

Software Development
G. Carman

Educational Outreach
R. White

Crew Training
D. Taylor

GSFC Station
NN1SS
K. Nichols

Space Station Program Office Interfaces

ARISS International

Program Manager-F. Bauer
Deputy Program Manager-M. Steiner
Technical Support Officer-C. Jackson

Team Interactions
AMSAT’s Vision for Space Exploration: To the Moon, Mars and Beyond

NASA working on architecture and funding for new initiative:
- Tentative plans include completing ISS development by 2010, ending Shuttle flights by 2010 and re-directing other funding to exploration priorities.
The Future

- ARISS team developing Exploration Initiative strategy
- ARISS’s solid performance and outstanding international teamwork is recognized and respected by the Space Agencies
- Some hardware thoughts:
  - Repeater on the moon?
  - Mars telecom satellite?
  - Hamsats at Moon-Earth libration point?
  - Audio? Video? Astronaut psych ops support?
- The challenges will be high due to the long path lengths
- The time to act is NOW, while interest within NASA is high
Conclusions

• Phase 1 and a portion of the Phase 2 hardware has been delivered on ISS on 5 launches
• Multi-mode, multi operations capability is now a reality on ISS
• Payload provides an outstanding Educational Outreach foundation for ISS
• ARISS’s solid performance and outstanding international teamwork is recognized and respected by the Space Agencies
• We are now positioned to venture beyond Earth orbit---ARE YOU READY??

Frank Culbertson During Scout Jamboree on the Air
ARISS Information

http://www.rac.ca/ariss
Backup Slides
Installation/Launch Status (2000-2001)

4 Launches in 2 Years!!

• STS-106 (2A.2B), September 2000
  – delivered Phase 1 VHF & UHF Ericsson radios to ISS
  – VHF FM (144 MHz) radio system installed in Zarya (FGB) & attached
to Sirius antenna system
  – Supports voice & packet ops
• Soyuz Flight 2R
  – Increment 1 crew activates VHF equipment on November 13, 2000 (14
days after crew arrives)
• STS-105 (7A.1) August 2001
  – Delivered new packet module to support simultaneous 2 radio
(VHF/UHF) ops in FGB & Service Module
• Progress 6P flight, November 2001
  – Delivered Russian antenna hardware
• STS-108 (UF-1) December 2001
  – Delivered antenna systems and add’l hardware to support 2 radio ops
Kenwood D-700E
User Interface

- 5 Program Modes using specially developed MCP software
- 200 frequency pairs w/ CTCSS/PL
- Packet radio defaults in EEPROM
- Right side of radio---primary interface w/ crew
- Left side of radio---special uplink capabilities