Amateur Radio on the International Space Station (ARISS)

ARISS Development & Operations

2008

Frank H. Bauer, AMSAT ka3hdo@amsat.org

This Presentation is Dedicated to the Memory of

Dr. Ronald A. Parise, WA4SIR

May his exploration spirit continue to live within us all!

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

USA Sponsors

National Aeronautics and Space Administration (NASA)

American Radio Relay League (ARRL)

AMSAT

Radio Amateur Satellite Corporation (AMSAT-NA)

On-Orbit Capabilities

VHF 2-way Voice in the FGB (Zarya) Module

Slow Scan TV (Picture uplink and downlink)

VHF and UHF Voice in Service Module (Zvezda)

On-Orbit Capabilities

Computer-to-Computer Radio Links

BBS message posts and IM-type text message relay using packet radio

Posted : 06/28/97 17:58
To : ALL
From : R0MIR
Subject: Mir Status

We have now got the base block, the module Kvant 2 back on line, leaving 2 more modules. Working very hard, lights in our mouths, in the dark, moving batteries about, to enable better charging, with solar arrays. O2 electrolysis soon, in old Kvant. Much interest from control center to do internal eva to reconnect power to lost Spkektr module, to receive its substantial electrical power from its large arrays.

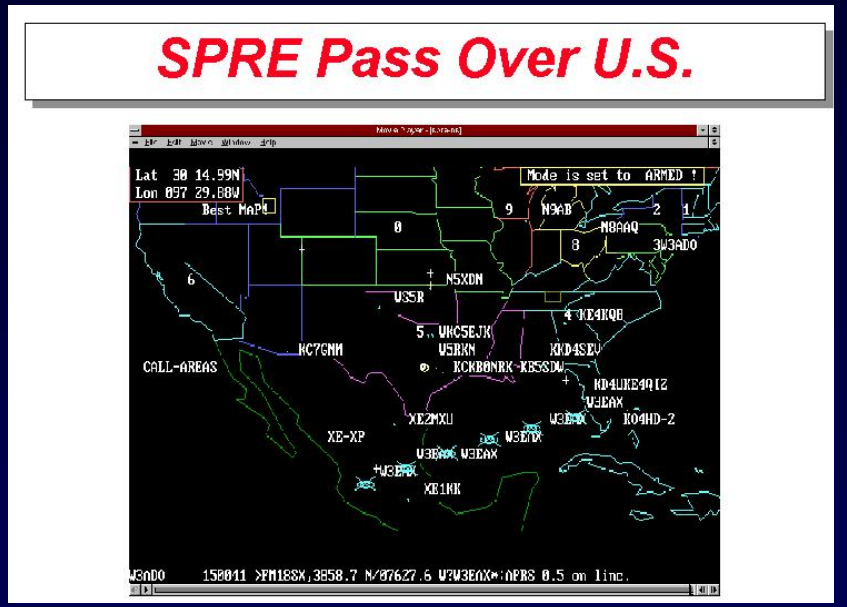
Thanks for all your good wishes. Mike.

CMD(B/H/J/K/KM/L/M/R/S/SR/V/?)>

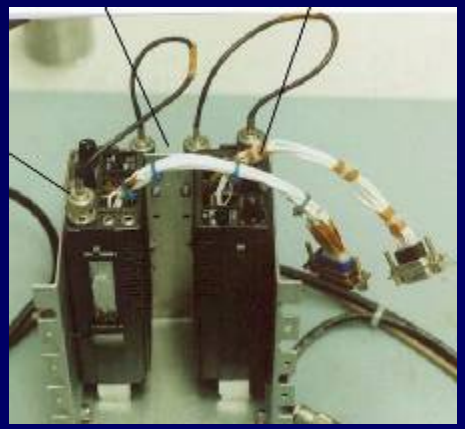
Amateur Radio BBS message from Mike Foale after Progress collision with Mir Spektr Module

Future Capabilities

Amateur TV
(Standard, Spread spectrum, & MPEG)



R/T Internet TLM using amateur radio



Express Pallet, External Payloads and Deployed Satellites---w/ student experiments

Examples: SuitSat-1 Deployment & SuitSat-2 Development

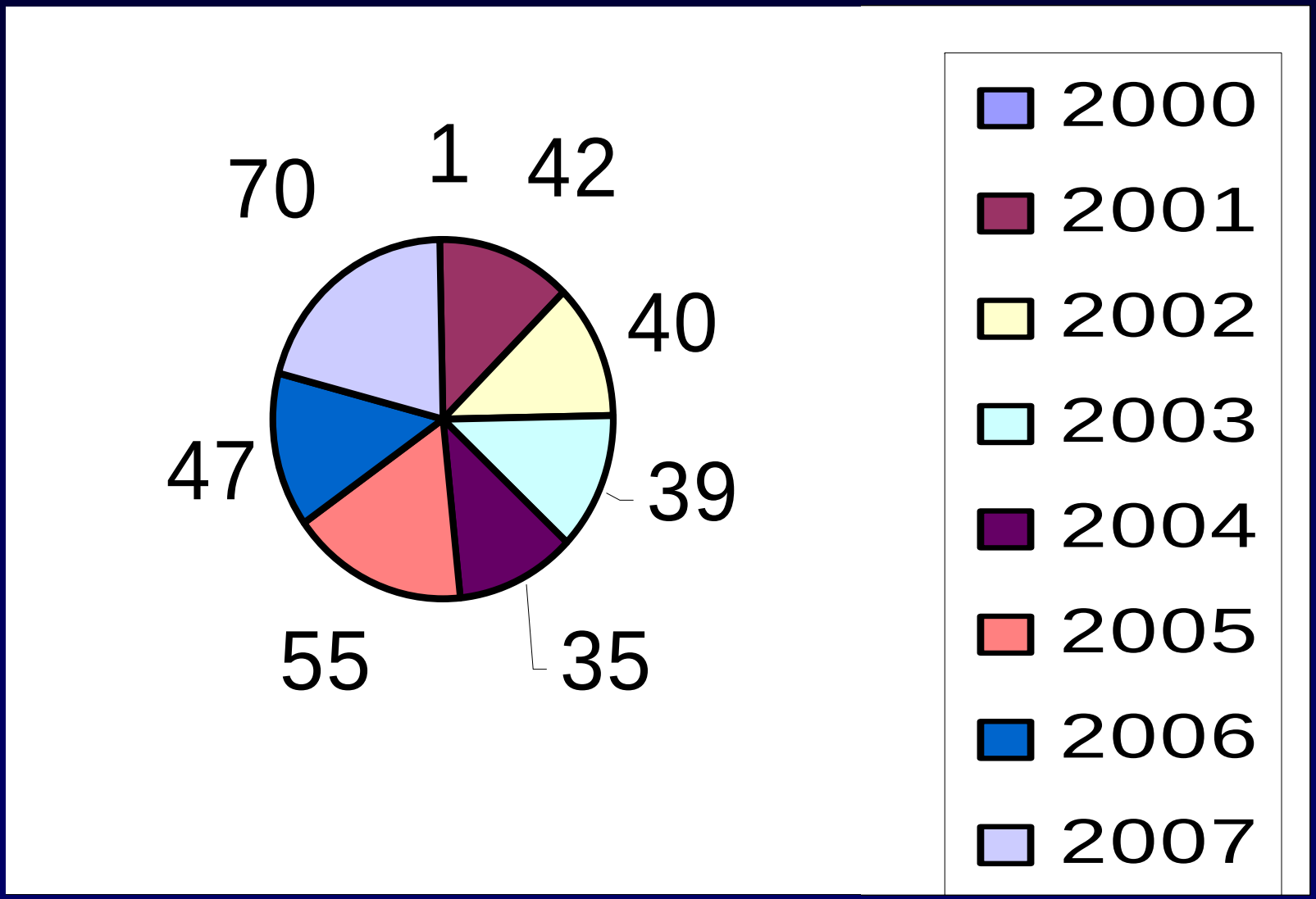
ARISS Capabilities & Impact

- 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**
- Developed 4 multi-band antenna systems; mounted on the periphery of the Russian service module via 3 EVAs→**2 m, 70 cm, L band, S Band, HF and GPS**
- Developed and installed 2 L/S-band antennas on European Columbus Module
- Installed UHF/VHF Kenwood D-700E in Service Module, near the dinner table and window
- Successful completion of **375** schools—kudos to the international operations team and volunteer mentors on a job well done!
- **17 consecutive ISS expedition crews** used our radio system to conduct thousands of QSOs with hams on the ground since November 2000
- Over **15,000** students touched each year
- **Millions, worldwide** have heard an ARISS connection
- Millions, worldwide see ARISS contact on ISS IMAX film
- 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; SuitSat-2 on the horizon.

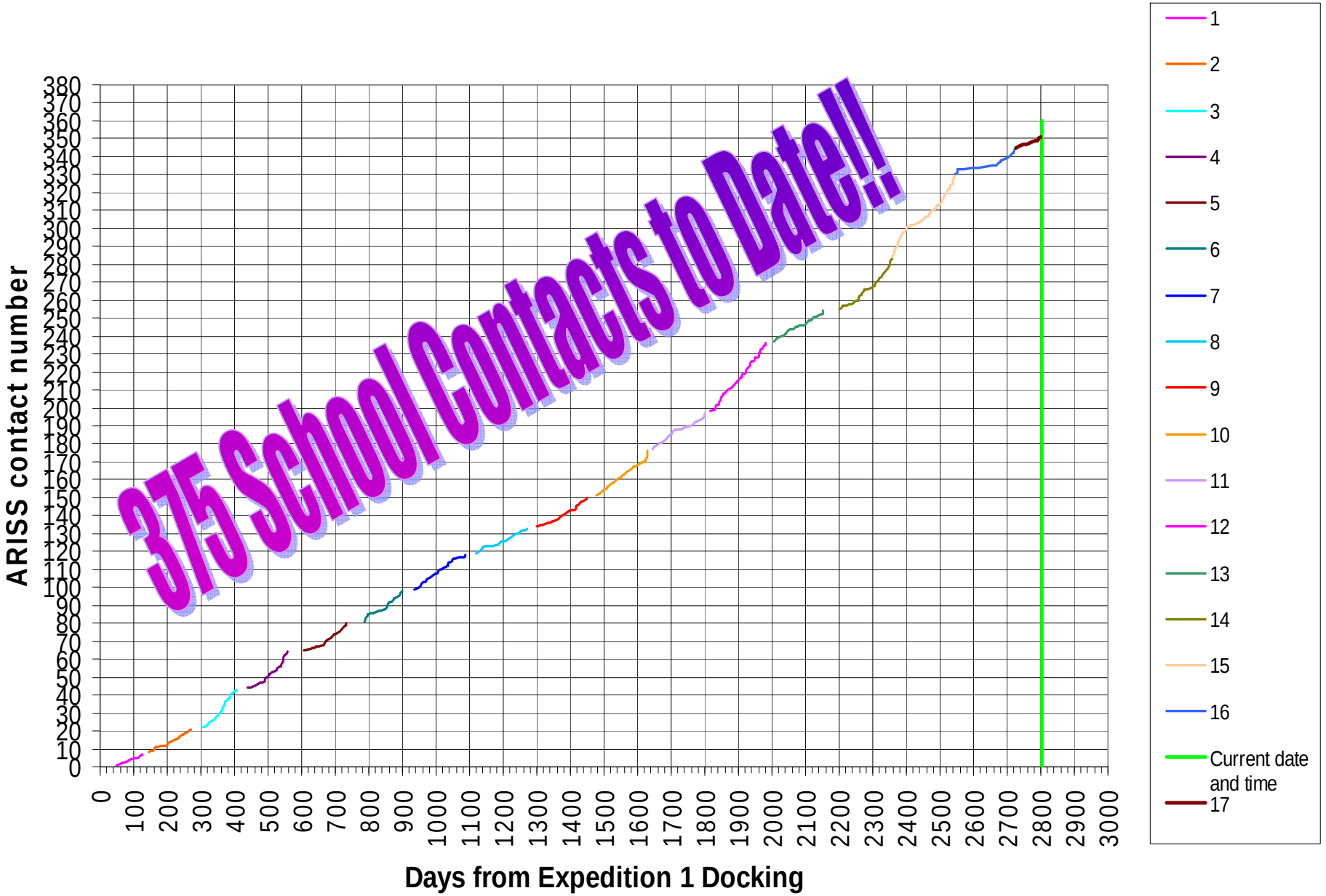
Historic Firsts

- **First human tended amateur radio in space (1983)**
- **First communications between astronauts and people outside official NASA channels (1983)**
- **First SSTV pictures uplinked and downlinked to Shuttle (1985)**
- **First astronaut-student interviews (1990)**
- **First crew contacts with families and friends (1990)**
- **First computer-to-computer radio links (1990)**
- **First Television uplink (1991)**
- **First backup communications during TDRSS outage (1992)**
- **Most frequent flyer payload in Shuttle Program (25 Flights)**
- **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**

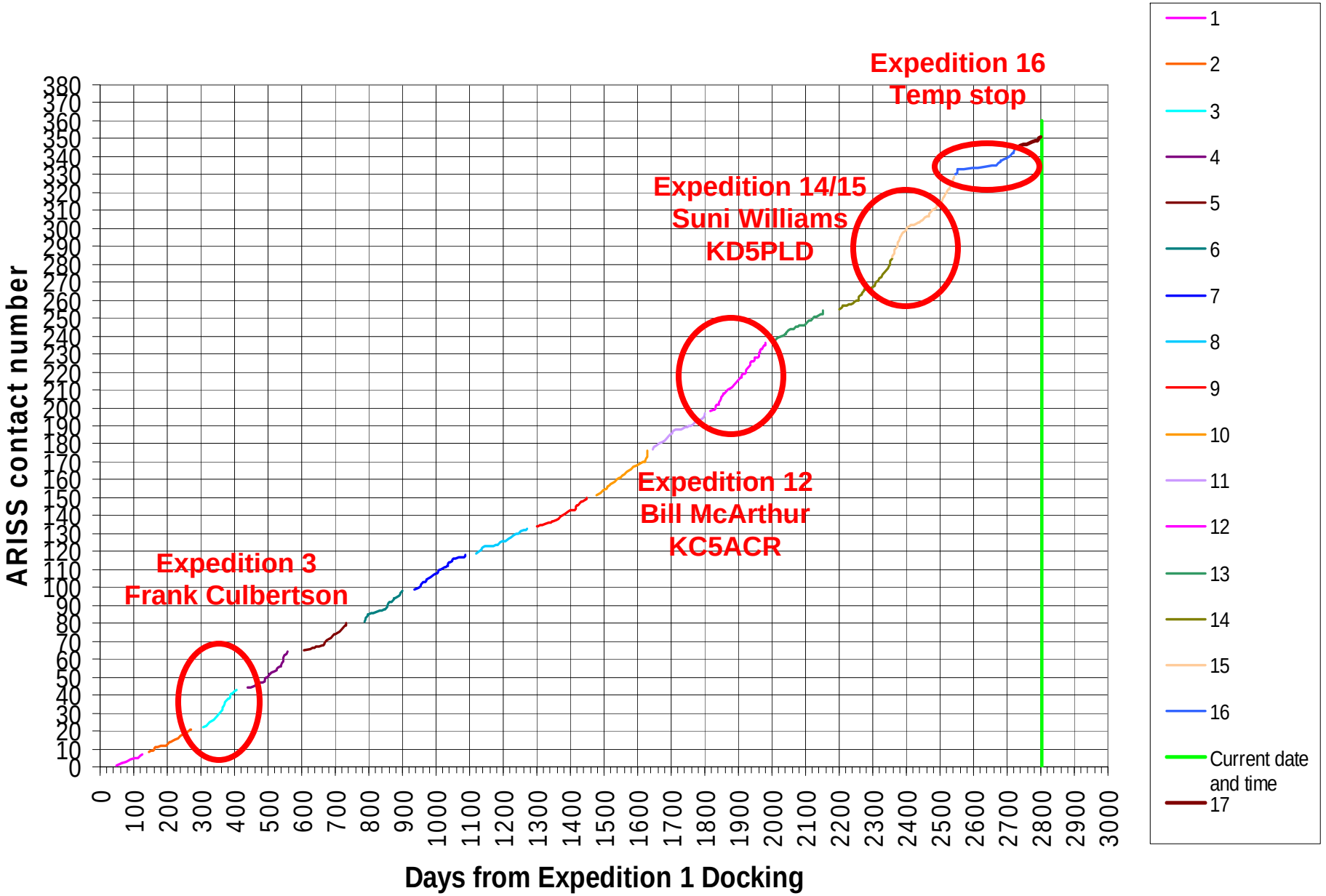
School Contacts Per Year



ARISS Total history running count from Expedition 1 Docking



ARISS Total history running count from Expedition 1 Docking



2008 Space Flight Participant
Richard Garriott

Richard Garriott
W5KWQ

Proposed ARISS Activities:

- **Earth-view SSTV downlinks—up to 50 Earth views per day**
- **School contacts—2 Challenger Centers, 2 international and 2 domestic**
- **Owen Garriott, W5LFL, 25th anniversary commemorative ham contacts**
- **<u>Support needed</u>: SSTV picture reception (multiple stations), collection & sorting and web distribution**

On-Orbit—Oct 12-24, 2008

Richard Garriott Mission Overview

- Richard Garriott, W5KWQ, sixth “spaceflight participant”
- Son of Owen Garriott, W5LFL, STS-9
- Progress-M 65: Upmass of replacement D700, installed before Garriott flight
- Soyuz TMA-13/17S launched on October 12, docked to ISS on the 14th, undocking on 23rd


W5KWQ - Richard

Where We Are on SSTV

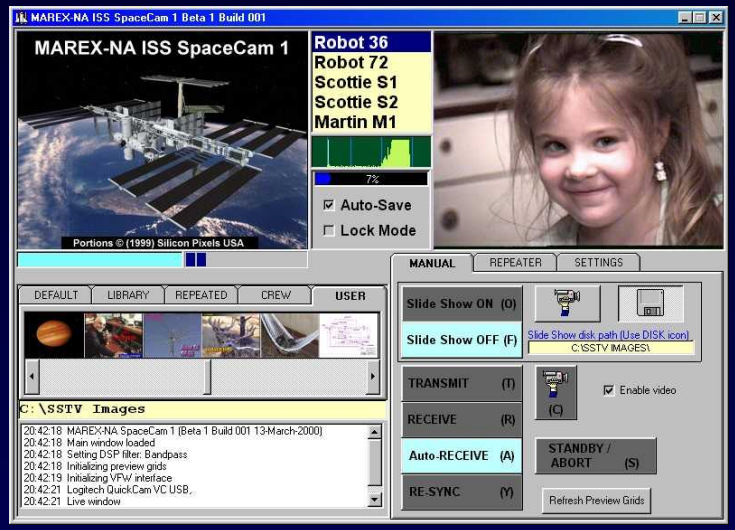
General

- Use of a computer has been problematic, at best, impacting the ability to support the SSTV software solution
  - Sergey Samburov, RV3DR, worked to get a computer delivered on ISS and the flight backup Kenwood D700 & VOX box; the computer is a prime capability for the Space Flight Participants and Backup for ARISS
- Still need to debug the SSTV issues observed on-orbit (constant transmit after image)

Richard Garriott's Flight

- Richard used the computer almost exclusively for high definition Earth Observations, precluding ARISS use of SSTV for bulk of mission
- An SSTV hardware solution was determined to be the best opportunity for Richard's flight; hardware space qualified, delivered to Space Adventures, and flown by Richard on Soyuz

SSTV—Current Capability



SpaceCam 1/MMSSTV H/W & S/W

VC-H1 SSTV Hardware Solution

Welcome to the AMSAT SSTV gallery - Windows Internet Explorer

http://ariss-sstv.ssl.berkeley.edu/SSTV/

File Edit View Favorites Tools Help

Welcome to the AMSAT SSTV gallery

Welcome to the ARISS SSTV gallery

Keep up with ARISS SSTV progress by visiting the SSTV mission blog. Learn more about this project by visiting the Frequently Asked Questions page. You may submit SSTV reception reports by going here. We may not be able to display every image because of quality or duplication but it is important for you to submit them for engineering analysis purposes. You may visit the archive page here.

SSL UC Berkeley

YAHOO! BABEL FISH
Choose a language to translate this page!
Select to language

Submitted by: Go Yeu Bin, 9M6YBG, Oceania
Acquired: 2008-10-22 07:27:00

Submitted by: Go Yeu Bin, 9M6YBG, Oceania
Acquired: 2008-10-23 06:21:00

Submitted by: Carol Szabo, YO3RU, Europe
Acquired: 2008-10-22 11:56:00

Submitted by: BRANKO MARTINCIC, 9A3ST, Europe
Acquired: 2008-10-23 10:40:00

Done

Internet 100%

start Microsoft PowerPoin... VZAccess Manager CNN.com - Breaking ... Welcome to the AMS... 7:33 PM

ARISS-SSTV IMAGES

SLOW SCAN TELEVISION (SSTV) IMAGES TRANSMITTED FROM THE INTERNATIONAL SPACE STATION.

INTRODUCTION

This site will be the focal point for some of the best SSTV images received during Oct 2008 and beyond. Images will be downlinked by ISS on **145.800 MHz**. To submit a received image for possible inclusion in this gallery, go to the following *website* to upload your image.

In addition to SSTV images, notes on planned events for the period of Oct 14-23 and reports of planned amateur radio activity will be provided.

FRIDAY, OCTOBER 24, 2008

Exp. 17 and Garriott land safely

See the NASA release for details at http://www.nasa.gov/home/hqnews/2008/oct/HQ_08-269_Expedition_17_landing.html

AT 14:55

THURSDAY, OCTOBER 23, 2008

Soyuz preparations and landing

First Images from W4KWQ
October 13, 2008


Two Generations in Space
W5LFL - W5KWQ


HAM Radio From Space


Generation II
HAM Radio From Space


"HAM" in Space
2008-OCT-19 1502

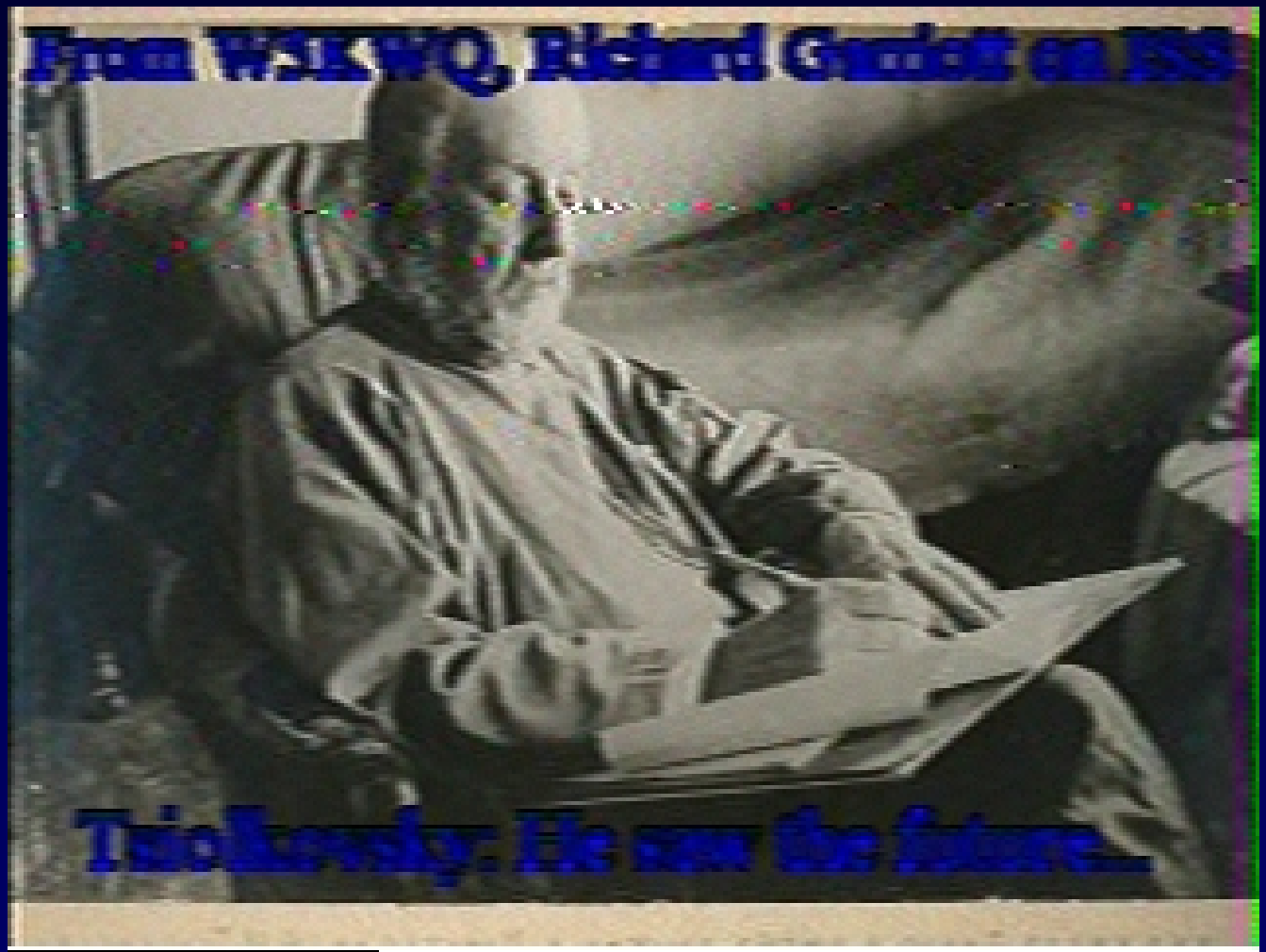

"HAM" in Space

SSTV Example

- Submission number: 406
- Name: Tony Messina
- Callsign: KD7TOG
- Email: t-rex@ix.netcom.com
- Continent: NorthAmerica
- Captured: 2008-10-16 15:09:00 UTC
- Original filename: 10-16-08-15.09z.JPG
- Mission: Richard Garriott 1
- Comments: ISS approaching Baja Peninsula Radio: Yaesu FT-8800 Antenna: Arrow JPole 40' RG58 coax Software: MMSSTV

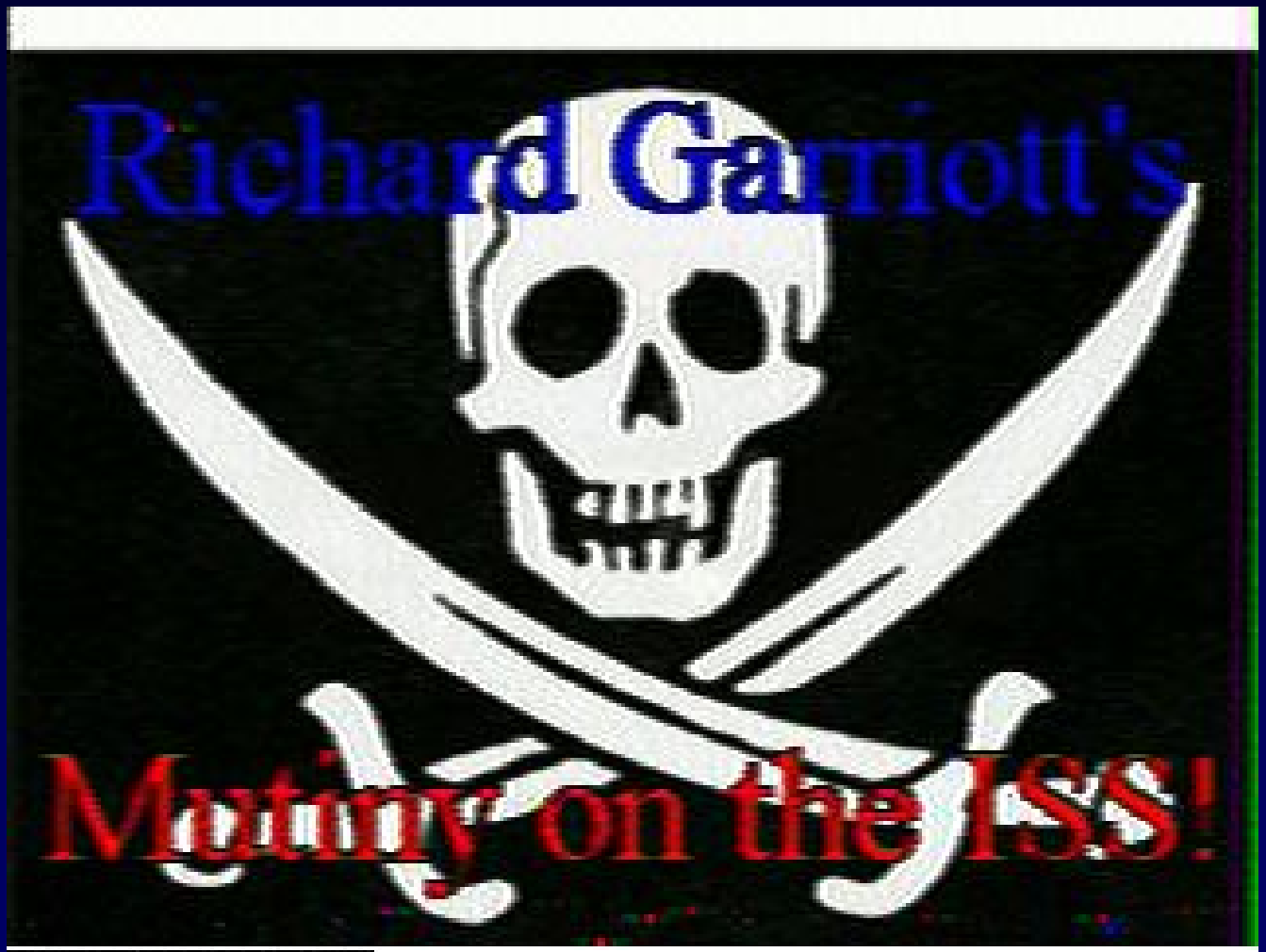
ISS over Caribbean region
Courtesy: YV6EVC


NA1SS
NA1SS
NA1SS
NA1SS



OCT-19-2008 1458


Stephen Hawking
See you in orbit soon!
OCT-19-2008 1459


Richard Garriott's
Mutiny on the ISS!
2008-OCT-19 1503


Goodbye From Space! - From Richard Garriott
W5KWQ 20081023T1332Z
NA1SS


Goodbye From Space! - From Richard Garriott
W5KWQ 20081023T1221Z
NA1SS

School Contacts

- Two Challenger Center telebridge events:
  - Four schools in one event, three in the other.
  - *October 16 & 17 Success!*
- Budbrooke School, UK:
  - *direct October 17 Success!*
- Austin Liberal Arts and Sciences Academy, USA: *direct Sun 19th Success!*
- Pinehurst School, USA: *Success!*
- National Space Challenge, Malaysia: *Success!*

Budbrooke School Contact

Other Events

- Successful Mayor of Austin, TX “friends & family” contact.
- *Scouting “Jamboree on the Air”*
- Hundreds of voice QSOs.
- SSTV: over 1000 images from VC-H1 and from SpaceCam/MMSSTV.
- Packet operations at night.
- Austin amateur radio club contacts.

Sample Voice QSO

- I've been trying for a couple of years to make contact with the ISS with no luck. Well, all that changed Tuesday morning as I made contact (by chance) with Richard. He had arrived aboard the ISS just 2 hours prior and I was his very first contact from space. And, that was my very first contact with the ISS.

  I've been a ham 31 years and can't remember another time that was more exciting. My wife said that my level excitement after the QSO was about on par with that of the birth of our children. Not so sure I'd go that far, but it was definitely an exciting moment.

- In the first part of the QSO, I told Richard that I'd wasted many hours playing Ultima (one of the games he created) 20+ years ago while in school at Auburn University. He said that he hoped that he hadn't disrupted my life too badly. :-)

- Randal DePriest
  N4AC
  Cumming, GA

Sampling of QSOs, Courtesy of Stan Vandiver, W4SV

17 October 2008 (times approx)
1231Z: WA4SCA (w/ Mike Fincke)
1232Z: ? IDI (w/ Mike Fincke)
1538Z: school QSO in progress
1541Z: K8DID Ron
1543: KD8CAO
1544Z: K9SM Scotty
1547Z: 13A

18 October 2008 (times approx)
1919Z: KC9ELU Mike SE IN
1921Z: KC8RAN Joe Cleveland
1923Z: WF1F Miles
1924Z: WK
1926Z: PSC, NA4PSC?

19 October 2008 (times approx)
1319Z:K5LBJ School QSO in prog
1324Z: W2ABG
1325Z: WB9L, WB8OTH Perry
1327Z: KA1DLK SW Vermont
1328Z: WY1U
1329Z: F (fox)
1632Z: K0KD Perry
1633Z: N7RYW Bill
1634Z: VE4AMU Winnipeg
1635Z: W9ORW Bob
1636Z: ?DID Green Bay fan, N0MUA Dave Kansas
1637Z: N8DZM Dan
1638Z: WF1F
1640Z: ?QRP
1808Z: VE5G?, VE5EI
1809Z: K6EL N California
1810Z: VE5CEM Chuck, KC5TER
1811Z: N9TAX, NM3M
1812Z: KC5TER Eddie
1813Z: VE4AMU, KC9MLN
1814Z: Richard calls for WF1F
1815Z: KA1DLK, WF1F
1816Z: ?PCR, KA1SON Rick MA
1817Z: N2DY
2120Z: KL7MF
2121Z: KO9LR
2122Z: AA5PK
2123Z: WD4LHD, J7WAN Jeff
2124Z: KE5ZW, WA5KBH
2125Z: XE3ISS

20 October 2008 (times approx)
1211Z: W5DZ College Station, New Orleans, K(E)5RTL JoAnne Lafayette
1212Z: KI5T
1213Z: AK5V Bob Ft. Worth, N5ZNL Mississippi, NM42
1214Z: N8MH, VKS (VI4KS) TN
1215Z: KI4ZKS
1216Z: N4ISS Al, WA3SWJ DC
1217Z: N4ISS

21 October 2008 (times approx)
1725Z: VA7DG, VE3JJA Woody
1726Z: VE5GZ Gary
1733Z: NX1Z
1734Z: WF1F
1900Z: VE5SWL
1901Z: VE5CEM
1902Z: VE5MJ, W3XO Bill
1903Z: WD0EQP Gene NE
1904Z: K9SM Scotty
1906Z: WA4NVM
1907Z: ?XT, N3TL
1908Z: N8DDK
1909Z: N5UXT N Orleans
1910Z: K5NDX

No recordings on 22 October 2008

23 October 2008 (times approx)
1507Z: VE5MJ, VE7MKF, KS7WY
1508Z: K7VK Vick, ?JAM
1509Z: KC5, WB9Z Illinois, KE0LX
1510Z: AB5XK, KC2FZD
1511Z: W8CO, N0MUA
1512Z: W2DPT, VE3TVV
1513Z: VA3HM VA3H? Brian VA3HAW
1514Z: KC2PCF, VE3DWI Tony
1515Z: N2MTH, VE1?
1642Z: W0TUP North Dakota
1643Z: VE4AHZ
1644Z: KC9NGZ, N0ORU
1645Z: VE4QZ, KD0FCY Rick, K9SM
1646Z: VE3DBP
1647Z: KD8JAM, K3LTM
1648Z: students at K3LTM
1649Z: W2ET?

1818Z: KG7P, k0T
1819Z: K0CQN, VA3P?, VA3ECO, VE3KHQ
1820Z: VE3KHQ (repeat), KA9ERV IN
1821Z: KC9NGZ WI
1822Z: KC9EIZ, K0RJS Ron
1823Z: N0UOE
1824Z: W4CMB
1825Z: KS4RX, W5KSI
1826Z: VE3IJD Gene, KN4F
1827Z: WA1QDP N4WTF W cntrl Florida

Current Crew Complement

	LAUNCH DATE	CDR	FE-1	FE-2
Exp. 17 Shuttle crew	May 2008 (1J)*			Greg Chamitoff **KD5PKZ**
Exp. 18 Soyuz up	October 2008*	Michael Fincke **KE5AIT**	Salizhan Sharipov	

	LAUNCH DATE	CDR	FE-1	FE-2
Exp. 14/15 Shuttle up	December 2007			Suni Williams **KD5PLD**
Exp. 15 Soyuz up	April 2007	Fyodor Yurchikhin **RN3FI**	Oleg Kotov	
Exp. 15 Shuttle up	June 2007 (13A.1)			Clay Anderson **KD5PLA**
Exp. 16 Soyuz up	October 2007	Peggy Whitson **KC5ZTD**	Yuri Malenchenko **RK3DUP**	**No Schools**
Exp. 16 Shuttle crew	Oct 2007 (10A)			Dan Tani **KD5DXE**
Exp. 16 Shuttle crew	Feb 2008 (1E)	**School Contacts Resume** →		Leopold Eyharts **KE5FNO**
Exp. 16 Shuttle crew	March 2008 (1J/A)			Garrett Reisman **KE5HAE**
Exp. 17 Soyuz up	April 2008	Sergei Volkov **RU3DIS**	Oleg Kononenko **RN3DX**	
Exp. 17 Shuttle crew	May 2008 (1J)*	**You Are Here**		Greg Chamitoff **KD5PKZ**
Exp. 18 Soyuz up	October 2008*	Michael Fincke **KE5AIT**	Salizhan Sharipov	
Exp. 17 Shuttle crew	Nov 2008 (ULF2)*			Sandy Magnus **KE5FYE**
Exp. 17 Shuttle crew	Dec 2008 (15A)*			Koichi Wakata **KC5ZTA**

*** Indicates planning dates. Subject to change**

Mike Finke on ISS—Expedition 18

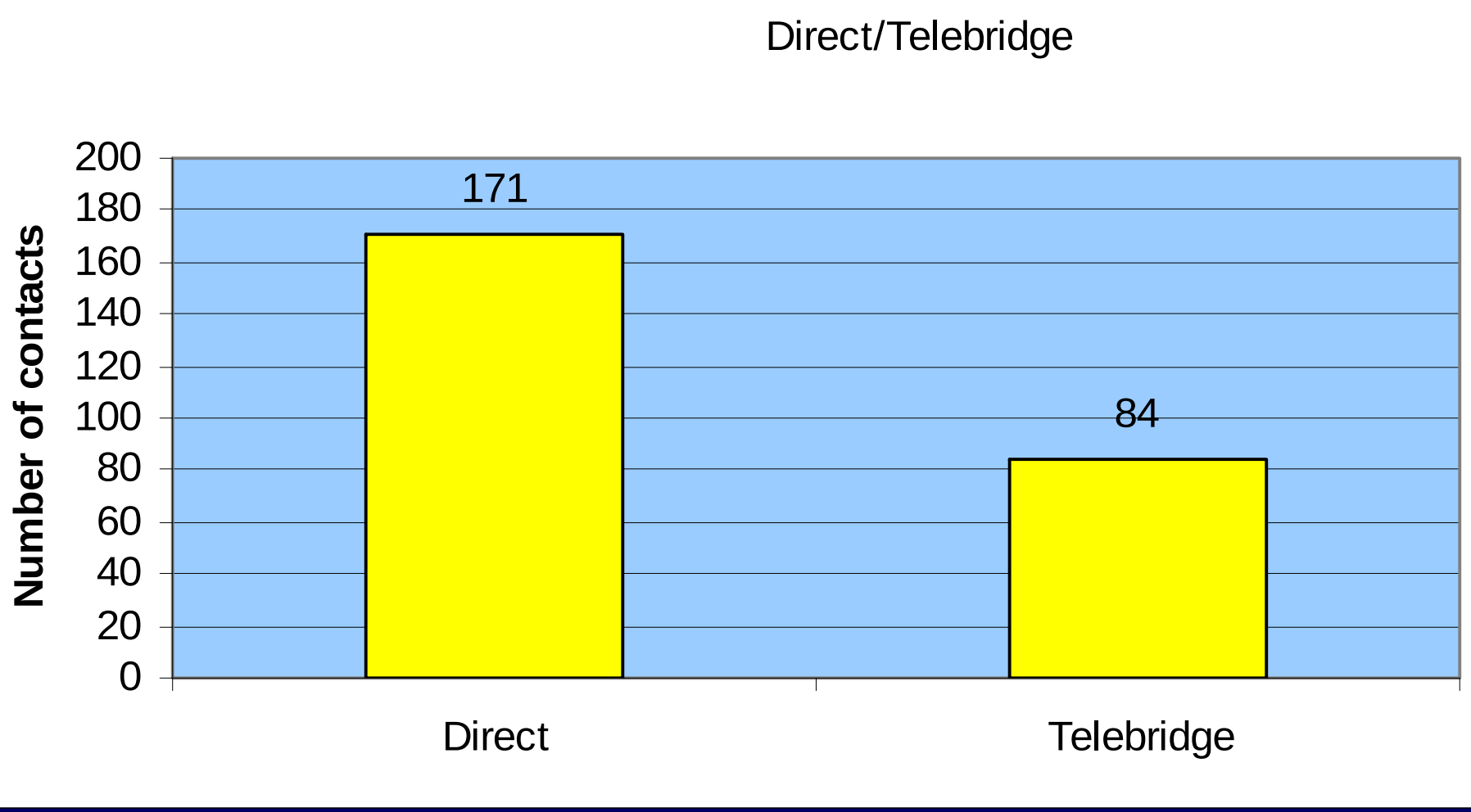
Mike Finke, KE5AIT
with the Phase 1 Ericsson Radio

Expectations:

- Numerous school contacts (up to 2-3 per week)
- Voice QSOs and voice repeater operations
- Re-programming of Kenwood D700
- SSTV operations
- Ericsson radio checkout
- Owen Garriott, W5LFL, 25th anniversary commemorative ham contacts

Expedition 18 Schedule:
October 2008-April 2009

Two Types of School Voice Contacts: Direct and Telebridge



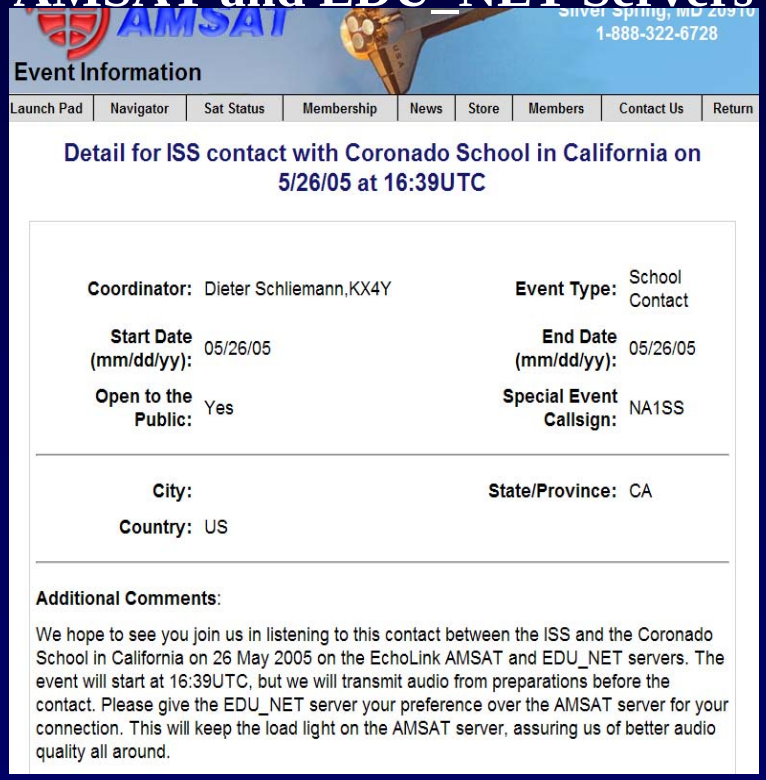
Courtesy: Charlie Sufana, AJ9N

Proposed Augmentation of Bridge Stations (South America and High Latitude)

Voice Over Internet Protocol (VOIP)

IRLP, Echolink and Internet Streaming Provides a Wider Reach to Schools and Ham Radio Operators

Echolink
AMSAT and EDU_NET Servers



www.amsat.org
Calendar of Events

IRLP
9010 "Discovery" Reflector

www.discoveryreflector.ca

Hardware Update

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 7 years of continuous operations little crew time for hardware installation, checkout or troubleshooting

Lesson Learned

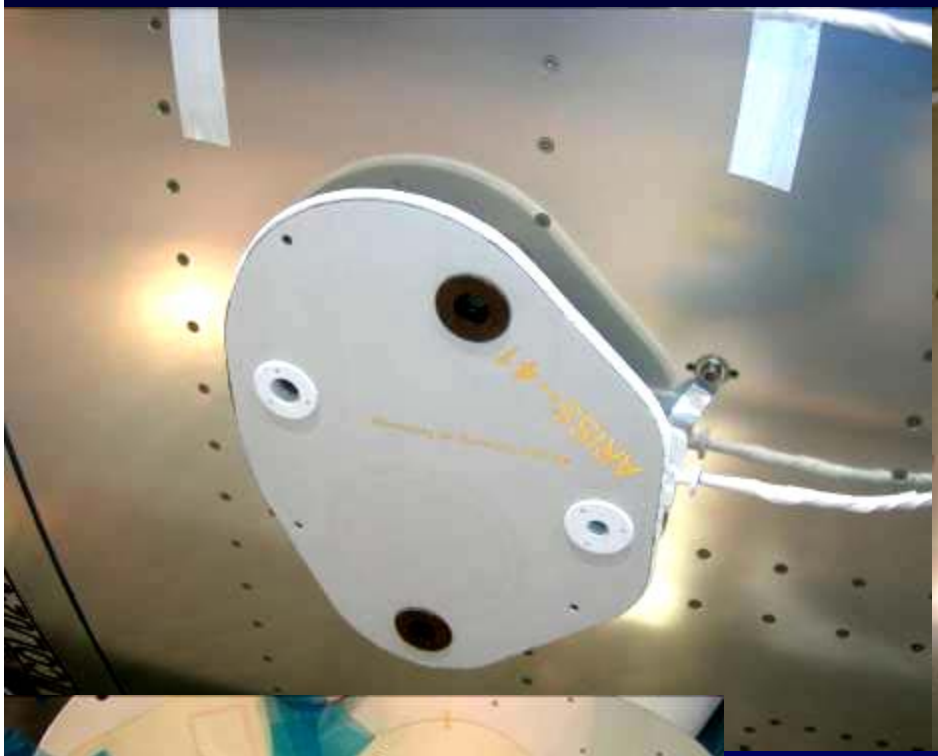
Future ARISS Equipment needs to be Completely Autonomous

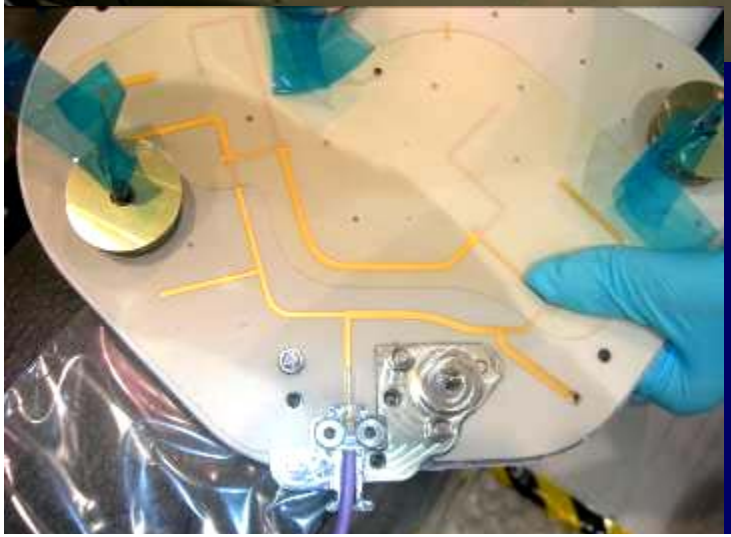
Columbus Module Antenna Installation and Inspection

Installation

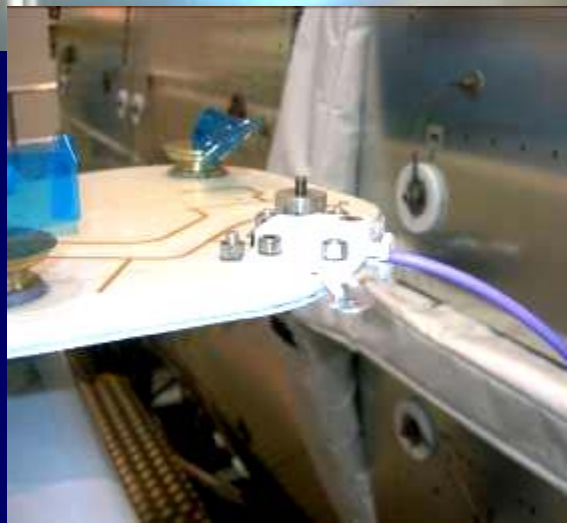
Inspection

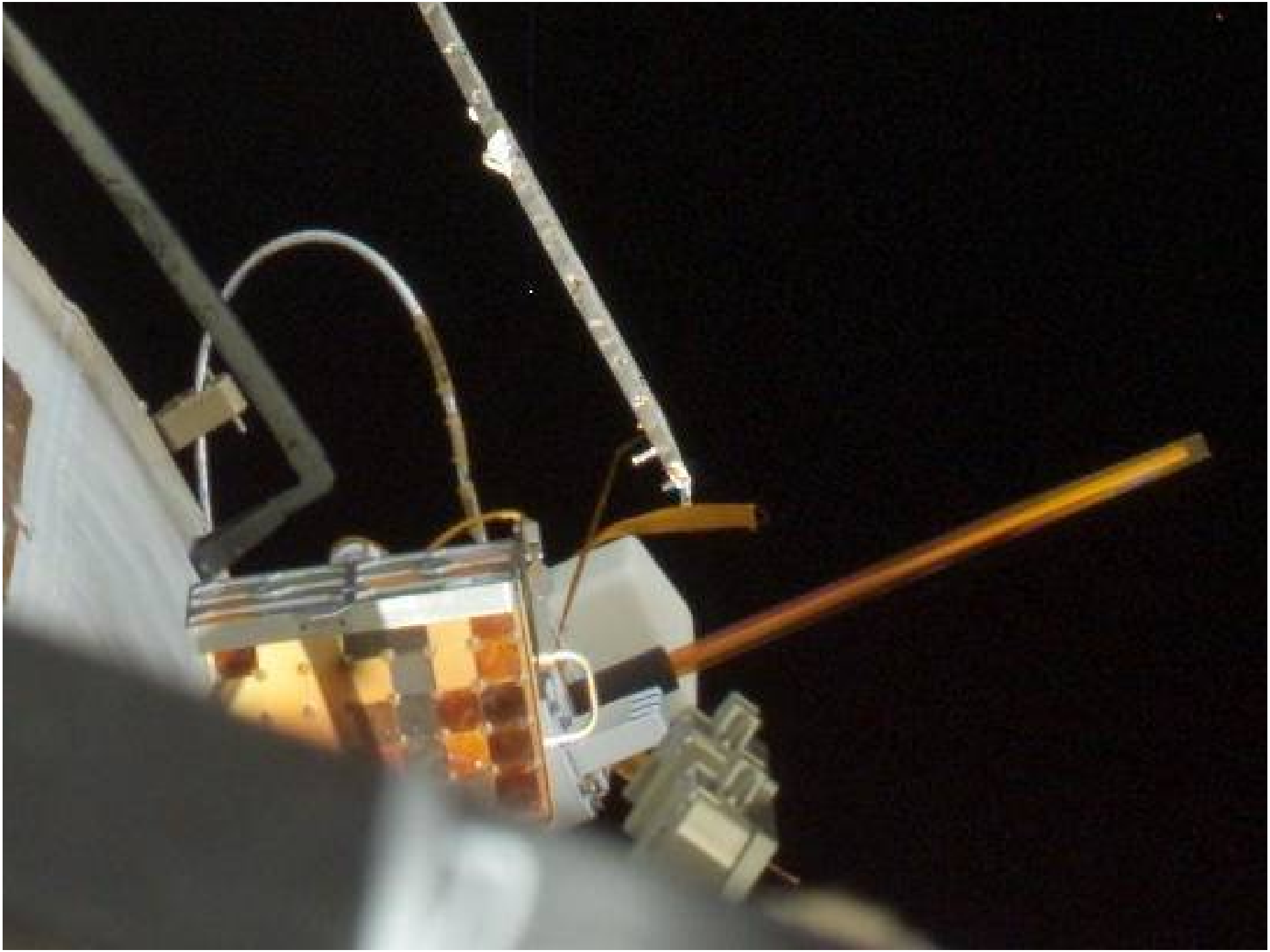
Two L/S Band Antennas Installed on European Columbus Module and On-Orbit!!





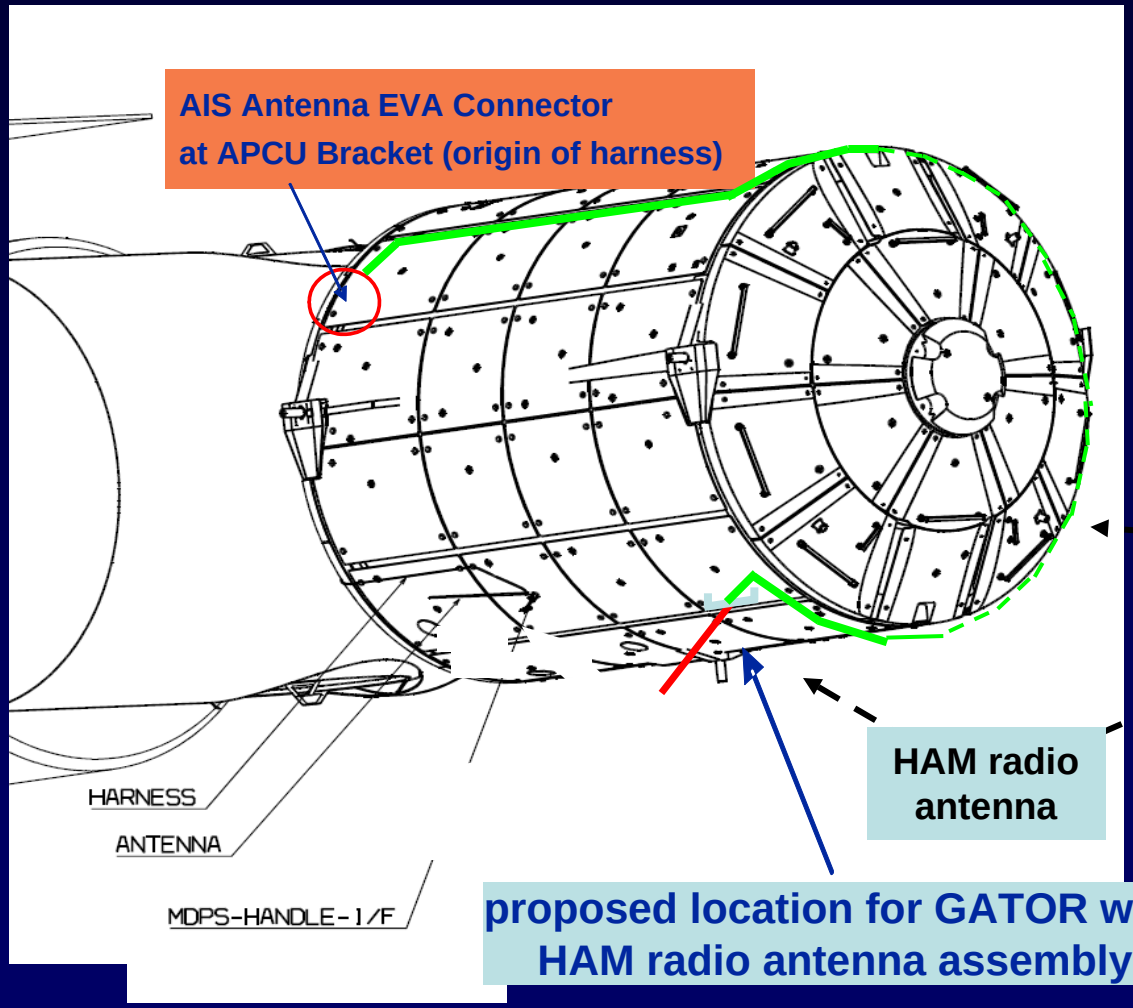
Launched
February 7, 2008





VHF/UHF Capability on the Columbus Module

Columbus GATOR EVA Clamp for Installing an ISS Ham Antenna Installation



AIS antenna

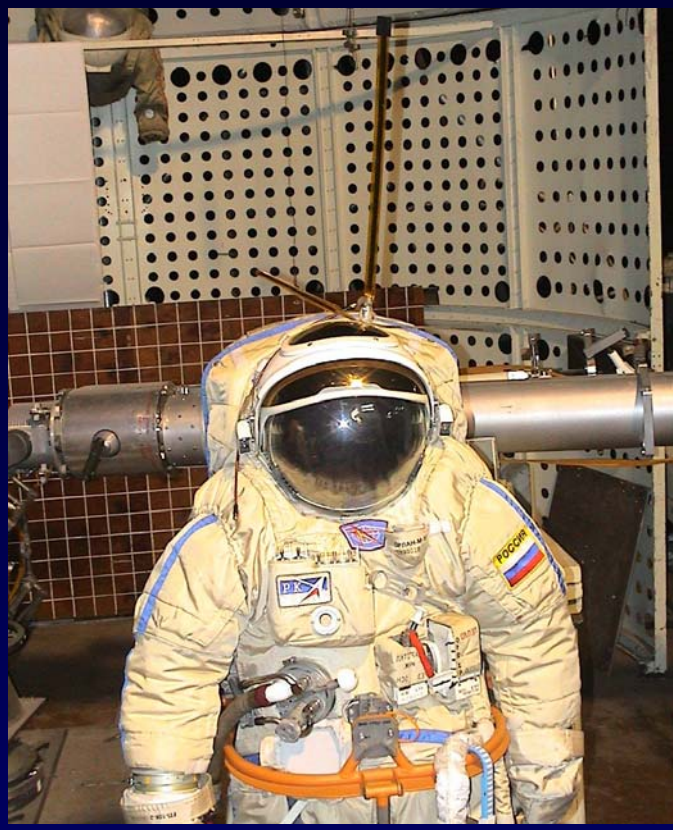
HAM radio antenna

ARISS derived antenna for AIS & HAM radio

SuitSat-2 Mission

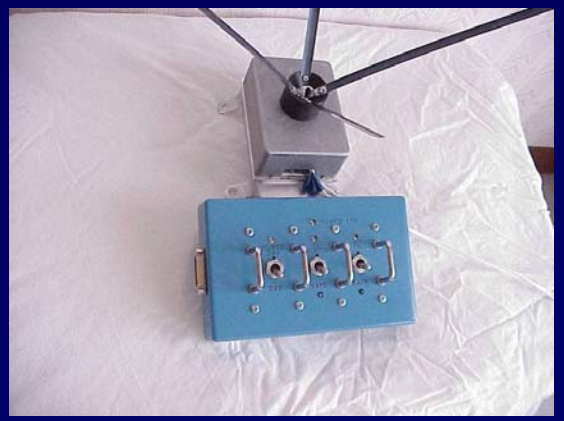
Primary misson

- Voice messages, including student audio greetings from Energia, Mr. Alexsandrov, ARISS Europe, ARISS Canada, ARISS USA, ARISS Japan
- A CD/DVD with photos contributed from schools around the world
- School lesson plans for SuitSat-2 educational outreach



Secondary Mission

- Testbed for systems planned for future Amateur radio satellites
- Planned operations
  - **CW ID**
  - **Packet ops**
  - **SSB Transponder**
  - **SSTV images of Earth and Station**
  - **Longer term operation using solar panels**



Tertiary Mission

- ARISS and Student Experiments (up to 4)

ARISS Phase 3 Hardware Concept

1996 ARISS Phase 3 Concept

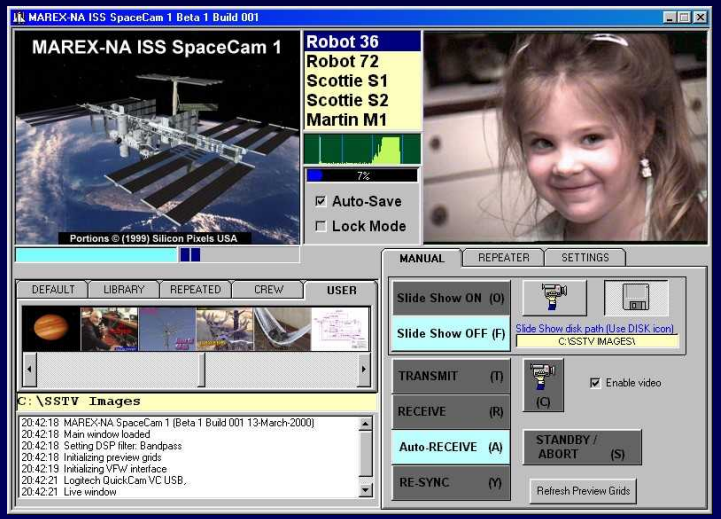
- Use SuitSat-2 core hardware to support multi-band autonomous ops
  - Voice
  - Packet
  - SSTV
  - Student Experiments

SuitSat-2 Core Hardware

Future & External ISS Hardware Deployments

- SSTV Ops—Expedition 18
- Phase 2 Yaesu FT-817 Shortwave hardware
- External payload—SuitSat-1—Next activity: SuitSat-2

Yaesu FT-817



SSTV

Operational!!

SuitSat-1

General Ham Radio 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:
  - DP0ISS
  - RS0ISS
  - NA1SS
  - OR4ISS
- Crew Schedule
  - ~0700 to 1900 UTC
  - Off Saturday Noon to Sunday evening

“QSL” Postcard

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

Help Needed—ARISS Volunteers

ARISS needs experienced team members to support the following:

- SuitSat Hardware & Software Development
- ARISS Operations Support
- Website Support
- Communications and Public Relations Support
- Educational Outreach

And generalists to support a multitude of tasks

Contact: Frank Bauer, KA3HDO and Mark Steiner, K3MS at their AMSAT e-mail addresses

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